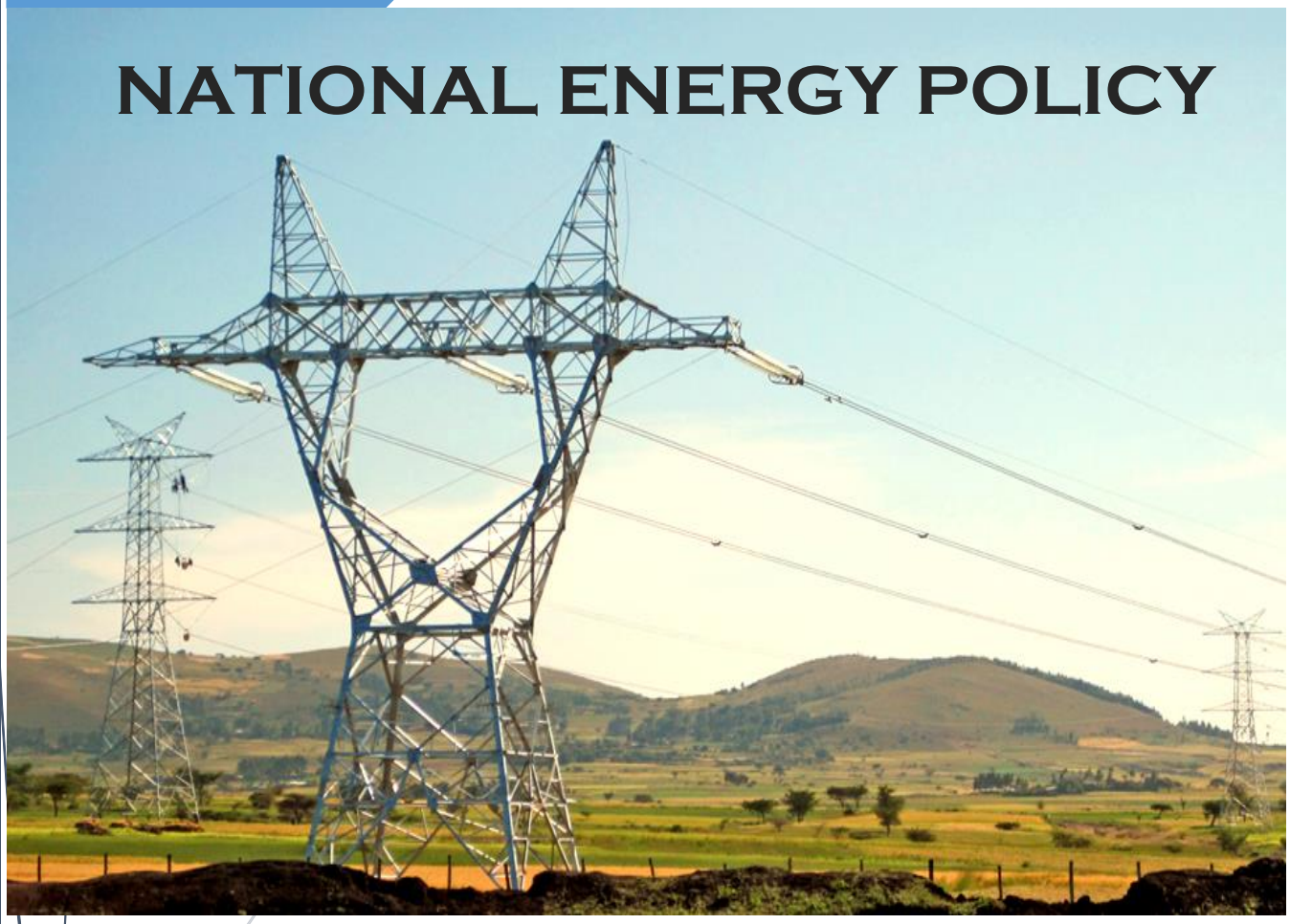
INDEPENDENT STATE OF PAPUA NEW GUINEA

NATIONAL ENERGY POLICY



2016 - 2020

Department of Public Enterprises and Department
of Petroleum And Energy

TABLE OF CONTENTS

FOREWORD BY THE MINISTERS

The way in which we produce, supply and consume energy is of vital importance to sustainable development in all facets, as energy has deep relationships with each of its four dimensions – the social welfare, the economy, the environment and the energy security.

These relationships are developing in a rather fast and complex manner due to increase globalization, growing market liberalization and new technologies, as well as by growing concerns about the climate which we live in and about energy supply security which is vital for vibrant economy and depends on adequate and reliable energy supply. PNG is a fast growing economy and the Government sees the importance to encourage diversification of energy supply sources in order to achieve energy security and promote competition amongst the suppliers.

Energy must be an integral part of sustainable development in PNG, and the Government is pleased that this policy- PNG's National Energy Policy, is cohesively balanced among the three dimensions of sustainable development. Energy the engine room for economic development of any successful nation and the O'Neill Government embraces this fact, and that is why the prudent management of the energy sector must is placed high in the echelons of the Government's top priorities.

Papua New Guinea lies at the cross-road from traditionally subsistence-based society to a modern era as one. Geographically, it is located at the cross-road between Asia and the Pacific nations including Australia and New Zealand. Also at the crossroad is the National Energy Policy.

PNG's energy sector was developed through various Acts of Parliament but its development was not coordinated properly for a period of 40 years since attaining political Independence in 1975. At this juncture, we need to develop and operationalize a National Energy Policy with its accompanying Plan - The National Energy Plan. Planning is essential for the nation's social and economic development within a sound environmental consideration. The Government recognizes the value and importance of the country's rich renewable sector and the focus of energy development in the future will be on this sector.

It is an honour and pleasure for us to dedicate this National Energy Policy to the people of Papua New Guinea for a prosperous, energized and a happy nation in the next 40 years.

…….

Honourable Ben Micah, MP

Minister

Ministry of Public Enterprises & State Investment

…….

Honourable Nixon Duban, MP

Minister

Department of Petroleum and Energy

PREFACE BY SECRETARIES FOR DEPARTMENT OF PUBLIC ENTERPRISES & DEPARTMENT OF PETROLEUM AND ENERGY

This document sets out the national policy and strategies for the energy sector that are aligned to the legislative reforms in tandem with Papua New Guinea's Vision 2050.

To transform Papua New Guinea into a globally competitive, newly industrialized, with middle income status and a prosperous country, it needs low cost energy. This will be the impetus for industrialization.

Within the energy sector, the production and consumption of electricity have changed along with the changes in the economy and the resulting changes in the sector's market.

The government has realized that Papua New Guinea is endowed with abundance of indigenous renewable energy sources which still remain underutilized and must be harnessed to stimulate the growth of this sector. Traditionally the State has focused on the classical forms of energy – the hydrocarbons, but must now consider developing the other sources of energy, including biofuel, biogas, biomass, coal, geothermal, hydro, solar and wind.

In essence, how do we harness this sources of energy to synergize the growth of the sector?

The emergence of this new policy and the legislative reforms that are being undertaken will support the Government's active participation within the industry to reform and stimulate the growth in the energy sector. This will include institutional reforms to align policy, regulations and commercial operations.

.....	.....
Dr Clement Waine PhD	Mr Rendle Rimua
Acting Secretary	Secretary
Department of Public Enterprises & State Investments	Department of Petroleum & Energy

EXECUTIVE SUMMARY

1. Energy is the engine of economic growth. Therefore the Government recognises the need to manage the energy sector in a manner that is efficient and sustainable. Development of the country's energy resources therefore will be coordinated in a manner that guarantees PNG attains sustainable income from energy exports while at the same time, the Government wants to see the unit cost of energy reduced in order to make PNG an internationally competitive country to invest in.

2. The provision of reliable, accessible and affordable energy contributes to economic and social development, and development in turn depends on more use of energy for the nation's sustenance but in a manner that is technically sound and the sector is efficiently regulated. Hence, this policy is all about finding a balance between making PNG an attractive investment destination for exporting energy to the energy hungry world and at the same time promoting PNG's economic development based on low energy cost.

3. The overall objective of the energy policy is to ensure affordable, competitive, sustainable and reliable supply of energy to meet national and provincial development needs at least cost, while protecting and conserving the environment.

4. The energy sector is guided by the Oil & Gas Act 1998, Mining Act, Electricity Industry Act and a number of other legislations. With the adoption of the PNG Vision 2050, there is need to formulate both the policy and accompanying legislations so as to align them with the Vision; the statutes shall be reviewed and consolidated into one.

Overview of the PNG Energy Sector

5. The energy sector currently accounts for 14% of the country's GDP and is a critical enabler for all other sectors for building a modern PNG economy. Major developments are expected in the energy sector and the economy on the back of the successful commencement of the world class PNG LNG project in 2014. The Energy sector will continue to contribute substantially to that growth

6. The Energy Sector includes assets related to three key energy resources: (i) electric power, (ii) fossil fuels (including petroleum, and natural gas and coal);

and (iii) renewable energy (including Hydro, Geothermal, Solar, Wind, Wave, Tidal, Ocean current, biofuel).

Fossil Fuels

7. Papua New Guinea has commercial reserves of LNG and a diminishing reserve of oil. In order to fast track petroleum discovery in other exploration blocks in the country, the Government shall intensify primary data acquisition in the available blocks to make them more attractive to investors.

8. There is therefore need to develop adequate petroleum production capacity in the country, and also develop the petroleum supply infrastructure to meet market requirements to match the increasing demand for petroleum products locally and in the region.

9. Coal is an affordable, competitive, reliable and easily accessible source of energy, especially for electricity generation. Extensive coal exploration has taken place in Gulf Province. More coal exploration is going on in other parts of the country.

10. The Government shall promote an intensive coal exploration programme and efficient utilisation of coal resources while minimising the environmental impacts associated with its use. It will establish data and information on coal resources intensify promotional campaigns in local and international conferences and exhibitions. A conducive investment environment for exploration and exploitation of coal will be created by providing fiscal incentives to attract investment in this sector. The National Government shall establish a coal development corporation as a special purpose vehicle to be the lead agency in the development of the coal industry.

Renewable Energy

11. Renewable energy, derived from the naturally occurring resources including geothermal, hydro, solar, wind and tidal wave energy, biomass, biofuels, biogas and municipal waste can supply our needs and those of future generations in a sustainable way if effectively harnessed through careful planning and advanced technology. In addition, renewable energy has potential to enhance energy security, mitigate climate change, generate income, create employment and generate foreign exchange savings.

12. Papua New Guinea has huge hydro power potential, currently estimated at 15,000MW, which when developed, would significantly boost PNG's energy requirements.

13. The Government shall establish the National Energy Authority of Papua New Guinea (NEA) to be the umbrella agency for development of fossil fuels and renewable energy resources.

14. The Government shall establish the Energy Regulatory Commission (ENERCOM) to take custody of all regulatory functions within the energy and electricity industries.

Electricity Sub-Sector

15. Electricity is a secondary source of energy generated through the consumption of primary energy sources. By virtue of its versatility in application, electricity is crucial to the socio-economic development of the country and is the most sought after energy service, access to which is associated with rising or high quality of life. In order to ensure there is affordable and accessible electricity supply, there is a need to restructure and reform the electricity supply industry.

Unbundling PNG Power Ltd

16. PNG Power Limited (PPL) is a fully integrated power authority responsible for generation, transmission, distribution and retailing of electricity throughout Papua New Guinea servicing individual electricity consumers in almost all urban centres throughout the country encompassing industrial, commercial, government and domestic sectors.

17. PPL suffers legacy issues requiring attention and redress. The GoPNG will unbundle the current PNG Power Limited (PPL) into distinct entities operating in the Generation, Transmission, Distribution and Retail and Regulation.

Energy Financing, Trading, Pricing and Socio-Economic Issues

18. The Government through the NEA shall:

Explore and adopt all viable financing options from local and international sources for cost effective utilization of all its energy resources, and in so doing shall endeavour to maintain a competitive fiscal investment climate in the country.

Support Public Private Partnerships (PPPs) in the development, operation and maintenance of energy infrastructure and delivery systems.

19. The Government shall set up a Consolidated Energy Fund (CONSEF) to cater for funding of the proposed:
    a. National Energy Institute;
    b. Infrastructure development;
    c. Acquisition and management of strategic petroleum resources;
    d. Energy sector environmental disaster mitigation, response and recovery;
    e. Hydro risk mitigation;
    f. Energy efficiency and conservation programmes, and:
    g. Promotion of renewable energy initiatives.

20. National Electricity Market will be developed where electricity will be traded as a commodity. It will involve both wholesale generation that is transported via interconnected grid of high voltage transmission lines to electricity distributors, who deliver it to consumers (homes and businesses). The transport of electricity from generators to consumers is facilitated through a 'pool', or spot market, where the output from all generators is aggregated and scheduled at five minute intervals to meet demand.

Energy Efficiency and Conservation

21. The importance of energy efficiency and conservation measures in the Papua New Guinean economy cannot be overemphasized. Challenges to implementation of energy efficiency and conservation initiatives include lack of awareness of the benefits and methods of conservation, apathy, limited technical capacity and inadequate data.

Land, Environment, Health and Safety

22. In carrying out its planning and development function regarding electricity and gas reticulation and energy regulation, every Provincial government shall set

aside suitable land for energy infrastructure development purposes, including but not limited to projects recommended in the indicative national energy plans.

Cross Cutting Issues

23. The Minister responsible for energy matters may establish directorates with responsibility for policy development as well integrated national planning in the areas of oil and gas, coal resources, renewable energy, electricity, nuclear energy for electricity generation as well as energy efficiency and conservation.

24. Research, Development and Dissemination as well as human resource development are key in achieving the objectives of this policy. It is therefore necessary to establish a National Energy Institute (NEI) to undertake training, research, development, innovation, dissemination, nurture talent and to enhance capacity building in the sector.

1 INTRODUCTION

1.1 PNG'S NEED FOR A NATIONAL ENERGY POLICY

1. In any country, one will find a definition that must fit the need of energy and what it must do for that country. Papua New Guinea is no exception. Since the country came in to being during the pre-colonial era, some form of strategies were adopted by different administrations in Papua and New Guinea to address pressing issues in the energy sector. There was very little development at least for the whole country compared to now.

2. Energy security is all about the continuous availability of energy at all times in various forms, in sufficient quantities, and at affordable prices. These conditions must prevail over the long term because energy contributes to sustainable development and growth of any nation. In PNG attention to energy security is critical because of the uneven distribution of the fossil fuel and other alternate renewable resources on which PNG currently rely and the capacity to develop other resources. Thus, the energy supply could become more vulnerable over the near term due to the growing global reliance on imported oil. Although energy security has been adequate for the past 50 years, and has contributed to the economic development of the Nation. However the potential for conflict, sabotage, disruption of trade, and reduction in strategic reserves cannot be dismissed. These potential threats point to the necessity of strengthening national energy security. Options to enhance energy security include:
    a. Avoiding excessive dependence on imports by increasing end-use efficiency.
    b. Encouraging greater reliance on local resources particularly those whose development will have other positive externalities such as job creation, capacity building, and pollution reduction, provided these do not involve disproportionate costs or waste scarce resources.
    c. Diversifying supply (including both suppliers and energy forms).
    d. Fostering greater political stability through international cooperation and long-term
    e. Agreements among energy importing countries and between importing and exporting countries.
    f. Encouraging technology transfers (for example, through Joint Ventures and Public-Private Partnerships) to developing countries so they can develop local resources and improve energy efficiencies.
    g. Increasing national strategic reserves of crude oil and its products.

3. Papua New Guinea has significant potential indigenous energy resources reserves including oil, gas, coal, hydroelectricity and renewable energy that can be harnessed to accelerate PNG's development and progress in leaps and bounds. The energy sector currently accounts for 14% of the country's GDP. On the back of the successful world class PNG LNG project which commenced shipment of gas to overseas market in April 2014, the PNG Energy Sector can provide the foundation for growth for all other sectors in building a modern PNG economy. This can only happen if PNG's equity is raised.

4. However energy shortages and supply disruptions coupled with high cost remains serious obstacles to economic activity and growth in PNG. At present eighty seven percent (87%) of PNG's population, still lack access to electricity services and the progress of rural electrification has lagged over the years. The prolonged absence of an overarching energy policy to guide the development of the energy sector and the high investment cost due to PNG's rugged topography and remote communities is a major impediment to provision of accessible and affordable energy and electricity services in particular. However, the government did well to approve the Electricity Industry Policy (EIP) and NEROP to carry out a 15 year programme on rural electrification.

5. The national government of Papua New Guinea envisions through its DSP 2010-2030 that by the year 2030, seventy percent (70%) of the country will be having access to electricity. By 2050 the PNG economy should attain one hundred percent power supply from renewable and sustainable energy sources, and all households would have access to a reliable and affordable energy supply (Vision 2050). There is one catch to all these effort and that is that everyone must pay for the energy he/she uses in order to be sustainable.

6. A comprehensive forward looking and well co-ordinated National Energy Policy is needed now more than ever to provide government leadership in the energy sector to seize major economic opportunities and respond effectively to long-term challenges for energy security including the issues of climate change.

7. This Policy is designed with Sustainable Development principles in mind and is intended to operate for a period of five years and reviewed thereafter.

1.2 STRUCTURE OF THE NATIONAL ENERGY POLICY

This policy document is organised into twelve substantive chapters, starting with the Introduction in Chapter 1. Chapters 2 provide the overview of the energy sector in PNG and the principles of the Policy; Chapter 3 and 4 treat in detail the primary energy sources, namely Fossil Fuels and Renewable Energy, including electricity generation from geothermal and hydro resources. Chapter 5 covers transportation of fuels; Chapter 6 deals with the secondary energy source, Electricity, followed by Chapter 7 which details the unbundling initiatives for PNG Power Ltd, Chapter 8 deals with Indigenous Participation. Chapter 9 covers Energy Financing, Trading, Pricing and Socio-Economic Issues. Chapter 10 deals with Energy Efficiency and Conservation. Chapter 11 covers Land, Environment, Health and Safety whilst the final Chapter 12 details the new proposed Institutional Arrangements to be implemented under the policy.

1.3 POLICY GOAL AND OBJECTIVES

1.3.1 VISION

Improve quality of life for every citizen and provide a platform for strong economic growth through sustainable development of the energy sector in line with Vision 2050.

1.3.2 GOAL

The Goal of the energy policy is to ensure affordable, reliable, and accessible provision of energy in a manner that is competitive, sustainable and environmentally friendly.

1.3.3 FOCUS AREAS

Key focus areas of the national energy policy will guide implementation to achieve the goal and objective of the policy:

1.3.3.1 SOCIAL

Principle 1 - Strengthen institutional capacity and recruit right human capital to manage the energy sector.

1.3.3.1.1 STRATEGIES

a. Establish the Petroleum Resources Authority (refer to NEC Decision 145/2013 dated 1st May 2013), National Energy Authority, and the Energy Regulatory Commission by legislation.

b. Ensure adequate resources including infrastructure are made available for the three entities the Petroleum Resources Authority, National Energy Authority and Energy Regulatory Commission.

c. Foster co-operative arrangements between the Department of Provincial Affairs and Local Level government, Provincial governments, District Development Authority's, Special Purpose Authority's by virtue of the National Energy Policy shall take ownership of the path of energizing the Province and Local Level areas under their jurisdiction by provisions made in 1995 where energy (electricity production and sale) is to be developed by the Organic Law on Provincial & Local Level Government, (*OLP&LLG)*.

d. The National Energy Policy with its accompanying National Energy Plan and sub policies and plans shall be made public to create widespread understanding, awareness and support for reform objectives and current practises amongst key stakeholders including government agencies, industry participants, consumers, and the community at large.

e. All Higher level and technical institutions shall include energy related subjects in their curriculum.

Principle 2 - Develop an integrated planning process for sustainable energy supply and utilization.

1.3.3.1.2 STRATEGIES

a. Ensure that a comprehensive, integrated and well informed energy sector plan - The National Energy Plan is approved along with the National Energy Policy.

b. Promote the development of appropriate regulatory guidelines including standards to meet the needs of producers, suppliers and users.

c. Promote the National Electrification Roll-Out Plan (NEROP) for Grid extension and off-Grid stand-alone power supply system.

d. Promote one hundred percent electricity usage from renewable energy sources by 2050.

e. Develop and promote an energy sub-plan for the hydrocarbon industry.

f. Promote Local Landowner Participation and Community Social Obligations in line with an established Local Content plan.

g. Promote energy data reporting both in supply and demand across all sectors.

Principle 3- All energy resources will be developed by the State for the betterment of all citizens.

1.3.3.1.3 STRATEGIES

a. The State should be an active participant in the development of all energy resources.

b. The State should empower landowner participation in the development of all energy resources ensuring landowner interest in these projects is equitable.

c. The State will review and define properly in law, the ownership and beneficial interest of its citizens in all energy resource developments.

d. Actively promote National and Local content in all energy businesses.

1.3.3.2 ECONOMIC

Principle 4- Promote a conducive environment for long term sustainable economic solutions in the supply of all energy sources.

1.3.3.2.1 STRATEGIES

a. Allow competition in the Oil and Gas upstream, midstream and downstream business and promote the long-term sustainability of energy supply from oil and gas products and improve the competitiveness of petroleum supply options through appropriate regulatory framework.

b. Ensure appropriate legal and financial frameworks are in place for energy sector development for private sector participants.

c. Promote public-private partnership in energy sector development.

Principle 5: Encourage involvement of the private sector in the development and provision of energy services.

1.3.3.2.2 STRATEGIES

a. Provide incentives for private sector investment through appropriate fiscal regimes.

b. Promote a competitive energy and electricity market environment for the expansion of independent power production and distribution.

c. Promote the efficiency and robustness of the Electricity Service Industries (ESI) through market reforms.

d. Promote corporatisation and commercialization mechanisms for power utility and Independent Power Producers (IPPs) to facilitate improvements in power production, transmission, distribution and retail by relevant entities.

e. Government shall continue to play an important role in the regulation of retail competition, including issues of prices control and market ownership in the ESI and allow for a lower tariff for rural electricity users based on Long run marginal

cost (LRMC). Any control mechanisms in ICCC shall be gradually transferred to Energy Regulatory Commission (ENERCOM).

1.3.3.3 ENVIRONMENT

Principle 6- Ensure energy resources are developed and delivered in an environmentally sustainable manner.

1.3.3.3.1 STRATEGIES

a. Minimize the adverse impact of energy production, distribution and consumption within the framework of the Environmental Act 2014 (as amended) and other appropriate legislation and laws including Environment Impact Assessment (EIA) of energy projects.

b. Ensure oil and gas manufacturing, storage, handling and transportation meets the minimum safety standards for export and consumption.

c. Support international action on reduction of greenhouse gases and ozone depleting substances from energy standpoint.

d. Promote and support efforts in the conservation and maintenance of forests and appropriate marine resources, aquifers as carbon sinks.

Principle 7 – Promote efficient systems and safety in energy supply in all sectors (transport, residential, commercial, industrial and agriculture).

1.3.3.3.2 STRATEGIES

a. Promote policy and regulatory framework for greater use of appropriate, cost effective and energy efficient modes of transportation including public transport.

b. Ensure minimum energy performance standards for electrical equipment, and adoption of building energy codes and other Standards for safety.

c. Ensure safe transportation of energy products and wastes.

d. Promote solar-power and solar-thermal systems and LPG for residential,

commercial and public institutions.

e. Promote best practise energy supply systems for agriculture industries.

f. Promote suitable energy supply and technology systems for industrial sector including mining and oil and gas industries.

1.3.3.4 ENERGY SECURITY

Principle 8 - Diversify the development and utilization of energy resources for the nation's well-being and economic prosperity.

1.3.3.4.1 STRATEGIES

a. Promote oil & gas downstream processing for domestic energy needs.

b. Promote utilization of coal using clean technology for domestic energy needs.

c. Promote electricity generation for domestic needs from diversified energy sources.

d. Promote the maximum use of renewable energy resources for electricity generation.

e. Promote the introduction of renewable fuels (biofuels) for use in the transport and power generation sector.

f. Ensure security of petroleum products supply through a regulated 90 day stock level to be held by a State nominee.

Principle 9 - Promote energy efficiency and conservation measures and wise use of energy.

1.3.3.4.2 STRATEGIES

a. Draft and enforce an Energy Efficiency Policy within one year of NEA's creation.

b. Promote energy efficiency measures in all sectors (industrial, residential, agriculture and transport) of the nation in end use of equipment and appliances.

c. Promote minimum energy performance standards and appliance labelling to all electrical equipment and appliances in collaboration with PNG Customs Services (PNGCS), National Institute of Standards and Industrial Technology (NISIT), Independent Consumer and Competition Commission (ICCC) and other relevant stakeholders.

d. Promote the concept of energy efficient buildings in accordance with Building Act and Regulations.

e. Promote energy audits in factories and industrial locations and demand-side management programmes in all sectors of the economy.

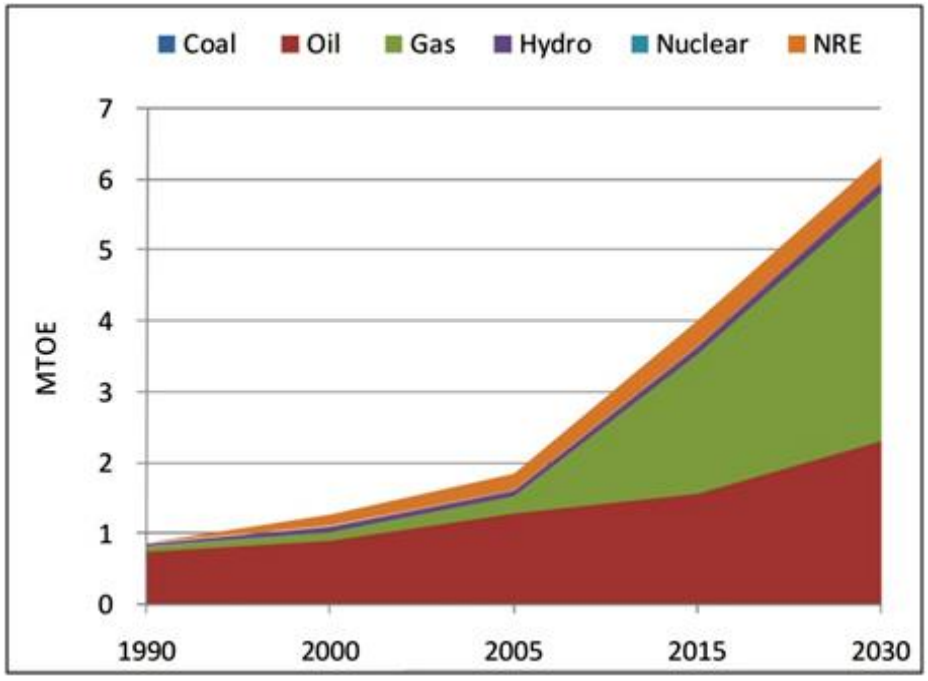
2 OVERVIEW OF ENERGY SECTOR IN PNG

2.1 THE ROLE OF ENERGY IN NATIONAL ECONOMY

1. Papua New Guinea has attained a strong economic growth achieving an average of 6.0% annual Gross Domestic Product (GDP) growth rate from 2005 – 2014 with projections of over 16% growth in 2015 and beyond.

2. The energy sector currently accounts for 14% of the country's GDP and is a critical enabler for all other sectors for building a modern PNG economy. Major developments are expected in the energy sector and the economy on the back of the successful commencement of the world class PNG LNG project in 2014. The Energy sector will continue to contribute substantially to that growth.

Figure 1: Primary Energy Supply in PNG



Source: APEC Energy Demand and Supply Outlook – 4th edition, 2009

3. Based on the Asia-Pacific Economic Cooperation (APEC) Energy Balance Report (EBR) 2009, PNG's primary energy supply is projected to increase at an average annual rate of 5.1%, from 1.8 Mtoe in 2005 to 6.3 Mtoe in 2030 (see Figure 1). In terms of primary energy supply in 2011 petroleum oil products accounted for approximately 57%, biomass 37% and hydro, gas and geothermal power the remaining 6%. Oil and natural gas will constitute most of the share in the total primary energy supply for domestic use and export. The demand for oil is

concentrated in the industrial sector, followed by electricity and transport, while the demand for natural gas will be driven by the electricity generation.

4. The Energy Sector includes assets related to three key energy resources: (i) electric power, (ii) fossil fuels (including petroleum, and natural gas and coal); and (iii) renewable energy (including Hydro, Geothermal, Solar, Wind, Wave, Tidal, Ocean current, biofuel). Each of these energy sources have been dealt with in detail in the subsequent chapters of this Policy.

5. As at 2014 petroleum accounts for about 57% of the total primary energy consumed in the country. Petroleum is mainly used in the transport, power generation, commercial and industrial sectors as well as households. There is no Coal usage in the country. Chapters 3 treated fossil fuels in greater detail in terms of upstream and mid and downstream petroleum and gas.

6. PNG is richly endowed with renewable energy sources that when harness can meet the Vision 2050 target of PNG been 100% power by renewable sources. It is estimated that PNG has hydropower potential of about 15,000MW comprising large and small hydros[1].

7. The electricity portion of the Energy Sector includes the generation, transmission, and distribution and retail of electricity.

8. Currently, there are two main stand-alone power grids—in Port Moresby and in the Lae–Madang–Highlands area (the Ramu grid)—and a number of smaller grids that service the smaller urban centres. Because of the unreliability of grid supply, there is considerable self-generation and back-up generation taking place in urban areas, but maintenance and operation costs are high and efficiencies low.

9. PNG has about 580 megawatts (MW) of installed generation capacity, including hydropower (230 MW or 39.7%), diesel (217 MW or 37.4%), gas-fired (82 MW or 14.1%), and geothermal (53 MW or 9.1%). PNG has significant underutilized indigenous energy sources such as hydropower, natural gas, geothermal, and solar.

[1] ADB 2009, TA 4932-PNG Final Report: "PNG Power Sector Development Plan", page 3.

10. In Papua New Guinea (PNG), about 13% of the household population has access to electricity. Where power is available (generally in the main urban centres), the supply is often unreliable. Access to electricity is very limited in off-grid rural areas. Lack of access to affordable, reliable power is limiting economic growth in urban areas, constraining growth in smaller urban centres, and contributing to poverty in rural areas

11. PNG Power Limited (PPL), the national state-owned corporatized power utility, manages installed generation capacity of about 300 MW, including the two main grids and 19 independent power systems that service 26 smaller urban centres. The remaining capacity of about 280 MW comprises: (i) self-generation systems owned and operated by industrial facilities, including mining companies; and (ii) private sector generators supplying the main grids or rural communities. The government's ownership in PPL is maintained through the Independent Public Business Corporation.

12. Sector policy formulation is managed by the Ministry of Petroleum and Energy and, specifically, the Energy Division.

13. Technical regulation of the sector is performed by PPL itself through agreement with the Consumer and Competition Commission; however, although it is intended to eventually transfer this function to the Energy Division, through this policy it should be transferred to National Energy Authority.

14. Key research activity in the power sector occurs at the University of Technology in Lae, particularly through the Rural Energy Research Group. Through this policy an Institute will be established for Energy RD&D.

Oil and Petroleum Products

15. As at 2014 petroleum accounts for about 57% of the total primary energy consumed in the country. Petroleum is mainly used in the transport, power generation, commercial and industrial sectors as well as households. There is no Coal usage in the country. Chapters 3 treated fossil fuels in greater detail in terms of upstream and mid and downstream petroleum and gas.

16. PNG is richly endowed with renewable energy sources that when harness can meet the Vision 2050 target of PNG been 100% power by renewable sources. It is estimated that PNG has hydropower potential of greater than 15,000MW comprising large and small hydros.

Gas

17. Gas development is on the rise with InterOil, Stanley project and Larus projects likely to come on stream. At the tail end of all these, the government must ensure some gas is available for domestic use in power generation to help meet the 70 percent of the households to be electrified by 2030. Then to progress upwards to meet the remaining 30 percent after 2030 and by 2050 all households must be fully electrified in terms of electricity connectivity.

Electricity

18. PNG Power Limited (PPL), the national state-owned corporatized power utility, manages installed generation capacity of some 300 MW, including the two main grids and 19 independent power systems that service 26 smaller urban centres. The remaining capacity of about 280 MW comprises: (i) self-generation systems owned and operated by industrial facilities, including mining companies; and (ii) private sector generators supplying the main grids or rural communities. The government's ownership in PPL is maintained through the Independent Public Business Corporation.

19. Technical regulation of the sector is performed by PPL itself through agreement with the Consumer and Competition Commission; however, although it is intended to eventually transfer this function to the Energy Division, through this policy it should be transferred to National Energy Authority under the auspicious of the Electricity Industry Policy.

20. There are several private sector power generators operating in PNG, including Hanjung Power, a private company that operates a power station (26.4 MW) supplying the Port Moresby grid; (ii) PNG Sustainable Energy, which operates various rural grids in Western Province and is expanding operations to other parts of the country; and (iii) mining operations that maintain significant levels of self-generation capacity. In addition, (i) provincial governments have responsibility for maintaining stand-alone rural generation facilities (C-centres), churches provide electricity to some off-grid villages, and (iii) the larger mining sites sometimes supply power to adjacent communities.

21. The electricity portion of the Energy Sector includes the generation, transmission, and distribution and retail of electricity.

22. Currently, there are two main stand-alone power grids—in Port Moresby and in the Lae–Madang–Highlands area (the Ramu grid); and a third grid called Gazelle grid and a number of smaller grids that service the smaller urban centres. Because of the unreliability of grid supply, there is considerable self-generation and back-up generation taking place in urban areas, but maintenance and operation costs are high and efficiencies low.

23. PNG has about 580 megawatts (MW) of installed generation capacity, including hydropower (230 MW or 39.7%), diesel (217 MW or 37.4%), gas-fired (82 MW or 14.1%), and geothermal (53 MW or 9.1%). PNG has significant under-utilized indigenous energy sources such as hydropower, natural gas, geothermal, and solar.

24. In Papua New Guinea (PNG), about 13% of the household population has access to electricity. Where power is available (generally in the main urban centres), the supply is often unreliable. Access to electricity is very limited in off-grid rural areas. Lack of access to affordable, reliable power is limiting economic growth in urban areas, constraining growth in smaller urban centres, and contributing to poverty in rural areas. An SME study in 2014 confirmed this.

Renewable Energy

25. Renewable Energy is the most abundant source of energy in PNG and if fully harnessed can contribute to 100 percent powering of electricity in the country. PNG is endowed with many of these resources. However, the drawback is the costs involved with their implementation and the maturity of the technology to harness electricity.

26. The Vision 2050 directs that by 2050, all electricity supply security must come from renewable energy so the onus is now on us to ensure various forms of renewable energy must be tested and planned for utilisation for the peoples and the business community’s benefit.

2.2 LEGAL AND REGULATORY FRAMEWORK

1. Energy is a broader subject with its various legal and regulatory environment loosely administered by various organizations under different laws.

2. Papua New Guinea's governing laws on the industry include: the Constitution of the Independent State of Papua New Guinea, Independent Consumer & Competition Commission Act 2002, Electricity Industry Act 2002, Oil & Gas Act 1996 and the Mining Act 1992. There are other key supporting legislations though that provides a cumbersome and loose legal framework within which the energy sector operates.

3. These institutions and agencies have their own weaknesses and challenges, together with the laws they are administering, some of which dates back to as far as independence days. Given such an operating environment, it would be an understatement to suggest any one legal and regulatory framework.

4. This Policy recognizes these many challenges and shortfalls some of which include, fiscal, funding, legal and policy vacuums, institutional, technical, entrepreneurial abilities, knowledge, environment and social; and aims to address the immediate needs of the industry, especially in so far as energy uses for electricity is concerned, to kick-start the process of aligning the legislative and policy environment.

2.2.1 CONSTITUTION OF THE INDEPENDENT STATE OF PAPUA NEW GUINEA

1. In the Preamble to the Constitution, National Goal and Directive Principal three (3) provides for the Government to base their planning for the political, economic and social development and take effective measures to control and actively participate in the national economic, and in particular to control major enterprises engaged in the exploitation of natural resources.

2. Goal four (4) provides for Papua New Guinea's natural resources and environment to be conserved and used for the collective benefit of all, and be replenished for the benefit of future generations.

3. These provisions in essence, provides for the aligning of the energy sector policy, legal and regulatory framework with these provisions, spirit and aspirations of the Constitution.

2.2.2 CURRENT POLICY AND LEGISLATION

There are several policies and legislations which have an implication for the energy policy, these are:

1. Electricity Industry Policy provides for inter-alia, the promotion of competition within the electricity industry. This Policy is operative for a period of only three years (2011-2014) and is overdue for a review. At this juncture too we hope to introduce two new policies; the Renewable Energy Policy and Rural Electrification which is being funded by the World Bank.

2. The Oil and Gas Act 1996 was enacted to regulate the negotiation and conclusion by the Government of petroleum agreements relating to the exploration for, development, production and transportation of, petroleum.

3. Geothermal Energy Policy provides the framework for the usage and regulation of geothermal resources use when it concerns electricity generation from heat and steam.

4. Mining Act 1992 was enacted to regulate the exploration for, development, production and transportation of minerals excluding petroleum.

5. The Mineral Resources Authority was established by an Act of Parliament in 2005 and is responsible for the management, exploration and development of Papua New Guinea's mineral resources, including safety in mining operations.

6. The ICCC Act 2002 establishes the regime for consumer protection, promoting and protection of competition, and regulating of State Owned Monopolies.

7. Alongside the foregoing principal Acts, there are several other Acts that impact the energy sector, including:-

   a. The National Institute of Standards and Industrial Technology Act - provides for establishment of minimum quality specifications, mode, materials and apparatus for energy used in the country. Also sets

standards for storage tanks and dispensing equipment for sale of petroleum products and calibrates and regulates them for accuracy.

b. The Environment Act 2000 – provides for the regulation of all environmental related matters across industries.

c. The Organic Law on Provincial and Local Level Government and the National Capital District Commission Act - grants authority for approval by local authorities of sites for construction and installation of fuel storage and dispensing facilities; business licensing and levies for electric power poles and way leaves charges.

d. The Physical Planning Act - provides for zoning of areas for storage, distribution and retailing of petroleum fuels and construction of electric power sub-stations and other infrastructure.

e. The Public Private Partnership Act 2014 – establishes institutional structures and governance arrangements for all Public–Private Partnerships projects.

f. The Land Act 1996 which establishes the department of lands of and physical planning and administers State Leases in Papua New Guinea.

g. Incorporated Land Group Act (Amended) 2009 which governs arrangements relating to customary land matters and incorporation of groups by landowners for land development and related purposes.

h. The Land Registration Act (Amended) 2009, which provides for the process and procedures in relation to registration of customary land for development and related purposes.

i. The Income Tax Act 1959, provides for the tax arrangements in the country.

j. The Land Titles Commission Act 1962 establishes the land titles commission as an independent judicial tribunal for the resolution of disputes of rights in land, including an interest in land, whether arising out of and regulated by custom or otherwise, provides for judicial procedures and the extrajudicial settlement of disputes and some other matters.

2.3 CURRENT INSTITUTIONAL ARRANGEMENTS

2.3.1 INSTITUTIONS

1. The institutional arrangements for the PNG energy sector are currently very fragmented where critical functions of the sector are vested in different institutions by the respective legislation as listed above. Each institution pursues separate but interlinked goals consistent with their own laws.

i. **Department of Petroleum and Energy (DP&E)**
The Department of Petroleum and Energy was established to promote and regulate the development of petroleum and other sources of energy for the long term benefits of the State in a way which is ethical, socially responsible and environmentally sound.

ii. **Department of Mineral Policy & Geo-Hazards Management (DMP & GM)**
The Function of the Department of Mineral Policy and Geo-hazards Management is to create effective mineral policies and to create policies for the reduction of Geological Risks.

iii. **Mineral Resources Authority (MRA)**
The Authority was established with the purpose of regulating the mining industry and its management, exploitation and development of Papua New Guinea's mineral resources;

- to promote the orderly exploitation for the development of the country's mineral resources.
- to oversee the administration and enforcement of the *Mining Act 1992*, the *Mining (Safety) Act 1977*, the *Mining Development Act 1955.*
- to receive and collect, on its own account and on behalf of the State, any fee, levy, rent, security, deposit, compensation, royalty, cost, penalty, or other money .

iv. **Department of Public Enterprises (DPE)**
The Department of Public Enterprises was created to provide policy oversight to remedy serious SOE performance weaknesses and provide serious oversight to SOEs to become profitable. The Department is looking at policy level interventions not only for rehabilitating and investing in the existing SOE businesses but also to incubate business opportunities and investments into one structure called the Kumul Consolidation Agenda.

v. **Independent Public Business Corporation (IPBC)**
The IPBC was established in 2002 as an independent entity under its own Act to hold the majority of State-owned commercial asserts in trust for the State of Papua New Guinea to manage those asserts prudently to improve commercial performance and underpin economic development.

vi. **Independent Consumer and Competition Commission (ICCC)**
The ICCC is a regulator established by the ICCC Act purposely for promotion of competition and fair trading, the regulation of prices for certain goods and services, and the protection of consumers' interest in the country. It has the regulatory powers to investigate and charges business and industries violating its market rules set by the State.

vii. **Department of Treasury (DoT)**
The Department of Treasury is one of the key central agencies that functions to undertake research and provide advice to the Government on economic issues and provide advice to Government on financial issues that arise from the National Budget. It also prepares and monitor the National Budget and provide policy advice to the Government on the finance and resource management of National Government Departments, Provincial and Local Level Government and state owned enterprises.

viii. **Department of National Planning & Monitoring (DNPM)**
The Department established to lead, plan, coordinate and facilitate sustainable development presenting a clear vision and direction for the nation's future. It ensures to monitor all implementation of projects and developments are undertaken in line with the national's strategic plans.

ix. **Conservation & Environmental Protection Authority (CEPA)**
The CEPA was established under the former Department of Environment and Conservation in 1985 and vested with the powers to protect the environmental values of air, water, soil and biodiversity and the sustainable use of natural resources as mandated by the Fourth Goal of the National Constitution.

x. **Office of Climate Change and Development (OCCD)**
The OCCD's mandate is founded upon the principles that Papua New Guinea's natural resources and environment are to be conserved and used for the collective benefit of all and are replenished for the benefit of future

generations. The Office of Climate Change and Development takes full and exclusive responsibility to coordinate and facilitate all policies, initiatives and actions under Pillar Five of Vision 2050, particular to climate change.

xi. **PNG Power Limited (PPL)**
PNG Power Limited is one of the State Owned Enterprises established as a regulatory regime vested with the powers and responsibilities to Plan, Develop, Generate, Transmit, Distribute and Retail electricity throughout Papua New Guinea.

xii. **National Petroleum Company PNG (NPCP)**
NPCP is the National Oil and Gas Company 100% owned by State, PNG Third Largest Partner in PNG LNG Project with 16.6% stake has 20.5% stake in 4 Petroleum Development Licenses (PDL 1, 7, 8, 9). NPCP is mandated to be the Nominee of all Petroleum Development in the Country.

xiii. **Petromin (PNG) Holdings Limited (Petromin)**
Petromin PNG Holdings Limited is an independent company created by the State of Papua New Guinea to hold the State's assets and to maximise indigenous ownership and revenue gains in the mineral and petroleum sectors.

It is empowered as the vehicle to better leverage the State's equity holdings and encourage more production and downstream processing of oil, gas and minerals in PNG through proactive investment strategies either wholly or in partnership with resource developers.

2. The Institutional arrangements of the energy sector will be streamlined to encourage efficiency, access and affordability. The energy regulatory functions both technical as well as economic will be brought under a new structure as detailed in chapter 11, specifically under the proposed Electricity Regulatory Commission which will perform this role.

3. The unbundled PPL will result in Kumul Power Ltd and the subsidiary companies and specialised entities as detailed in Chapter 7.

3 FOSSIL FUELS

3.1 BACKGROUND

1. Fossil fuels consists of petroleum (oil, and natural gas) and coal resources. As at 2014 petroleum accounts for about 57% of the total primary energy consumed in the country. Petroleum is mainly used in the transport, power generation, commercial and industrial sectors as well as households. There is no Coal usage in the country.

2. The petroleum industry is broadly divided into three categories namely: upstream (exploration and production), mid-stream (storage, refining and transportation) and down-stream (supply and distribution). Midstream and downstream operations are usually combined.

3. The monetization of natural gas is frequently more complex than the commercialization of liquid hydrocarbons. Frequently investments will be required in interrelated links in the supply chain, including upstream, midstream, downstream and consumption facilities.

3.2 UPSTREAM PETROLEUM

3.2.1 PETROLEUM EXPLORATION & PRODUCTION

1. Papua New Guinea has benefited profoundly through significant foreign investment in its upstream petroleum exploration sector over the last 30 year where some of the players are leading international oil companies.

2. The existing oil fields have already reached their peak plateau and are now declining due to natural pressure decline.

3. Currently there are accelerated exploration activities undertaken in the country and the prospect of new oil and gas discoveries appears promising. The marked increase in petroleum exploration interest is attributed to;

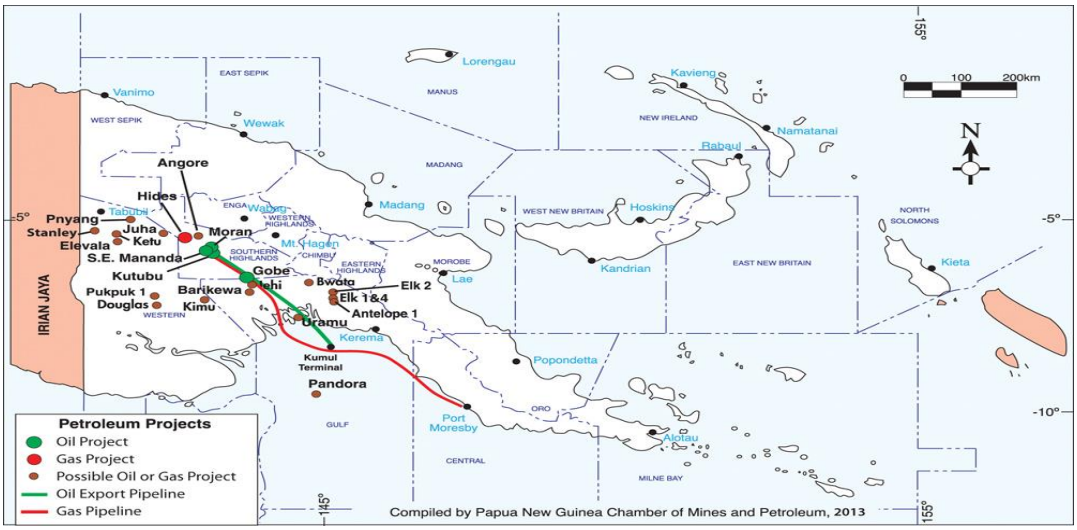
    a. Existence of an attractive legal, regulatory framework, fiscal and acceptable risk-reward balance incentive;
    b. Intensive promotion activities by the Government; and
    c. Rising world crude oil prices.

4. PNG commissioned its first commercial gas project in 1991 which was to produce electricity for a nearby gold mine. Its major export-based gas project

was the US$ 19 Billion PNG LNG Project which was successfully commissioned in 2014.

5. As at 2014, Papua New Guinea's Petroleum Projects are shown in Figure 2.

Figure 2. – Petroleum Projects, 2014



Source: PNG Chamber of Mines and Petroleum, 2013

6. There are many undeveloped gas fields in the country with proven and probable reserves of over 20 trillion cubic feet of gas. Most of these discoveries are small to medium size fields.

7. As of May 2014, Papua New Guinea has joined the exclusive club of LNG producers and exporters. With increased petroleum exploration being undertaken both on-shore and off-shore in the country's major sedimentary basins there is now the possibility that more reserves of natural gas would be discovered in commercial quantities. The Government will ensure 15% of gas reserves in new Oil and Gas projects should be made available for domestic gas utilization.

8. The Government recognises the significance of the industry and is determined to promote efficiency in the overall administration and regulation of the hydrocarbon industry.

3.2.2 CHALLENGES IN PETROLEUM UPSTREAM

1. There are several challenges in the petroleum sector; these are:

   (a) Attraction of capital for petroleum exploration and production activities, which are highly capital intensive due to the rugged geography.
   (b) High cost of acquisition of new technology.
   (c) Limited primary technical data in most of the country's exploration blocks.

2. Inherent weaknesses in the Petroleum Development License are:

   (a) Compensation regime.

   (b) Licensing rounds.

   (c) Community awareness and participation.

   (d) Windfall profits.

   (e) Gas sharing terms.

   (f) Environmental protection, conservation and management.

   (g) Mechanism for working out national government, provincial government and local level government benefits sharing.

   (h) Payment of royalty on gross oil produced.

   (i) National Content in Project Development.

   (j) Domestic Market Obligation.

3. Petroleum resource is finite.

4. Inadequate policy for sustainable utilization of petroleum revenue and its management.

5. The lower wellhead price of natural gas, be it caused either by having to compete with lower cost alternative fuels in the domestic market or as a result of lower netback prices into the export markets, and longer project lead times, makes it extremely challenging to economically develop a natural gas industry based on oil-based fiscal terms.

6. High cost and inexistence of gas infrastructure to support gas discovery and development both offshore and onshore.

7. Inability to disaggregate into component elements of supply chain e.g cost of wholesale gas, transportation and distribution in order to price the gas.

8. Unlike oil, there is no world gas price.

9. Lack of gas master plan.

3.2.3 POLICIES AND STRATEGIES – PETROLEUM UPSTREAM

1. Necessary amendments to be made to the existing legislations (especially Oil and Gas Act and the ICCC Act) governing hydro carbons to ensure that no vertical integration takes place in the investment, extraction, processing distribution and transportation of hydrocarbons.

2. Establish a one stop source for petroleum upstream licensing and operations to be known as the Petroleum Resources Authority. It will be the overall Regulator of the Industry.

3. Develop a policy on management of commercial discoveries of petroleum resources.

4. Promote petroleum exploration and production activities through encouragement of PPP arrangements.

5. Sub-divide and create new petroleum exploration blocks, based on technical data and negotiate favourable work programmes that will see investors with requisite capacity assist in data acquisition.

6. Introduce model Production Sharing Contracts (PSC).

7. Continuation of petroleum and gas agreements but with fiscal terms taken out and included in the general legislation.

8. Cash bidding for the unallocated, relinquished and surrendered exploration acreage.

9. Contracting out of early stage geological survey work, financed out of proceeds of cash bidding for exploration acreage.

10. Review the Oil & Gas Act 1998 (OGA 1998) to incorporate industry best practice adapted to fit local conditions. The revised Act shall provide for gas sharing terms, compensation, windfall profits, royalties and Corporate Social Responsibility, licensing rounds; community awareness and participation; windfall profits; bonuses as may be applicable, gas sharing terms; government share out of monetary gains, environmental protection; conservation and management; sharing of benefits mechanism between the national , provincial and local level governments and local community; payment of royalty on gross oil produced; local content requirement.

11. Develop mechanisms for sharing and management of petroleum benefits, in line with the Extractive Industries Transparency Initiative (EITI).

12. Enhance corporate governance in the Government institutions charged with petroleum charged with exploration and development.

13. Strengthen monetary and fiscal regimes to maximize the government take on petroleum exploitation while taking into account the investors interests.

14. Provide incentives for investments in marginal oil and gas discoveries that could have the potential to deliver much financial and socio- economic value.

15. Develop local content policy that covers technology and knowledge transfer, capacity building of local industry and local employment opportunities as well as laws and regulations to govern local content implementation.

16. Ensure that petroleum exploration and production activities shall include technology transfer and development of local manpower; including engaging qualified local personnel as a priority.

17. Enhance manpower and technical capacity in petroleum exploration by establishing programmes in conjunction with local industry associations, local training institutions and international institutions.

18. Support local investors that have the financial capacity and interest to participate in and/or undertake petroleum exploration and production.

19. Support collaboration and synergy by government owned agencies keen to participate in petroleum exploration and production.

20. Develop oil and gas infrastructure such as crude oil pipelines and storage tanks, through PPP and JV arrangements where appropriate.

21. Develop a comprehensive Oil & Gas Master Plan; intensify exploration activities; enhance the utilisation of local capacity in oil exploration; upgrade the local exploration technology; commence commercial production of petroleum.

22. To facilitate efficient use of capital and Government oversight, a segmented fiscal structure covering the upstream, midstream and downstream shall be adopted. The upstream shall be subject to the proposed PSC regime while the midstream and downstream activities shall be held in separate entities outside the PSC and subject to the ITA 1959 on corporate taxation governance principles.

23. Adopt a transfer pricing mechanism to address the possibility of tax avoidance by affiliated parties in the gas value chain, based on international best practice guidelines for transfer pricing.

24. Provide mechanisms for commercialization of gas, taking into account elements of supply chain which shall consider the value of natural gas upon discovery, development, processing and the market for end products in order to determine the pricing.

25. Undertake measures to fast track commercial gas discovery including CBM and Shale Gas.

26. In the event of discovery of crude oil together with natural gas, companies should endeavour to ensure that secondary measures are instituted to exhaustively produce from such wells.

27. Flaring of natural gas must be regulated by way of formulating a gas flaring policy and regulation.

28. Offer more favourable fiscal terms for natural gas including more favourable profit splits as an incentive for natural gas exploration and development.

3.3 MIDSTREAM AND DOWNSTREAM PETROLEUM

3.3.1 PETROLEUM DEMAND AND CONSUMPTION

1. The average consumption of petroleum products in Papua New Guinea has been increasing over the years. Some of the factors that explain this increase in consumption include GDP growth, electrical energy demand, population growth, urban population growth, and increase in motorization and air transport.

2. Demand for petroleum products is projected to rise in line with the boom in economic activities triggered from the PNG LNG project.

3.3.2 PETROLEUM SUPPLY AND DISTRIBUTION

1. The world economy emerged from the recession experienced in 2009 recording a significant growth of 4.6% in 2010. This influenced world oil demand and supply.

2. In 2011 oil prices fluctuated rapidly with the lowest at US$ 95.6 in January, peaking in April at US$ 120 per barrel and averaging at more than US$110 per barrel most of the year. In 2012 the average oil price went up by 3.1% to US$112.97 per barrel.

3. The rapid prices changes were mainly attributed to strong global demand, appreciation of the dollar and the unrest in the Middle East and North Africa. High international oil prices and a weak Papua New Guinean Kina have led to spikes in prices of petroleum products in the domestic market.

3.3.3 PETROLEUM INFRASTRUCTURE ISSUES

1. Sufficient and efficient infrastructural systems are key to ensuring adequate, reliable and cost effective production and supply of petroleum products. The increase in local and regional demand for petroleum products has not been matched by the development of the infrastructure to meet supply chain and market demands.

2. In addition, the volatile international prices of petroleum products and the volatile foreign exchange rates have led to unpredictable consumer prices, more so in the local pump prices. From 2010 the resulting cost-push inflation has led to unsustainable increase in the cost of living.

3.3.4 IMPORT/OFFLOADING FACILITIES IN NAPANAPA

1. PNG's only oil refinery, the Napa Napa oil refinery, located outside of Port Moresby has a processing capacity of about 35, 000 barrels a day. By industry standards, this is a very small refinery. The refinery currently imports both crude oil and refined petroleum products.

2. The State would like to encourage competition in the petroleum fuels market, hence competition in the entire value chain of the fuels market from refinery to retailing will be promoted.

3. The State shall use its best endeavours to secure domestically produced crude as feedstock to transfer cost benefits to the national economy.

3.3.4.1 STORAGE FACILITIES IN NAPA NAPA

1. Napa Napa has a storage capacity of 750,000 barrels of crude feedstock and approximately 1.1 million barrels of refined products while its operational capacity is 36, 000 bpd. This comprises JetA1, diesel and gasoline. This capacity is adequate for domestic demand of petroleum products but the refinery currently imports some refined petroleum products as it often produces at below capacity.

3.3.4.2 STRATEGIC PETROLEUM RESERVES

1. The State recognizes the critical need to put in place energy security mechanisms, particularly with respect to refined fuels and therefore will address issues pertaining to feedstock, refinery capacity, storage and efficiency.

3.3.5 PETROLEUM REFINING

1. The Puma Energy-owned Napa Napa Oil refinery has been refining 36,000 bpd of crude oil. The refinery produces Jet A-1, diesel and gasoline. The State is determined to encourage competition in the oil refinery sector in order to achieve efficiency and low unit cost of production, which should be transferred to the end users and this is fundamentally crucial for the Government in growing the national economy.

2. The State would encourage local refineries to purchase domestically produced crude and that the price of feedstock crude shall be equivalent to cost of production and transportation plus a 10 percent margin.

3.3.6 PETROLEUM TRANSPORTATION

3.3.6.1 PIPELINE

1. Oil and Gas pipeline as well as processing and storage facilities are very important national infrastructure.

2. The Government will encourage third party access in major oil and gas pipelines, particularly pipelines which have a capacity of 30 inches and over, hence a project developer must make provision for excess capacity to be made available in the system.

3.3.6.2 SEA TRANSPORT

1. PNG's LNG sector has a huge potential for expansion and the Government's desire is to maximise PNG's benefits by encouraging State Owned Companies and Nationally Owned Companies to participate in each segment of the LNG value chain, including LNG tankers.

2. Being a marine nation, sea transport is a vital part of life in PNG and the Government's desire is to create an environment where the cost structure of business in PNG is reduced, including the cost of sea transportation.

3.3.6.3 ROAD TRANSPORT

1. Road transport will continue to play a vital role in the distribution of petroleum refined fuels in PNG and the Government recognizes the importance of making transportation less costly by addressing elements which add to increased cost of business such as bad roads and high cost of fuel.

3.3.7 OIL MARKETING COMPANIES (OMC)

1. Puma Energy, since taking over InterOil's refining assets in Papua New Guinea, is the major licensed OMC allowed to import and market crude and petroleum products in Papua New Guinea. There are two more OMCs in the market, Niugini Oil Company and Mobil Oil Limited.

2. InterOil retail and wholesale distribution business distributes diesel, jet fuel, gasoline, kerosene and fuel oil as well as Shell and BP branded commercial and industrial lubricants such as engine and hydraulic oils.

3. Both Mobil and InterOil own and operate large terminals and depots throughout Papua New Guinea. InterOil supplies the aviation companies.

4. In addition to their wholesale distribution networks, both Mobil and InterOil run retail service stations networks throughout the country.

5. InterOil owned eleven (11) airfield operations in Papua New Guinea located on or adjacent to the airstrip. Customers include the following; the National Government carrier, commercial passenger airlines, mining and exploration and independent airlines operators.

6. The current Service Agreement between Puma Energy and GoPNG is under review to allow in additional competitors.

7. The Government endeavours to create an environment of level playing field for OMCs to compete fairly so that the market forces of supply and demand will set the true economic price for refined petroleum products.

3.3.8 REGULATED INDUSTRY/REGULATORY CONTRACTS

1. The retailed petroleum refined fuels market is regulated but there are imbalances in the market, hence making the cost of fuel in PNG very expensive.

2. The Government is determined to ensure the market is regulated properly in a manner where both the suppliers are able to make a reasonable return in their investment while the consumers, including the PNG economy and ordinary citizens, including SMEs benefit from low unit cost of fuels.

3.3.9 GLOBAL GEO-POLITICAL ISSUES

1. On the international scene, crude oil prices have been on a continuous and gradual increase and sometimes abrupt fluctuations. There are a number of geo-political issues that affect the oil prices in the international scene not only in recent years but also in the past. The recent plummeting in crude oil prices, are in one way or another influenced by factors or events such as the unrests in the Middle East countries, reduction in production by OPEC, piracy in the Indian Ocean, increased tension between the USA and Russia over the Ukrainian/Russian conflict, increased demand for petroleum products worldwide, foreign exchange fluctuations and fluctuations in the USA strategic reserves.

2. This fluctuation of the international prices has been causing a shock to the domestic oil prices.

3. The imported petroleum products are paid for in US Dollars. Fluctuation of the exchange rate against the US Dollar shows an overall gradual depreciation. The depreciation of the Papua New Guinea Kina against US Dollar negates any drop in international crude oil prices and makes imports more expensive.

4. Other major costs that impact consumer prices are taxes and levies on petroleum products.

5. Other costs which have increased are the transportation and distribution costs and the allowed marketer's margin to cover overheads and profit.

3.3.10 CHALLENGES IN THE MID AND DOWNSTREAM PETROLEUM

1. Out-dated refinery:

(a) Higher than normal fuel and loss performance because of Tops recirculation;

(b) Programme yield is based on test run conditions (i.e. under controlled condition for a day, neat crude processing and without any upsets) which may not ordinarily be achieved.

(c) High sulphur levels have adverse impacts on the environment and health. Diesel sulphur specification is becoming stringent world-wide for cleaner environment.

2. Frequent power interruptions.

3. Inadequate infrastructure for storage and evacuation of petroleum products.

4. High initial cost of acquiring the necessary infrastructure.

5. Lack of proper planning and coordination of petroleum infrastructure.

6. Lack a petroleum (oil and gas) master plan.

7. Whereas spot buying has various advantages, it exposes the country to price volatility and unreliability as opposed to long term supply contracts which come with price stability and reliability.

8. Inadequate competition.

9. High prices of petroleum products.

10. Adulteration of petroleum products.

11. Lack of centralized gas reticulation infrastructure to homes.

3.3.11 STRATEGIES IN MIDSTREAM AND DOWNSTREAM PETROLEUM

1. Necessary amendments to be made to the existing legislations (especially Oil and Gas Act and the ICCC Act) governing hydro carbons to ensure that no vertical integration takes place in the investment, extraction, distribution and transportation of hydrocarbons.

2. Provide a legal and regulatory framework for midstream petroleum and gas Infrastructure including third party access at reasonable terms and conditions.

3. Government to co-ordinate energy infrastructure development which are interlinked to facilitate efficient utilization of petroleum resources.

4. Establish a one stop source of petroleum upstream licensing and operations to be known as the Petroleum Resources Authority. It will be the overall Regulator of the Industry.

5. Facilitate NPCP's role of stabilizing the market/prices by using appropriate measures including market presence and importation of at least 30% of the country's demand.

6. Introduce incentives to attract investment in retail networks in the remote areas of the country.

7. Enhance consumption of LPG, being an environmentally friendly and economic modern fuel by:
    (a) Constructing import handling, storage, and distribution facilities.
    (b) Providing fiscal incentives on LPG and related appliances.
    (c) Encouraging private sector investment in additional capacity for handling and storage of LPG.

8. Enforce minimum construction and operation standards for retail and wholesale dispensing sites.

9. Creation and Provision for Strategic Petroleum Reserves in the Oil & Gas Act 1998.

10. Enhancing security of supply of petroleum products by raising the operational stock level from 21 to 30 days consumption after construction of additional storage tanks.

11. Provide appropriate incentives to facilitate and support public and private investments in the development of petroleum infrastructure including petroleum jetties, gas filling terminals, loading and storage facilities in all parts of the country at least cost.

12. Construct petroleum storage facilities at appropriate locations to meet 30 days of operational stocks and 90 days of strategic reserve stocks.

13. Petroleum products quality to be reviewed occasionally to align them with international standards by enhancing institutional capacity in Papua New Guinea National Institute of Standards & Industrial Technology (NISIT) to enforce compliance with fuel quality specifications for both domestic import and export market.

14. The Government shall facilitate NPCP to procure the ninety days petroleum strategic reserve stock.

15. The Government shall fast track the development of new refineries to enhance petroleum refinery capacity in the country.

16. The Government shall facilitate and support public and private investments in off-loading, storage, transportation and evacuation infrastructure for adequate supply and distribution of petroleum products.

17. The Government shall establish mechanisms to ensure stable power supply to support petroleum business.

18. Government shall where necessary cushion Papua New Guinean consumers from the negative effect of high petroleum prices.

19. Assess the continuing feasibility of pump price regulation.

20. Introduce measures to increase consumption of LPG.

21. Provide incentives for investment in centralized gas reticulation systems.

22. Transportation of petroleum products by road to be restricted where other cheaper and safer modes of transportation are available.

23. The government shall put enabling mechanisms to allow NPCP apply its expertise regionally in petroleum infrastructure development.

3.4 MID AND DOWNSTREAM NATURAL GAS

3.4.1 BACKGROUND

1. Natural gas has the potential of meeting future energy needs of the country and offers a number of significant environmental benefits over other fossil fuels mainly due to its chemical simplicity that burns cleaner than all other fossil fuels.

2. The country could harness some of the indigenous gas to meet the growing energy requirements of the country and would seek to reduce reliance on imports.

3. The monetization of natural gas is frequently more complex than the commercialization of hydrocarbon liquid reserves as demonstrated in the PNG LNG Project. Frequently investments will be required in interrelated links in the supply chain, including upstream, midstream, downstream and consumption facilities.

3.4.2 UTILIZATION

1. **Electric Power Generation:** The main use of natural gas is through gas-fired power generation, preferably Combined Cycle Gas Turbines (CCGT) to ensure maximum efficiency. Generation of power through gas fired plants has several advantages over other fossil fuelled power plants in that it has much lower environmental impact. Natural gas pipeline would need to be

constructed from the field to the power plant or from the LNG import handling facility or import pipeline.

2. **Industrial:** The following industries are feasible when sufficient quantities of natural gas are available at reasonable cost:
   a. Manufacture of ammonia for fertilizer production. More than 97% of the world's strategic fertilizer is produced from synthetically produced ammonia derived from natural gas. The natural gas is both a feedstock and fuel.
   b. Manufacture of fuel additives, plastics detergents, formaldehyde, among others.
   c. Manufacture of steel through the modern Direct Reduced Iron method which directly removes oxygen by reacting the ore with a hydrogen-rich and CO-rich gas produced by catalysing methane derived from natural gas. The natural gas is both a feedstock and fuel.

3. **Gas to Liquids**: This application is used to produce diesel and other fuels. However the technology for Gas to Liquids (GTL) has not yet been commercially proven and therefore shall not be an option until such technologies are well developed and available at reasonable cost.

4. **Transport:** Compressed Natural Gas (CNG) is methane pressured at 200 to 250 bars (2900 to 3,500 psi) at which it is stored and distributed. In this case, Methane is compressed to less than 1% of the volume it occupies at standard atmospheric pressure. CNG technology shall be applied in Papua New Guinea for transport.

5. **Commercial and domestic use:** The Government shall initiate pilot projects for residential domestic and commercial purposes for space heating, water heating, cooking, and street lighting. Networks shall be developed for supplying residential and commercial consumers with clean and reliable natural gas.

3.4.3 CHALLENGES

1. Lack of legal regulatory and fiscal framework to facilitate the export options as the easiest and quickest option to monetize natural gas discoveries.

2. Lack of facilities to exploit natural gas reserves, e.g., power plants, petrochemical plants, and fertilizer plants.

3. Lack of infrastructure for supply to commercial, industrial and residential consumers.

4. Lack of gas master plan.

3.4.4 STRATEGIES – MID AND DOWNSTREAM NATURAL GAS

1. Necessary amendments to be made to the existing legislations (especially Oil and Gas Act and the ICCC Act) governing hydro carbons to ensure that no vertical integration takes place in the investment, extraction, distribution and transportation of hydrocarbons.

2. Develop a Gas Master Plan and a policy that identifies priority domestic sectors for gas utilization and, provided sufficient volumes are discovered, will allow gas to be separated and exported at international market prices.

3. Develop a Standard Gas Project Agreement template.

4. Develop the gas sector by: ensuring the safe supply of gas to end users; attracting investment in the sector by establishing a transparent and efficient legislative framework; promoting private sector participation in all parts of the gas chain and establishing a regulatory framework ((Economic Regulation, Negotiated Access and Operational Regulation (ERNADOR)) according to international norms.

5. Adopt a segmented fiscal structure covering the upstream, midstream and downstream segments to facilitate efficient use of capital and Government oversight.

6. Facilitate industries to exploit supplies of natural gas based on market studies of priority markets.

7. Initiate networks to supply residential and commercial consumers with clean and reliable natural gas.

8. For Gas to Liquids (GTL) the policy shall be to allow the technology to be commercially proven before adoption locally.

9. CNG technology shall be applied for transport starting with public transport initially on pilot basis in areas with supply of natural gas.

10. Carry out studies for overall gas demand in the country to facilitate planning.

11. Establish a regulatory framework for the midstream and downstream natural gas sector.

12. Develop the Domestic Gas Reservation (DGR) Policy.

3.5 COAL RESOURCES

3.5.1 OVERVIEW

1. Coal has been identified as one of the indigenous sources of energy that will drive the development of strategic initiatives for Vision 2050. It was recognized that the key to increased development lay in early identification of indigenous energy sources, exploiting them and establishing an appropriate institutional framework for their delivery to consumers.

2. Coal is a readily combustible rock containing more than 50% by weight and more than 70% by volume of carbonaceous material formed from compaction of variously altered plant remains. It is used as a source of energy, mainly for electricity generation. It is the most affordable fuel worldwide and has a potential to become the most reliable and easily accessible energy source.

3. The introduction of clean coal technology (CCTs) in coal fired power plants reduces emissions and extracts sulphur for other applications such as chemical and fertilizer production while capturing carbon for storage (CCS). Current world coal energy consumption by sector is 42% electricity, 25% industrial and 4% other uses.

4. The country has adequate coal deposits for commercial exploitation and the Government is fast tracking exploration and development of the resource for power generation and industrial use.

5. Interest in coal has also increased recently in Papua New Guinea, with prospectors snapping up dozens of new coal exploration permits starting in early 2011. Australian based Waterford is investigating coal shale long the Sepik and the Ramu basin in the northeast of the country, while other attention has also been shown in the Gulf basin in the southwest. Having

completed initial exploratory efforts, the results are now being analysed and expected to be submitted to the Mineral Resources Authority (MRA) by mid-2012.

3.5.2 DEMAND FOR COAL

1. In Papua New Guinea, there is a demand for coal for cheap and alternative electricity generation. Coal has been considered an alternative option for base-load electricity generation in PNG, and thus its domestic demand is expected to rise with introduction of the technology.

2. Domestic consumption is expected with the discovery of coal deposits by Mayur Resources[2], in the Gulf Province and other parts of the country.

3.5.3 COAL UPSTREAM DEVELOPMENT

1. There are commercially viable coal reserves in the Gulf Province.

2. Coal reserves there are yet to be confirmed.

3. Further exploration for coal is being carried out in other parts of the country.

3.5.4 CHALLENGES IN COAL EXPLORATION

1. Limited skills and expertise in core drilling disciplines.

2. Limited coal reserve data due to low intensity of exploration.

3. Poor infrastructure; coal resources are mostly situated in remote areas where there is lack of developed road, water, communication and electricity.

4. Lack of interest by major coal exploration companies due to limited technical data.

5. Absence of a legal, fiscal and regulatory framework for coal exploration, exploitation and development.

[2] Mayur Resources is a privately held company with one of the largest tenement holdings in PNG; this comprises a pipeline of exploration and development projects, across a diversified portfolio including Coal, Iron sands, Copper & Gold.

6. Lack of a special purpose vehicle to spearhead exploration, assessment and development of coal resources.

3.5.5 COAL MID AND DOWNSTREAM DEVELOPMENT

1. There are no coal fired power plant in the Papua New Guinea as yet.

2. The Government will encourage clean-energy technology for the development and consumption of coal in the country.

3.5.6 CHALLENGES IN COAL MID AND DOWNSTREAM

1. Inadequate technical capacity for coal mid and downstream activities.

2. Absence of a standard import and export coal handling facilities.

3. Underdeveloped road transportation system.

4. Undeveloped processing facilities for coal.

5. Insufficient power supply in the coal field.

6. Undeveloped capacity to store and evacuate coal products.

7. High initial cost of acquiring the necessary infrastructure.

8. High transportation cost from the processor to end user.

3.5.7 STRATEGIES - COAL (UPSTREAM, MIDSTREAM AND DOWNSTREAM)

1. Necessary amendments to be made to the existing legislations (especially Oil and Gas Act and the ICCC Act) governing hydro carbons to ensure that no vertical integration takes place in the investment, extraction, distribution and transportation of hydrocarbons.

2. Develop a standard Model Mining Development Contract (MMDC) and or alternatively Mining Code for Coal (MCC) and other minerals.

3. Continuation of resource development agreements/mining development contracts but with fiscal terms taken out and included in general legislation.

4. Cash bidding for unallocated, relinquished and surrendered exploration acreage.

5. Contracting out early-stage geological survey work, financed out of proceeds of cash bidding for exploration acreage.

6. Develop local expertise and enhance local content in coal exploration and production through training and collaboration with exploration companies, training and research institutions.

7. Create appropriate legal, fiscal and regulatory framework for coal exploration, exploitation and development.

8. Establish coal energy research centre within the proposed national energy institute capable of handling coal analysis and other related studies.

9. Adapt clean coal technology and provide appropriate fiscal incentives.

10. Create new coal exploration blocks based on technical data.

11. Enhance regional co-operation in data and information exchange for coal exploration.

12. Papua New Guinea's State Owned Entities shall maximise the utilisation of available transport modes and do the feasibility of Rail Transport for transportation of coal products.

13. Enhance budgetary support for exploration and development of coal resources.

14. Encourage private sector participation in coal exploration, mining, development and use through PPP and JV arrangements by providing appropriate incentives.

15. Construct necessary infrastructure to support coal industry, including provision for handling import and export of coal.

16. Intensify coal exploration activities by upgrading exploration technology and mobilizing resources.

17. Facilitate development of 10MW coal fired plant in Port Moresby, and development of other coal fired plants in other feasible sites in the country.

18. Develop an integrated infrastructure for coal storage, transportation and utilization to facilitate development of the coal industry.

19. Incentivize Provincial and Local Level Governments with coal deposits to develop infrastructure to potential coal mining sites to encourage investments in coal mining.

20. Put in place mechanisms of sharing of revenue to ensure that the local community benefit from the development of the resource.

21. Ensure compliance with the best coal industry practice in exploration, mining, processing, development and rehabilitation.

22. Ensure that all coal development activities are clearly documented and communicated to the Chief Secretary and the respective Provincial and Local Level Governments.

3.5.8 CROSS CUTTING STRATEGIES IN FOSSIL FUELS

1. Adopt and implement the Extractive Industries Transparency Initiative (EITI) principles (governance, increasing scrutiny over revenue collection from oil and gas) as a demonstration of its commitment to good as well coal resources, and improving the country's investment climate.

2. Enhance infrastructure development for fossil fuels.

3. Adopt clean technologies in exploration, exploitation and development of fossil fuels.

4. Develop frameworks and methodologies for determining the oil, gas and coal resource reserves, reporting fossil fuel discoveries and provide penalties for falsification of data.

5. Government shall classify strategic energy installations such as oil and gas fields, coal mines, refineries, jetties, pipeline systems, petroleum, storage

facilities as protected areas and provide security during construction and operation.

4 RENEWABLE ENERGY

4.1 BACKGROUND

1. Renewable energy harnesses naturally occurring non-depletable sources of energy, such as hydro, solar, wind, geothermal, wave, tidal, ocean current, biofuel and biomass, to produce electricity, gases and liquid fuels, heat or a combination of these energy types. Some of these renewable energies such as wind, biomass have been used for thousands of years.

2. Current consumer energy in PNG mostly depends on three main fuels; electricity, oil and biomass. In terms of primary energy supply in 2011 oil products accounted for approximately 57%, biomass 37% and hydro, gas and geothermal power the remaining 6%. The energy sector accounts for 14% of the country's GDP.

3. With the developments of renewable energy technologies, these renewable energy sources can be used to generate electricity. Taking into account the sustainable character of the majority of renewable energy technologies, they are able to preserve resources, promote energy security and diversify energy supply virtually without environmental impact.

4. With the possibility of PNG becoming a net oil importer over the medium to long term, there may be considerable change in PNG's future energy mix and PNG's energy security would remain vulnerable to external shocks. However, the technical potential for renewable energy sources in PNG is enormous and the majority occurs/exists in rural areas.

5. PNG is endowed with abundant renewable energy resources, yet 90% of the country's population is without access to electricity. PNG has significant underutilized indigenous energy sources such hydro, natural gas, geothermal, solar-based systems and wind, development of these resources would accelerate PNG's potential to sustain economic growth and enhance the electrification rate.

6. For instance, in hydro power, the potential hydroelectric resources are capable of generating some 15,000 MW of electricity. Less than one percent of this 15,000MW capacity is currently utilized. Significant reforms are needed and specialized business entities focusing on renewable energy must be created to materialize the dreams of the Vision 2050. The proposed involvement of the state to promote renewable energy power companies

through the auspices of the new Kumul Power Limited (KPL) is a stride in the right direction.

7. In electricity generation, utilization of hydro (mini hydro) and solar power are appropriate choice in off-grid and rural areas to accelerate rural electrification. PNG situated along the equator has abundance of sun shine all year round and there are high wind spots along the coastlines and the isolated islands that can be harnessed to produce electricity for the isolated rural communities.

8. The PNG Vision 2050 asserts that by the year 2050 PNG will be 100% powered by renewable energy sources, at the backdrop of our aspirational policy, PNG is at the crossroads and must now more than ever drive its attention to promote and develop our indigenous resources such as hydro, geothermal, natural gas, solar and wind to sustain economic growth.

9. Perhaps the jewel in the crown of infrastructure development and economic growth is the potential to develop Purari Hydro Power Project to produce low cost energy to drive industrial growth in the country with excess power supplied to neighbouring countries. The feasibility studies identified Wabo as the preferred site for the construction of the dam with a capacity to produce up to 2,500 MW of power. This level of generation has the potential to propel industrial development in PNG, supply consumers in Port Moresby and the Ramu power systems as well as the potential to export excess power to Australia and Indonesia. However, it might be the most expensive project ever undertaken in PNG.

10. These new renewable energy power companies will operate under the following share arrangement; State 60%, respective Provincial Government 30% and Landowners 10%. The intent is to promote landowner participation and ownership in resource development.

11. The recent launch of the National Biofuel Policy Consultation workshop in 2014 and the drive to develop a Biofuel Policy by the Department of Public Enterprises (DPE) is also a step in the right direction to meaningfully utilise PNG's renewable energy resources under the auspices of the governments 'Green Growth Strategy'. The workshop findings revealed that the growth of biofuels in PNG in recent years has been spurred by increasing prices of fossil fuels, the need to survive financially in business, environmental concerns and unreliable supply of energy. Biofuels are also viewed as a potential means to stimulate rural development and create employment opportunities. The thrust

of the Biofuel Policy would be to facilitate and bring about optimal development and utilization of indigenous biomass feedstock for production of biofuels.

4.2 GEOTHERMAL ENERGY

4.2.1 BACKGROUND

1. Below the earth's crust, there is a layer of hot and molten rock called magma. Heat is continually produced there, mostly from the decay of naturally radioactive materials such as uranium and potassium. The amount of heat within 10,000 metres of the earth's surface contains 50,000 times more energy than all the oil and natural gas resources in the world.

   Four types of geothermal energy are usually distinguished:

   a. Hydrothermal – Hot water or steam at moderate depths (100 – 4500 meters.
   b. Geopressed – Hot water aquifers containing dissolved methane under high pressure at depths of 3-6kilometers.
   c. Hot dry rock – Abnormally hot geologic formations with little or no water.
   d. Magma – Molten rock at temperatures of 700 – 1200 degrees celcius.

   Nowadays only hydrothermal resources are used on a commercial scale for electricity generation and as a direct heat source.

2. The areas with the highest underground temperatures are in regions with active or geological young volcanoes. These occur at plate boundaries or at places where the crust is thin enough to let the heat through.
3. Papua New Guinea is situated on the “Pacific Ring of Fire”, a seismically active zone. Known active seismic zones are in the New Guinea Islands Region and the Northern Coast of the Mainland. The Gazelle Peninsula and Talasea are known areas for geothermal activity. Incidentally they also contain viable commercial quantities of geothermal energy reserves.
4. The only commercially known use of this energy source in the country is on Lihir Island where a plant uses the energy to supply power to the mining operations at the Lihir Gold Mine.

5. Geothermal power plants use steam or hot water from a natural underground reservoir to generate electrical energy and heat for other industrial applications. Other uses of geothermal energy include:

    (a) Dairy industry - refrigeration and pasteurization of milk products;

    (b) Grain Silos - drying of grains (wheat & maize) and other farm products such as pyrethrum;

    (c) Space heating and cooling - green houses, residential houses, hotels and other buildings;

    (d) Industry - production of industrial sulphur, treatment of hides and skins and honey processing, and

    (e) Water heating for fish and crocodile farming, and spas/swimming pool.

6. The specific details of the Geothermal Energy will be captured in the Renewable Energy Policy to be produced by the Institution mandated to draw up this sectoral policy.

4.2.2 CHALLENGES

1. Relatively long lead time of between 5-7 years from conception to production of electricity.

2. Geothermal projects typically progress through stages of reconnaissance, surface exploration, feasibility study, exploratory drilling, appraisal drilling, production drilling, steam field development and power plant construction stages which normally involve high upfront investment costs.

3. High resource development risks.

4. Inadequate geothermal expertise and expensive external technology.

5. Remote location, siting restrictions and long distances to existing load centres necessitating heavy investment in transmission and other support infrastructure.

6. Competing and conflicting interests in use of land and natural energy resources by various sectors of the economy.

7. Relocation and resettlement of affected persons during geothermal development.

4.2.3 STRATEGIES - GEOTHERMAL ENERGY

1. The PNG Government shall support and fund the Geothermal Development Company (GEODEVCO) so as to manage the geothermal exploration risk and attract investors.

2. The Government shall draft a new legislation specifically to regulate Geothermal Energy.

3. The Government shall develop a Geothermal Policy as a matter of urgency and align it with this Energy Policy.

4. The Government will continue to support and facilitate the public sector as well as encourage the private sector to invest in geothermal subsector through various means including PPP and joint venture arrangements.

5. The government will promote research development and dissemination and capacity building for geothermal development through provision of fiscal and other incentives.

6. The government shall streamline licensing and allocations of geothermal.

7. Promote and encourage direct uses of geothermal resources such as utilization of heat, water, gases and minerals.

8. Utilize the best available technologies that optimise the resource and conserve the reservoir such as binary generation and bottoming cycles.

9. The developer of a geothermal field shall guarantee geothermal steam supply for the contract term of the plant.

10. Promote early geothermal generation through implementation of efficient modular geothermal wellhead technologies.

11. Undertake further geothermal resource assessments to determine additional economically viable geothermal resources.

12. Increase Government allocation of funds for the geothermal programme and support GEODEVCO in sourcing more funds.

4.3 HYDRO ENERGY

4.3.1 BACKGROUND

1. Hydropower is electricity generated using the energy of moving water. Rain or melted snow, usually originating in hills and mountains, create streams and rivers that eventually run to lakes, seas or oceans. This energy has been exploited for centuries. In the late 19th century, hydropower became a source for generating electricity.

2. A typical hydro plant is a system with three parts: an electric plant where the electricity is produced; a dam that can be opened or closed to control water flow; and a reservoir where water can be stored. The amount of electricity that can be generated depends on how far the water drops and how much water moves through the system.

3. Hydropower is, to date, the most successful form of renewable energy. The amount of electrical energy generated depends upon the quantity of available water. Adverse hydrology can have a devastating effect on an economy that is heavily dependent on hydropower.

4. Papua New Guinea has an estimated hydropower potential of about 15, 000 MW comprising of large hydros (sites with capacity of more than 10MW) and small hydros.

5. There are 4 major Drainage Basins in the Country; the Strickland-Purari, Fly, Ramu and Sepik River Drainage Basins. The two promising ones for major hydro developments are the Ramu and Strickland-Purari due to the geography and volume.

6. There are four major hydro power stations in Papua New Guinea, namely: Rouna (Port Moresby), Yonki (Kainantu), Warangoi (Gazelle) and Baiune (Bulolo). These hydro power stations are critical to the country's socio-economic well-being.

4.3.2 LARGE HYDROS

4.3.3 BACKGROUND

1. PNG has significant potential in large hydro based power generation, given its high rainfall and many large fast flowing rivers systems.

2. There are 4 major Drainage Basins in the Country; the Strickland-Purari, Fly, Ramu and Sepik River Drainage Basins. The two promising ones for major hydro developments are the Ramu and Strickland-Purari due to the geography and volume.

3. The Government will continue to promote and encourage feasibility studies to develop large hydro potential in the country.

4. The specific details of Hydro Energy as a Renewable Energy resource will be captured in the Renewable Energy Policy to be produced by the Institution mandated to draw up this sectoral policy.

4.3.4 CHALLENGES

1. Hydropower is vulnerable to variations in hydrology and climate. This is a big challenge as poor rains results in power and energy shortfalls, reducing the contribution of hydro power in the energy mix.

2. The economic risk in hydropower projects is relatively higher than other modes of electricity generation because they are capital intensive and wholly dependent on hydrology.

3. A major challenge for hydro power projects is relocation and resettlement of affected persons given PNG's customary land tenure arrangement.

4. Long lead time of between 7-10 years.

5. Insufficient hydrological data throughout Papua New Guinea. It does not capture quality nor cover required periods of at least 50 years.

6. Water charges that have an effect of increasing the cost of hydro generated electricity.

7. Conflicting and competing land and water uses between various sub-sectors of the economy with regard to development and utilization of the same for electricity generation.

8. Ownership of physical dam reservoirs which have stifled redevelopment.

4.3.5 STRATEGIES – LARGE HYDROS

1. Develop a hydro risk mitigation to address risks such as prolonged droughts so as to cushion generators, transmitters, distributors and consumers against effects of adverse hydrology.

2. Address competing interests in the use of water resources for large hydropower generation and other purposes.

3. Establish an inter-departmental committee comprising of relevant stakeholders to advise policy direction on ownership and management of dams.

4. Energy conservation and efficiency will be promoted in the design of hydropower plants.

5. Environmental conservation of catchment areas will be promoted to mitigate soil erosion and land use practices which do not aggravate the top soil and cause rapid siltation of dams and river systems. The developer shall be responsible for funding the initiative. Where possible use other alternate hydro generation technologies (provide suitable technology).

6. The Government shall, where possible implement hydro power projects as multi- purpose projects. Consideration will also be given to leasing of such projects for operation through long-term concessions.

7. The private sector will be encouraged through Feed-in-Tariff to develop potential sites to generate electricity for their own consumption and for export of any surplus to the national grid and neighbouring countries. Government will provide letters of comfort to investors which guarantee purchase of electrical energy on just and reasonable terms.

8. Provide necessary support for raising of Purari dam and other large scale hydropower projects.

9. Undertake pre-investment studies on hydro resources to define their technical and economic viability.

10. Adequately fund the PNG Dams Limited to be the SPV/SOE to cater for large dams.

4.3.6 SMALL HYDROS

4.3.7 BACKGROUND

1. Classification of hydro by sizes (MW) varies in jurisdictions. Therefore, for our purposes, we categorise most hydro systems within Papua New Guinea to fall under the category of small hydro. Small hydro can range from generating capacity up to 10MW or further subdivided into mini hydro, less than 1000 kW and micro hydro, less than 100 kW.

2. PNG's system comprise several small to medium scale hydro ranging from 0.8 MW to 58 MW. Tables 1 and 2 below shows existing and propose hydro developments.

Table 1: Existing Hydropower plants

Existing Hydropower plants - owned and operated by PPL (176MW)										
	Port Moresby System		**Ramu System**		**Gazelle System**		**Minor hydros (West NewBritain)**		**Other Initiative**	
		Installed Capacity		**Installed Capacity**		**Installed Capacity**		**Installed Capacity**		**Installed Capacity**
Name	Sirinumu Dam	1 MW	Yonki	75MW	Warangoi	10 MW	Ru Creek	0.8 MW	Privately owned	
	Rouna 2	40 MW	Pauanda	12 MW			Lake Hargy	1.5 MW	Ok Tedi Mine	58 MW
	Rouna 1 & 3	12 MW							PNG Forest products	8 MW
	Rouna 4	24 MW								

Source: PNG Power 2010

Table 2: New and Proposed Hydropower projects

New and proposed Hydro		
Name	**Installed Capacity**	**Status**
Yonki Toe of Dam (Yonki)	18 MW	Preliminary Site works; PPL
Divune - Popondetta	~4MW	Preliminary Site works; ADB/PPL/DP&E
Ramazon- Buka	~4MW	Preliminary Site works; ADB/PPL/DP&E
Naoro-Brown	~80MW	Feasibility Stage; PPL through PPP
Wabo - Purari	~1800MW	Feasibility Stage; PNG EDL

Source: PNG Power 2010

3. PNG has significant hydroelectric potential with vast river, numerous creeks, streams and mountain spring water flows throughout the country that can be harnessed to produce hydroelectricity power for the rural population of PNG.

4. The specific details of Small Hydros as a Renewable Energy resource will be captured in the Renewable Energy Policy to be produced by the Institution mandated to draw up this sectoral policy.

4.3.8 GOVERNMENT ACTIONS

1. The upsurge in demand for electrical energy in PNG fuelled by high economic growth provides an exciting potential for investment in the small hydro sector. This Government will endeavour to:
    a. Promote investment in the infrastructure sector both new and existing.
    b. Provide adequate financial resources and technical capacity to carry out feasibility studies and development of sites.
    c. Promote collection and processing of hydrological database.
    d. Mitigate and address competing interests between stakeholder's sites (landowner issues).
    e. Promote participation in all power infrastructure projects.

4.3.9 STRATEGIES – SMALL HYDROS

1. Promote protection of the environment and catchment areas.

2. Provide incentives for public private partnerships and increase funding.

3. Promote small micro-enterprises through fiscal incentives to reduce small hydro's start-up costs.

4. Create awareness and disseminate information on the benefits of small hydros and its coexistence with other usages of the resource.

5. Promote development of capacity and knowledge upon the youth, on usage of appropriate technologies.

6. Provide incentives to promote the local production and use of efficient small hydro power systems.

7. Formulate and enforce standards, legal and regulatory regimes for small hydros.

4.4 BIOMASS

4.4.1 BACKGROUND

1. Biomass is organic matter that can be used to provide heat, make fuel and generate electricity. Wood-fuel, the largest source of biomass has been used to provide heat for thousands of years. Many other types of biomass are also used as an energy source such as plant residue from agriculture or forestry and the organic component of municipal and industrial wastes. Landfill gas is also considered a biomass source. Biomass resources can be replenished through cultivation of crops such as fast growing trees and grass.

2. Biomass fuels are the most important source of primary energy in Papua New Guinea with wood-fuel (firewood and charcoal) being the predominant consumer energy fuel.

3. In spite of past efforts to promote wood fuel substitutes, the number of people relying on wood fuel is not decreasing. Consequently, wood fuel will continue to be the primary source of energy for the majority of the rural population and urban poor for as long as it takes to transform the rural economy from subsistence to a highly productive economy.

4. Wood fuel supply management is crucial to ensure sustainable supply to meet the growing demand. Key issues here include: competing land use activities, the growing imbalance between supply and demand and the attendant adverse environmental as well as related land and tree tenure issues, among others.

5. The specific details of Biomass as a Renewable Energy resource will be captured in the Renewable Energy Policy to be produced by the Institution mandated to draw up this sectoral policy.

4.4.2 CHALLENGES

1. Unsustainable use of biomass with attendant negative impacts on the environment, leading to serious climate variability and unpredictability in rainfall patterns.

2. Emissions from wood fuel in poorly ventilated houses leading to health hazards among users.

3. Lack of appropriate legal and regulatory framework for sustainable production, distribution and marketing of biomass.
4. Insufficient awareness of fast maturing tree growing for fuel as a commercially viable business.
5. Inadequate data on biomass production and consumption.
6. Disjointed approach in policy implementation by the various ministries and organizations responsible for biomass energy use.
7. Inadequate recognition of biomass as a source of energy, despite its predominance in the energy mix.
8. Use of inefficient technologies in production, conversion and consumption of biomass energy.
9. Limited awareness programs aimed at encouraging investment in renewable energy.
10. Competing interests over land use between biomass plantations, food production and other commercial uses.

4.4.3 STRATEGIES– BIOMASS

1. The Government shall draft a new legislation specifically to regulate Renewable Energy.

2. The Government shall formulate a National Renewable Policy as a matter of urgency and align it with this Energy Policy.

3. Undertake a comprehensive base line study on biomass energy resources and potential, and establish status of tree cover in PNG.

4. Develop and maintain a database on biomass energy resources and potential in PNG.

5. Formulate and implement a national strategy for coordinating subsistence and commercial biomass production.

7. Promote and update standards for efficient conversion and cleaner utilization of biomass including cleaner charcoal and wood burning stoves.

8. Promote Research, Development and Dissemination (RD&D) of biomass energy technologies.

9. Undertake capacity building for biomass energy technologies

10. Provide incentives for private sector participation in generation, exploitation, production, distribution, supply and use of biomass energy.

11. Enhance public participation in the management, protection and conservation of the environment

12. Promote alternative sources of energy and technologies such as biogas and solar as a substitute for biomass.

13. Collaborate with other relevant ministries and other stakeholders to grow and sustain tree cover to above 10%.

14. Collaborate with other stakeholders to ensure efficient use of land resource to minimize the adverse effects arising from competition for land use between biomass energy and food production.

15. Identify and reserve land for use in biomass energy production and undertake awareness programmes to sensitize the public on the importance of the various land uses such as for biomass, food production and other human needs.

16. Undertake studies to identify and promote the most appropriate biomass energy conversion technologies and implement the recommendations.

17. Promote inter-fuel substitution to reduce the over reliance on wood fuel.

18. Strengthen existing Energy Centres and establish others to cover all provinces with a view to promote efficient biomass energy use.

19. Promote the use of biomass briquettes as alternatives to wood fuel and kerosene in cooking, water heating and steam generation.

20. Undertake a comprehensive study on the viability of use of renewable sources with a view to eliminating use of kerosene in households.

21. Prepare, review and update biomass energy development plans.

4.5 BIO FUELS

4.5.1 BACKGROUND

1. Unlike other renewable sources, biomass can be converted directly into liquid fuels called biofuels to meet energy needs.

2. The use of bio-fuels would reduce vehicle emissions and save on foreign exchange required for importing petroleum fuel, improve on the balance of trade and create employment.

3. A strategy for introduction of bio-fuel blends in the market is soon to be developed by the Government of Papua New Guinea in 2015[3].

4. Commercial extraction of biodiesel for blending has already been initiated by several private companies and some institutions in PNG.

5. Land will need to be set aside for the production of energy crops as feedstock for bio-fuels. This calls for the formulation of strategies to optimise land use, as well as to harmonise land use policies with the energy policy. Most bio-fuel projects underway or being planned involve sugarcane and sweet sorghum as the main feedstock for ethanol; and jatropha, castor and other vegetable oil crops such as, coconut, croton and cotton seed for biodiesel.

6. The specific details of Biofuels as a Renewable Energy resource will be captured in the Renewable Energy Policy to be produced by the Institution mandated to draw up this sectoral policy.

4.5.2 CHALLENGES

1. Insufficient feed-stocks to produce bio-fuels.

2. Limited research data/information for the use and production of bio-fuel.

[3] Workshopped in 2014, the Policy and the accompanying NEC Submission is yet to be approved.

3. Insufficient legal and institutional framework to support sustainable generation, utilisation, production, distribution, supply and use of liquid bio-fuels.

4. Insufficient supply of bio-fuels for blending due to competing uses.

5. Threat of competition over land use that could lead to food insecurity.

6. Reliance on slow maturing crops and dependence on rain fed agriculture.

7. Inadequate RD&D on alternative bio-fuel feed-stocks and technologies.

8. Lack of knowledge among the public on the viability of growing crops for bio-fuel as a business.

9. Illegal export and illicit use of ethanol.

4.5.3 STRATEGIES– BIOFUELS

1. The Government shall draft a new legislation specifically to regulate Biofuels Energy.

2. The Government shall formulate the Biofuels Policy as a matter of urgency and align it with this Energy Policy.

3. Support RD&D for the cultivation of high yielding and fast maturing feedstock so as to enhance the production and use of liquid bio-fuels.

4. Review the existing legal, regulatory and institutional framework to enhance the sustainable generation, production, distribution, supply and use of liquid bio-fuels.

5. Provide fiscal incentives for bio-fuel production projects, plant and equipment in so far as such products are used to meet energy demands.

6. Collaborate with other stakeholders to ensure efficient use of land resources to minimize the adverse effects arising from competition for land use between liquid bio-fuel feedstock and food production.

7. Work with provincial governments to increase economic development through bio-fuel programmes.

8. Create awareness on the importance and viability of growing bio-fuel feedstock among the public.

9. Promote joint venturing between Government agencies and private sector on the development and utilisation of bio fuels.

10. Invest in research on the production chain and sustainability of biofuels particularly biodiesel.

11. Facilitate farmers to access cheap farm inputs and high yielding fast maturing bio-fuel feedstock.

12. Undertake a comprehensive study on the viability of bio-fuels and map out potential bio-fuels production feedstock across all provinces.

13. Provide fiscal incentives for bio-fuel production plant and equipment in so far as such entities are marketing the products solely for blending.

14. Government to identify and set aside land in potential locations for piloting of bio-fuel feedstock production.

15. Review the feasibility of gasohol and biodiesel production.

16. Pilot a 10% ethanol-gasoline (E-10 Mandate) blend in Government vehicles and in public transport vehicles.

17. Pilot 1% biodiesel blend in Government vehicles and in different blending ratios for use as hybrid fuel at isolated power generation plants.

18. Develop a blueprint and road map for national bio-fuel implementation programme.

19. Use annual Agricultural Show in Lae for trade fairs, workshops seminars and energy centres to demonstrate and disseminate information on the importance and viability of growing biofuel feedstock among the public.

20. The Government to enter into PPP arrangements with the private sector entities to accelerate the development of bio-fuels.

21. All gasoline vehicles in PNG to be using at least 10% ethanol gasoline (E-10 Mandate) blend.

22. Provide incentives to encourage all diesel vehicles in the country to use at least 5% biodiesel.

4.6 BIO GAS

4.6.1 BACKGROUND

1. Any gas fuel derived from the decay of organic matter, as the mixture of methane and carbon dioxide produced by the bacterial decomposition of sewage, manure, garbage, or plant crops.

2. Biogas is considered to be a renewable source of energy. Since it often produced from materials that form sewage and waste products, the only time it will be depleted is when we stop producing any waste.

3. It is also considered to be non-polluting in nature. The production of biogas does not require oxygen, which means that resources are conserved by not using any further fuel.

4. It also uses up waste material found in landfills, dump sites and even farms across the country, allowing for decreased soil and water pollution.

5. Applications for biogas are increasing as the technology to utilize it gets better. It can be used to produce electricity and for the purpose of heating and cooking as well. Compressed Natural Gas (CNG) is biogas that has been compressed and can be used as a fuel for vehicles. Production can be carried out through many small plants or one large plant.

6. New Britain Palm Oil Limited and the West New Britain provincial government have held preliminary talks which could see electricity generated from the company's waste products provided across the entire province. Figure 3 overleaf shows the Biogas collection at New Britain Palm Oil Limited's operation in West New Britain.

Figure 3. Biogas plant in New Britain Palm Oil's operation.

Source: Business Advantage

7. There is a great opportunity for West New Britain to be solely powered by green energy in future years according to Harry Brock, General Manager of New Britain Palm Oil Limited (NBPOL) operations in the province.

8. If the arrangement becomes successful, the province is likely to become the first to use bio gas for its power generation needs.

9. The specific details of Biogas as a Renewable Energy resource will be captured in the Renewable Energy Policy to be produced by the Institution mandated to draw up this sectoral policy.

4.6.2 CHALLENGES

1. Lack of information on the benefits and potential of biogas technology.

2. Lack of RD&D on biogas emerging technologies.

3. High upfront costs of domestic and commercial biogas plant and equipment.

4. Inadequate skilled installation contractors in the country.

5. Lack of post installation operation and maintenance service for plant, equipment and appliances.

6. Lack of clear registration and regulation guidelines for biogas installation contractors.

4.6.3 STRATEGIES– BIOGAS

1. The Government shall draft a new legislation specifically to regulate Renewable Energy.

2. The Government shall formulate a Biogas Policy as a matter of urgency and align it with this Energy Policy.

3. Create awareness on the benefits and potential of biogas technology.

4. Provide appropriate fiscal incentives for local manufacture as well as importation of biogas plant and equipment.

5. National and Provincial Governments to initiate capacity building programmes in institutions such village polytechnics on biogas installation, operation and maintenance skills.

6. Develop guidelines for registration and regulation of biogas contractors and technicians.

7. Promote domestic and community based biogas plants to cater for the urban poor.

8. Promote large scale production, piping and storage of biogas.

9. Use public trade fairs, workshops, seminars and energy centres to demonstrate and disseminate information on the importance and viability of growing bio-fuel feedstock among the public.

10. Promote the use of biogas as an alternative to wood-fuel and kerosene for domestic and commercial energy needs.

11. Develop training programmes for biogas technologies in collaboration with relevant training institutions and through the energy centres.

12. Undertake a comprehensive study on the viability of bottling biogas for rural development.

13. Roll out biogas initiatives to supply the remaining public institutions including prisons, schools and hospitals as well as biogas bottling plants across PNG

4.7 SOLAR ENERGY

4.7.1 BACKGROUND

1. Solar energy is the light and heat radiated from the sun that powers earth's climate and supports life. The solar radiation, often called the solar resource, is a general term for the electromagnetic radiation emitted by the sun. Solar technologies allow controlled use of this energy resource. Solar radiation can be captured and turned into useful forms of energy, such as electricity and heat, using a variety of technologies. Solar energy is among the largest potential renewable energy resources in Papua New Guinea due to its close proximity to the equator where the country experience sunshine all year around.

2. Solar photovoltaic (PV) panels are the most common solution for harnessing the suns energy. The basic building block of a PV system is the solar cell. Thermal systems convert sunlight into thermal energy, most often providing heated water.

3. Solar PV has spread gradually in PNG over the past 30 years, with small independent solar systems marketed by private supplies and used mainly for lighting, but also for communications. From 1998 – 2002 some 3000 solar home lighting systems were sold to individuals. The PNG Telecommunication Company (TPNG and or referred to alternatively as Telikom PNG) has hundreds of solar sites with a total capacity of over 200kWp. The expansion the mobile phone system into rural areas is rapidly increasing solar use for telecommunications and increasing demand for solar-powered phone chargers. A PGK 15 million (about USD 11.3 million) Japanese-supported project provided solar electrification for 320 schools in as much as twenty (20) provinces of the country from 1997 – 1998, but by 2004, only a few of the panels installed were still operating (IRENA, 2013).

4. The PNG University of Technology (UNITECH) has supported small-scale applied research projects involving solar energy. The latest initiative is the Renewable Energy (Solar & Wind) Resource Mapping project aimed at determining the potentials of solar and wind energies and support its

development in various locations though out PNG for both utility-scale generation and for village power and other off-grid applications.

5. The specific details of Solar Energy as a Renewable Energy resource will be captured in the Renewable Energy Policy to be produced by the Institution mandated to draw up this sectoral policy.

4.7.2 CHALLENGES

1. Disjointed approach in policy implementation and promotion of solar energy projects in the PNG.

2. The percentage of solar energy harnessed for commercial and domestic applications is insignificant relative to the potential.

3. Prohibitive costs of solar home systems despite favourable fiscal incentives and arising from lack of appropriate credit and financing mechanisms.

4. Erosion of consumer confidence because of inappropriate system standards, faulty installations, importation of sub-standard systems and poor after sales service.

5. Rampant theft of solar photovoltaic panels, which discourages their installation.

6. Lack of awareness on the potential, opportunities and economic benefits offered by solar technologies.

4.7.3 STRATEGIES– SOLAR ENERGY

1. The Government shall draft a new legislation specifically to regulate Solar Energy.

2. The Government shall formulate the Solar Energy Policy as a matter of urgency and align it with this Energy Policy.

3. The Government to setup a National Energy Authority of Papua New Guinea.

4. Promote the wide spread use of solar energy while enforcing the existing regulations and standards.

5. Ensure that all commercial buildings adopt solar and hybrid solar energy sources for water heating and lighting.

6. Provide incentives to promote the local production and use of efficient solar systems.

7. Provide a framework for connection of electricity generated from solar energy to national and isolated grids, through direct sale or net metering.

8. Promote the use of hybrid power generation systems involving solar and other energy sources to manage the effects caused by the intermittent nature and availability of solar energy.

9. Formulate and enforce minimum standards for solar energy technologies.

10. Provide fiscal incentives on solar panels and equipment.

11. Provide for offences and enhance penalties for theft and vandalism of solar systems.

12. Create awareness on the potential opportunities and economic benefits offered by solar energy technologies.

13. Partner with financiers to enable the public access credits schemes.

14. Install solar PV systems in 50% of all the remaining public facilities in the off grid areas.

15. Promote installation of at least 100,000 units of solar PV home solar systems by 2020.

16. Roll out a programme to distribute solar lanterns as substitute for kerosene in lighting rural areas, poor peri-urban and urban settlements.

17. Develop a programme to convert diesel stations to hybrid power generation systems harnessing solar energy.

18. Develop a programme for raising awareness on requirements for conformity with mandatory regulations for solar water heating systems.

19. Provide incentives to promote the local production and use of solar systems.

20. Undertake RD&D on solar technologies.

21. Facilitate generation of electricity from solar by among others, funding, setting aside land, fast-tracking issuance of permits and licences, as well as acquisition of data and information so as to realise at least 100MW from solar by 2030.

4.8 WIND ENERGY

4.8.1 BACKGROUND

1. Wind energy uses naturally occurring energy of the wind for practical purposes like generating electricity, charging batteries, or pumping water. Large, modern wind turbines operate together in wind farms to produce electricity for utilities.

2. With the rising cost of oil, exploitation of wind energy has become more attractive. Substitution of thermal generation with wind power plants will cut down on the large amounts of foreign exchange required to import fossil fuels for the thermal power plants.

3. Further, partial substitution or combining wind with gen-sets (wind–diesel hybrid) and some form of renewable energy storage such as pumped storage in hydropower could cut down on running or overall costs by substituting renewable energy sources for significant amounts of diesel.

4. Using wind energy to substitute thermal generation will also lead to less CO_2 emissions thus contributing to reduction in global warming. The carbon credits associated with the reduction of the emissions can be sold as certificates of emission reduction.

5. There is currently a lack of data on the potential wind energy resources in the country. Usage of wind energy in the country is limited to pumping of water by windmills on cattle farms or for irrigation. Areas near the coast often experience a good steady flow of wind. The Markham Valley being the largest plain in the Morobe Province is a very ideal location and good area

for development of wind farms as well as other valley systems in the country.

6. The specific details of Wind Energy as a Renewable Energy resource will be captured in the Renewable Energy Policy to be produced by the Institution mandated to draw up this sectoral policy.

4.8.2 CHALLENGES

1. High upfront costs.
2. Most potential areas for wind energy generation are far away from the grid and load centres requiring high capital investment for transmission lines.
3. Inadequate wind regime data.
4. Limited after sales service.
5. Inadequate wind energy industry standards due to fast changing technologies and enhanced capacities of turbines.
6. Competing interest in land use with other commercial activities.
7. Lack of RD&D in wind technologies.

4.8.3 STRATEGIES– WIND ENERGY

1. The Government shall draft a new legislation specifically to regulate Wind Energy.
2. The Government shall formulate the Wind Energy Policy as a matter of urgency and align it with this Energy Policy.
3. The Government to setup a National Energy Authority of Papua New Guinea.
4. Enhance the institutional capacity to promote wide spread use of wind energy while enforcing the existing regulations and standards.
5. Designate an entity to promote, undertake data acquisition, accelerate exploitation of wind energy and provide a one stop shop for information and guidance to investors in wind energy projects.

6. Provide incentives to promote the local production and use of efficient wind systems.

7. Promote the use of hybrid power generation systems involving wind and other energy sources.

8. Provide a framework for connection of electricity generated from wind energy to national and isolated grids, through direct sale or net metering.

9. Formulate and enforce minimum standards for wind energy technologies.

10. Plan transmission lines to facilitate evacuation of power from areas with high wind potential to major load centres.

11. Undertake Research Development and Dissemination (RD&D) through institutions of higher learning.

12. Enhance capacity building on wind technologies to provide support services.

13. Provide fiscal incentives on wind energy equipment.

14. Collect and compile wind energy data and update the wind atlas.

15. Facilitate development of wind power generation of at least 100MW by 2030.

4.9 MUNICIPAL WASTE

4.9.1 BACKGROUND

1. Municipal waste consists of solid waste including durable and nondurable goods, containers, food scraps, yard waste and inorganic waste from homes, institutions and businesses, wastes generated by manufacturing, agriculture, mining and construction and demolition debris, as well as sludge and liquid waste from water and wastewater treatment facilities, septic tanks, sewerage systems, slaughter houses.

2. In order of preference, municipal waste can be managed by reduction of its production at source; reuse and/or recycling; treatment to destroy or

reprocess waste to recover energy or other beneficial resources if the treatment does not threaten public health, safety, or the environment; or dumping and disposal.

3. Most of the municipal waste in PNG is disposed in poorly managed dump sites. With appropriate waste-to energy technologies, municipal can be used to provide energy while helping to clean the environment.

4. The current upgrading of the Baruni Waste Dump in the National Capital District as aided by the Japanese International Cooperation Agency (JICA) by using the Fukuoka Method can be utilised to produce Biogas for commercial use.

5. The specific details of Municipal Waste as a Renewable Energy resource will be captured in the Renewable Energy Policy to be produced by the Institution mandated to draw up this sectoral policy.

4.9.2 CHALLENGES

1. Lack of legal, regulatory and institutional framework for exploitation.

2. Inadequate data and information on potential of municipal waste.

3. Lack of incentives for exploitation.

4.9.3 STRATEGIES– MUNICIPAL WASTE

1. In collaboration with the relevant line departments, develop legal, regulatory and institutional framework to address management and utilisation of municipal waste.

2. In collaboration with Provincial Governments, acquire adequate data and information on potential of municipal waste.

3. Provide incentives for conversion of municipal waste to energy.

4. Rollout Fukuoka Method to other Waste Dump sites in the country's major cities and towns.

4.10 BIOMASS CO-GENERATION

4.10.1 BACKGROUND

1. Co-generation refers to the simultaneous production of heat and power from one single fuel source. It is common where plant processes require both heat and power such as sugar processing and offers opportunity for improved plant energy efficiency besides reducing energy costs and providing additional revenue stream through surplus power export to the national grid.

4.10.2 CHALLENGES

1. Use of obsolete, inefficient plant and equipment in the cogeneration industry.
2. Lack of a reliable and continuous supply of bagasse.
3. Limited technical, human and financial resources for cogeneration development.
4. Inadequate technical capacity in commercial and emerging cogeneration technologies.
5. Lack of awareness in cogeneration potential in areas where the agro-wastes are available.
6. Inadequate data and documented assessment of resources and potential.
7. Lack of model Power Purchase Agreement (PPA) for cogenerated power in PNG.
8. Insufficient information to investors on issues relating to licensing, taxation and feed in tariff policy

4.10.3 STRATEGIES– BIOMASS COGENERATION

1. Accelerate investment in efficient and emerging technologies.
2. Promote community programmes and projects in production and supply of raw materials such as bagasse.
3. Undertake capacity building programmes in cogeneration technologies.

4. Carry out awareness programmes in cogeneration potential areas.

5. Carry out a comprehensive study on cogeneration potential.
6. Develop a model PPA for cogeneration projects.
7. Provide incentives to promote cogeneration from biomass.
8. Formulate and implement a national strategy for coordinating development of co-generation.
9. Undertake RD&D in co-generation technologies.
10. Collaborate with players in the sugar industry to address governance issues.
11. Reduce start-up costs by providing appropriate fiscal incentives.
12. Promote local manufacture and maintenance of cogeneration technologies.
13. The National and Provincial Governments to promote the utilization of municipal and industrial waste as sources of energy.
14. Prepare integrated solid waste management plans and roadmaps.
15. Government to enter into PPP arrangements with the private sector entities to accelerate co-generation.
16. Develop criteria for certification schemes for cogeneration projects.
17. Undertake Pilot programmes to generate electricity using municipal and or industrial solid waste.

4.11 FEED IN TARIFFS

4.11.1 BACKGROUND

1. A Feed in Tariff (FiT) is an instrument of promoting electricity generation from renewable energy sources. It enables power producers to generate and sell Renewable Energy Sources Generated Electricity (RES-E) to a distributor at a pre-determined fixed tariff for a given period of time.

2. The objectives of the FiT Policy are to:

a. Facilitate resource mobilization by providing investment security and market stability for investors in electricity generation from Renewable Energy Sources.

b. Reduce transaction and administrative costs and delays by eliminating the conventional bidding process and lengthy negotiations of PPA.

c. Encourage private sector investors to operate their plants prudently and efficiently so as to maximize returns.

3. The specific details of FiT for Renewable Energy resources will be captured in the Renewable Energy Policy to be produced by the Institution mandated to draw up this sectoral policy.

4.11.2 CHALLENGES

1. Insufficient data and analytical tools to inform the level of tariffs for different technologies.

2. Lack of awareness on FiT among the potential investors.

3. No clear guidelines on PPA negotiations which results in lengthy negotiations.

4. Inadequate technical and financial capacity of some community based projects.

4.11.3 STRATEGIES– FEED IN TARRIF

1. Undertake a study on the capital expenditures and the operating costs on the different types of technologies and develop sufficient analytical tools to inform the level of tariffs for different technologies.

2. Initiate promotion campaigns to reach potential investors.

3. Develop model Power Purchase Agreements for the various modes of generation under FiT.

4. Provide capacity building and financial assistance to community based projects.

5. Expand the scope of FiT to include the emerging technologies.

6. NERC to provide guidelines and timelines for PPA negotiations.

7. Develop an investment guide.

8. Set minimum and maximum tariffs to guide the negotiations for PPA under the FiT.

9. Review the FiT Policy to include operations and maintenance escalation components.

4.12 OTHER RENEWABLES

4.12.1 BACKGROUND

1. Other renewable energy sources and technologies are not yet widely demonstrated or commercialised. These include ocean energy, biomass gasification, bio-refinery technologies and concentrating solar power. Particularly, a subject of interest is ocean energy, owing to the coastline of Papua New Guinea.

2. The oceans contain huge amounts of power that can be drawn from different sources and exploited for generating useful energy. The most developed conversion systems use tidal energy, thermal energy, marine currents and ocean waves.

3. Fast-flowing ocean currents like Sohano Island Passage in Buka, North Bougainville can be harnessed as well as other coastal areas of extreme differences in high tides and low tides.

4. Other renewable energy resources will be captured in the Renewable Energy Policy to be produced by the Institution mandated to draw up this sectoral policy.

4.12.2 CHALLENGES

1. Lack of legal, regulatory and institutional framework for utilization of emerging renewable energies.

2. Inadequate data and information on potential of renewable energies.

3. Lack of incentives for utilization.

4.12.3 STRATEGIES– OTHER RENEWABLES

1. The Government shall draft a new legislation specifically to regulate Renewable Energy.

2. The Government shall formulate the Renewable Energy Policy as a matter of urgency and align it with this Energy Policy.

3. The Government to setup a National Energy Authority of Papua New Guinea.

4. Develop legal, regulatory and institutional framework for utilization.

5. Acquire data and information on potential of other renewable energies.

6. Provide incentives for exploitation.

4.13 CROSS CUTTING ISSUES

4.13.1 CHALLENGES

1. Inadequate institutional, legal and regulatory framework for management of renewable energy resources including:

2. Criteria for allocation to investors of energy resource areas such as geothermal fields.

3. Licensing of Renewable energy areas.

4. Management of multi-purpose projects such as dams and reservoirs for power generation, portable water, flood control and irrigation.

5. Management of energy resource areas such as, catchment areas, forests, municipal waste as well as areas with good wind regimes, tidal and wave energy.

6. Corporate Social Responsibility requirements.

7. Environmental protection, conservation and management.

8. Mechanism for working out national government, Provincial government and local community benefits sharing.

9. Payment of royalty on proceeds from renewable energy resources.

10. Other than geothermal energy and large hydros, there is no lead agency to spearhead development of other renewable energy resources.

11. Absence of local credit schemes and financing mechanisms.

12. Inadequate public awareness on the economic opportunities offered by renewable energy and renewable energy technologies.

4.13.2 STRATEGIES– CROSS CUTTING RENEWABLE ENERGY

1. The Government shall establish an inter-departmental Renewable Energy Resources Advisory Committee (RERAC) composed of members representing; Departments in-charge of Petroleum and Energy, Mineral Policy And Geo-Hazards Management, Finance, Treasury, Environment and Conservation, and the relevant Provincial Governments to advise the Chief Secretary on criteria for allocation of renewable energy resource areas and specifically in relation to:
    a. Licensing of renewable energy resource areas.
    b. Management of multi-purpose projects such as dams and reservoirs for power generation, portable water, flood control and irrigation.
    c. Management of energy resource areas such as, catchment areas, forests, municipal waste as well as areas with good wind regimes, tidal and wave energy.

2. The Government shall:
    a. Transform PNG Power Limited (PPL) into a profitable business by unbundling it into independent bodies for generation of power, transmission, distribution and retail.

b. Develop a tariff for net metering for electricity generated from renewable energy sources by electricity consumers.
c. Revitalize the existing Department responsible for Petroleum and Energy matters in PNG and establish others with a view to promote renewable energy use.

3. Partner with financiers to enable the public to access credits schemes.

4. Develop capacity building programmes for players in renewable energy technologies in collaboration with training institutions and the energy centres

5. Introduce net and smart metering policy to encourage consumers sell excess power generated from the renewable energy systems.

6. Prepare a master plan for renewable energy.

7. Promote community based power generation.

8. Create awareness on the benefits resulting from development of clean energy technologies.

9. Establish a Renewable Energy Research Centre (RERC) under the auspices of the new National Energy Authority (NEA) and supported by other Research Institutions in the country and abroad for the handling of renewable energy promotion, potential analysis, mapping and other related studies.

10. Establish green energy certification schemes.

11. Establish energy efficiency/conservation projects certification schemes.

12. The government will provide necessary support for the implementation of the renewable energy projects in the populated areas including facilitation of acquisition, relocation and resettlement of project affected person.

5 TRANSPORTATION FUELS SECTOR

5.1 BACKGROUND

1. It is of significant national interest that the transportation fuels sector is regulated in a manner that is efficient and environmentally sound while at the same time security of supply is adequate managed through appropriate mechanisms, The Government understands the inherent need to better regulate this sector as the national economy cannot progress without the fuels sector performing efficiently.

2. What is principally important to the Government is that the provision of fuels in the country is affordable, accessible, and reliable. Most importantly, fuels sold in PNG must meet quality and environmental standards and the Government would make sure appropriate standards and regulations are put in place to better regulate the sector.

3. This policy supports the PNG National Transport Strategy (NTS) for the use of sustainable energy through encouraging the following measures;
    a. The introduction of fuel-efficient transport and engines that are able to operate on bio-fuels from sustainable sources.
    b. Domestic biodiesel and bio-ethanol for the transport sector.
    c. The operation and maintenance of equipment in a manner that minimizes consumption and emission of carbon dioxide emissions; and
    d. The use of vehicle fleet-weighted against the fuel and emissions efficiency, ascertained from annual report.

5.1.1 ROAD TRANSPORTATION FUELS

1. Road transportation is a very important mode of transportation and a very reliable medium for the delivery of goods and services in PNG. The Government would like to see this sector grow and significant capital investments have been already made in road building and more funds will be injected into this vital sector of the economy.

2. Diesel and petrol are the two main fuel types used widely in the country, apart from lubricants. Prices for these fuels are amongst the highest in the region and the world. The Government would address high fuel cost concerns by encouraging competition in the market, including encouraging investments in new oil refineries.

3. The cost of fuel and basic goods and services in areas located far from the main cities and towns are even far higher because of the associated cost involved with long distances. The Government will open up many new roads and focus on building a modern road network that provides the catalyst for economic growth.

4. The Government will strongly push for the development and use of alternative clean fuels to replace high pollutant fuels like diesel and petrol. Natural gas in the form of Compressed Natural Gas (CNG) is one fuel that will be seriously assessed for use in the future as the environmental, cost and efficiency benefits are considered to be high. Other fuels like solar and hydrogen will be also considered for research and trials as well for use in the road transportation sector.

5. Specific regulations will be formulated to also control noise and air pollution from the production and use of fuels. These regulations will also cover the production and use of lubricants as well.

5.1.2 SEA TRANSPORT FUELS

1. Marine transportation is also very crucial for coastal villages and towns as well as for all other economic and commercial activities. The current high cost of fuel is a concern to the Government because businesses often transfer the high costs they incurred down to the end users. For instance, the fisherman would always factor the cost of fuel to be reflected in the price of fish that he sells to the consumers.

2. Diesel, petrol and lubricants are the main fuel types used in this sector.

3. Again, the Government believes that the fuels market in PNG must be open to competition so the fuel consumers benefit from comparatively cheaper fuel prices.

5.1.3 AIR TRANSPORTATION FUELS

1. The aviation sector plays a pivotal role in the PNG economy. It is a sector that is so important to the country because of the rugged and mountainous conditions of the country.

2. Cost of air transportation is extremely high in PNG and perhaps this is one of the reasons why the cost structure of business in PNG is very high. In

simple, it means that the high cost of fuel is captured in the prices of all other goods and services in the country.

3. The Government is aware that high aviation cost is a disincentive to investment in PNG, including tourism. It will therefore take appropriate actions to address the high cost issues.

4. One key area of interest to the Government is to assess how Jet-A1 fuel can be produced domestically using domestically produced crude oil. Additionally, the PNG Government is aware that the international aviation industry is undertaking research and development in harnessing solar energy as an alternative fuel to the fossil-oriented Jet-A1 fuel. Therefore the Government will closely observe the development of this new technology and when the timing is appropriate, will consider how best to use this technology.

5.1.4 SUPPLY SOURCES

1. The Government recognizes the importance of the fuels market and how important it is to growing the PNG economy and to improve the living standards of the people. Therefore efficient management of the sector is an important priority of the Government.

2. In order to reduce the cost of fuels and transfer cost benefits to business and individuals, the Government would seek to secure feedstock crude oil from domestic oil and gas projects and refined in a refinery owned by a State owned entity (SOE). The feedstock crude will come from a portion of the State's equity share in various oil and gas fields in the country or from any of the oil and gas projects at a purchase price equivalent to the cost of production. This policy is also applicable to the off-take and utilization of natural gas for domestic purposes including the use of gas for transportation fuels such as CNG.

3. The objective of this policy is to reduce the current high business cost structure in PNG which is a major disincentive to business and investment in the country. Hence, the Government aims to ensure the price of refined fuels in PNG is reduced by 40 – 50 percent of the current market price which is based on the Import Parity Price (IPP).

5.1.5 COMPRESSED NATURAL GAS (CNG)

1. The Government would seriously look into the commercial and technical viabilities of utilizing CNG as the predominant transportation fuel in PNG. Once studies confirm that CNG is feasible to be used, the Government would make to mandatory for all vehicles in PNG to use CNG.

2. All CNG requirements would be produced domestically and the feed gas would be sourced from a portion of the State equity interest in any oil and gas project in PNG or would be secured under the 15 per cent Gas Reservation Policy and at a price equivalent to the cost of production.

3. The Government would invest in Research and Development in order to determine the feasibility of utilizing CNG in the marine transportation sector as well.

5.1.6 COMPETITION

1. The Government would encourage competition in the fuels market in the entire business value chain. This means any investor can invest in a new refinery or import refined fuels as long as they conform to quality standards and specifications. The PNG economy and the people would be the biggest beneficiaries under such a competitive market environment.

2. In order to promote efficiency and price transparency, the Government shall encourage the separation of ownership in all segments of the market from wholesaling to distribution and retailing.

5.1.7 OWNERSHIP

1. All new players as from the commencement of this policy in the fuels market in PNG will be wholly nationally-owned companies from wholesales to retailing segments of the market.

5.1.8 REGULATION

1. The PNG ICCC will be the principal regulator of the fuels market.

5.1.9 GOVERNMENT SUBSIDY

1. Many governments around the world offer price subsidies to the fuels sector in order to relief businesses and citizens from high fuel prices. The PNG Government considers that the most appropriate way to support the economy and the citizens is to establish the appropriate policies as well as regulatory and legislative frameworks for a strong and robust market economy where competition is promoted so the correct price is set by the market forces.

6 ELECTRICITY

6.1 BACKGROUND

1. Electricity is a secondary source of energy generated through the consumption of primary energy sources namely fossil fuels, renewable energy and nuclear energy. By virtue of its versatility in application, it is crucial to economic growth and is the most sought after energy service by society. Access to electricity is associated with rising or high quality of life.

2. The electricity supply industry (ESI) value chain consists of four elements, as shown below.

   a. First, there is generation, requiring both a fuel source (e.g., hydro, geothermal, petroleum or wind energy) and a power plant to convert the fuel source into electrical energy.

   b. Second, the generated electricity is transformed (stepped up) for transmission over high voltage power lines; and matching end user requirements (demand) with energy availability (supply), referred to as system operations.

   c. The third element is distribution where electricity is transformed again (stepped down) to enable delivery or supply of electrical energy to end users or consumers via a vast network of power lines and substations.

   d. Finally, there is delivery or supply which entails retailing of electrical energy to consumers through a series of commercial functions – procuring, pricing, selling, metering, billing and revenue collection.

   e. Generation, transmission, system operations and distribution are physical functions, while wholesaling and delivery/retailing are merchant or commercial functions.

3. Competition in the industry generally means competition in the generation of electricity, as well as in the commercial functions. The transportation

(transmission and distribution) as well as system operation functions are natural monopolies as it does not make economic, environmental or aesthetic sense to build multiple sets of competing systems in any one area. System operations is also non-competitive, since the system operator has to control all the plants in a control area, otherwise the system would not function efficiently or safely.

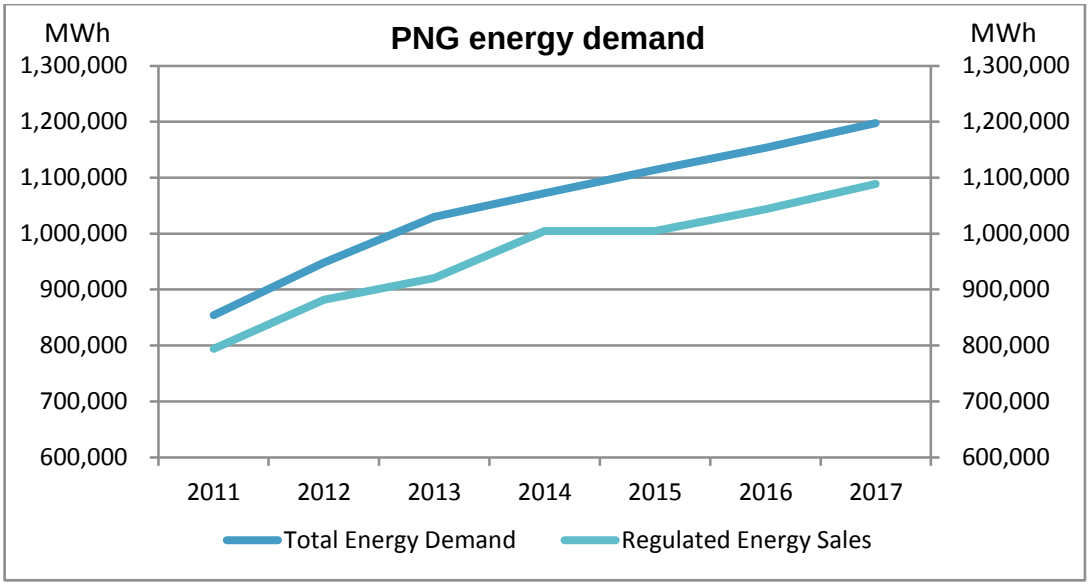
4. The electricity supply industry (ESI) in Papua New Guinea has been undergoing reforms and restructuring since the mid-90s with the aims of, *inter alia*:
    a. Creating appropriate legal, regulatory and institutional framework for the ESI.
    b. Ensuring provision of affordable reliable, efficient, accessible and sustainable electric power supplies.
    c. Increasing the population's access to electricity as a means of stimulating economic growth. To date only 13 percent of the households are connected to electricity after 50 years of existence by the States ESI.
    d. Improving the efficiency of power distribution and supply through reductions in technical losses and collection of revenues.

5. Creating a more competitive market structure with clear definition of roles for public and private sector players in generation, transmission, distribution and retail functions.

6.2 DEMAND FOR ELECTRICITY

1. Demand for electricity has shown an upward trend since the year 2011 due to accelerated economic growth. Figure 3, overleaf shows ICCC's forecasted demand for electricity (regulated and total demand).

Figure 4 - Estimated domestic energy demand



Source: ICCC Report on the PNG Power Ltd Regulatory Contract Review

2. PNG does not operate on an interconnected national power grid instead with only islanded electricity networks located around the more populated areas and industrial sites. Out of the total 580 MW installed generation capacity in PNG, PPL capacity is estimated at 300MW, while the 280MW is generated by other entities that consume power mainly for their own use (e.g. mining enclaves).

3. Due to the population distribution where the majority of the population live in rural areas (and difficult terrain) the electrification rate is only 13% in PNG; with less than 1% access to electricity by most people in the outer provinces, except NCD with some 16.4% access to electricity in terms of the total population.

4. Major drivers of the demand include increased economic activities in various zones, particularly within the Lae (Ramu), Port Moresby and Gazelle systems. Additional latent demand coming mainly from the extractive industries remains unmet due to the very large electricity requirements. Table 3 overleaf shows PPLs generation demand per zones as of end of 2014.

Table 3: PPL's Generation Demand per zones

ZONES[4]		Peak (kW)	Base Load (kW)	Energy (MWh)
3	Aitape	277	133	1,297
3	Alotau	2,670	1,149	12,441
3	Arawa	557	253	3,010
3	Daru	700	450	4,096
3	Finschafen	150	75	767
1	(Rabaul)	9,730	5,200	51,310
3	Kerema	319	156	1,610
2	Kimbe	4,272	1,677	15,012
3	Bialla	551	323	3,030
3	Manus	1,299	656	6,977
3	Maprik	323	150	1,772
3	Samarai	137	75	245
3	Vanimo	1,180	555	5,532
2	Wewak	3,609	1,847	17,144
1	Port Moresby*	N/A	N/A	N/A
1	Ramu*	N/A	N/A	NA

Source: PNG Power Limited; (*Information not available at the time of finalisation of policy

5. It is anticipated that electricity demand will rise sharply as energy intensive activities such as mining, infrastructure developments, new LNG facilities, commercial and residential building constructions and numerous other activities are ramped up in the short to medium term. Table 4 overleaf shows some of the recent and proposed project in the mining sector with estimated electricity demand.

[4] Zone 1-(Port Moresby, Ramu and Gazelle systems); Zone 2-(Wewak, Kimbe system), Zone 3- (Alotau, Buka, Daru, Finschaffen, Kavieng, Kerema, Lorengau/Lombrum, Maprik, Popondetta, Samarai, Vanimo and Bialla systems)

Table 4 shows existing and proposed mining projects

Table 4: Existing and proposed projects		
Existing and proposed Project	**Status**	**Estimated Demand**
Yandera	Exploration	135MW
Wafi-Golpu	Developed	200MW
Ramu-Nickel	Developed	85MW
Hidden Valley	Developed	20MW
Frieda Gold Mine	Exploration	<200MW

Source: Department of Public Enterprises

6. To meet these new demand, several key generation projects will be initiated as shown in Table 5 below:

Table 5: New and potential generation projects				
Energy Source	**Site**	**Potential (MW)**	**Size**	**Status**
Hydro	Edevu	20-50	Small	Ready for construction
Hydro	Naoro Brown	70-80	Small	Advanced feasibility
Hydro	Purari	2000	Large	Feasibility
Hydro	Tua (Simbu)	1000	Large	Pre-feasibility
Geothermal	Talasea	>1000	Large	Pre-feasibility
Geothermal	Rabaul	<500	Medium	Pre-feasibility
Geothermal	Lihir	80	Small	Operating
Geothermal	Milne Bay	<100	Small	Pre-feasibility
Gas	LNG	75	Small	Feasibility

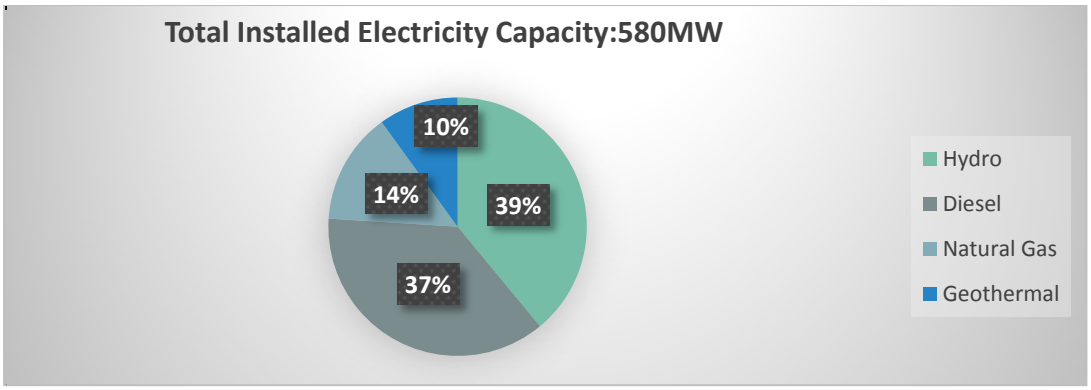
Source: Department of Public Enterprises, 2014

6.3 ELECTRIC POWER GENERATION

6.3.1 BACKGROUND

1. Electricity generation in PNG is liberalised with several licensed electric power producers whose combined installed capacity was 580MW as of December 2013[5]. This includes privately owned generation by major mining activates. A combination of several renewal and non-renewal sources used for this generation as shown in Figure 4 below.

Figure 5 – PNGs Total Installed Capacity



Source: PNG Power Limited

2. The Ramu (especially Lae City) and the Port Moresby Systems rely on hydro power generated from Yonki in Eastern Highlands Province and Rouna in Central Province. These hydro powered centres are also backed up by diesel power stations (both reciprocating diesel generators and open cycle gas fired turbine generators being run on heated diesel). Western Power also relies on small diesel power stations to supply electricity to its customers in Western Province.

[5] ICCC PPL regulatory Contract Review Report 2013

3. IPP's like PNG Forest Products Limited and Hanjung Power Limited generate power in Bulolo and Kanudi respectively and sell the power generated to PPL.

4. Whilst total installed capacity stands at some 580MW, total electricity demand is projected to increase to a substantial 800MW by year 2020.

5. In order to provide affordable electricity for these activities which are expected to transform our economy, a roadmap to raise the generation capacity has to be undertaken.

6. The road map will require the construction of various transmission lines to evacuate power to respective load centres. This will require significant investment by the Government of Papua New Guinea (GoPNG).

6.3.2 GENERATION OF ELECTRICITY USING FUELS

6.3.2.1 BACKGROUND

1. Thermal power plants generate electrical energy using fossil fuels, mainly, oil, natural gas and coal.

2. All thermal generating plants in PNG are run on imported petroleum fuels which are subject to volatile international oil market prices which are passed through to consumers. Consumption of oil will be progressively reduced and be replaced by natural gas.

6.3.2.2 ADVANTAGES

1. Thermal power generation:
   (a) Requires a relatively shorter period of between 12 to 18 months for construction.
   (b) Requires smaller physical space compared to hydro and geothermal power plants.
   (c) Lower capital cost compared to hydro power and geothermal power plants.
   (d) Can be installed in any part of the country as compared to hydro power and geothermal plants which are site specific.
   (e) Attractive to private investment due to faster return on investment.

6.3.2.3 CHALLENGES

1. Inadequate infrastructure for power supply to communities in the neighbourhood of generation plants.

2. High recurrent cost due to use of petroleum fuels leading to higher electricity costs.

3. Petroleum fuel is not renewable.

4. Causes environmental pollution which requires costly mitigation measures.
5. Thermal power plants have a relatively shorter life span of about 20 to 25 years compared to hydropower plants which have a lifespan of over 50 years.

6. Thermal power has relatively lower conversion efficiency of less than 50% compared to hydropower plants which have over 90% efficiency.

6.3.2.4 STRATEGIES– ELECTRIC POWER GENERATION

1. The Government shall do necessary amendments to the Electricity Industry Act 2002 (EIA 2002) and other legislations and vest the regulating of the industry with the industry regulator to be known as the Electricity Regulatory Commission.

2. The Government shall review the Electricity Industry Policy as a matter of urgency and align it with this Energy Policy.

3. Put in place mechanisms to ensure that the local communities benefit from developments of the electricity supply infrastructure.

4. The Government will encourage electricity generation using indigenous fossil fuels primarily natural gas and coal including facilitating PPPs.

5. The Government will ensure that all equipment procured for thermal power plants shall be designed and constructed to minimise the environmental impact while giving consideration to visual impact, wildlife and temporary disturbance during construction, maintenance and operation.

6. The Government shall promote the utilisation of Combined Cycle Gas Turbine (CCGT) plants to increase efficiency.

7. Regulator to develop appropriate standards and mechanisms for consumer protection including but not limited to reliable, and stable, power supply includes repair and maintenance time lines. The regime should include penalties.

8. Establish natural gas handling and storage facilities in the country.

9. Enforce compliance for pollution prevention and reduction in thermal power plants.

10. Promote generation from renewable energy resources based on least cost and efficiency criteria.

6.4 GENERATION OF ELECTRICITY USING NUCLEAR ENERGY

6.4.1 BACKGROUND

1. The uptake of nuclear power technology has been growing over time across different countries and regions. Various countries without existing nuclear power technology in their power systems have expressed interest in investing in nuclear electricity production, while developed countries with existing nuclear plants have been expanding their capacities. All over the world, as of September 2013, there were 435 nuclear power plants in operation, 28 under construction and 222 in the planning stage.

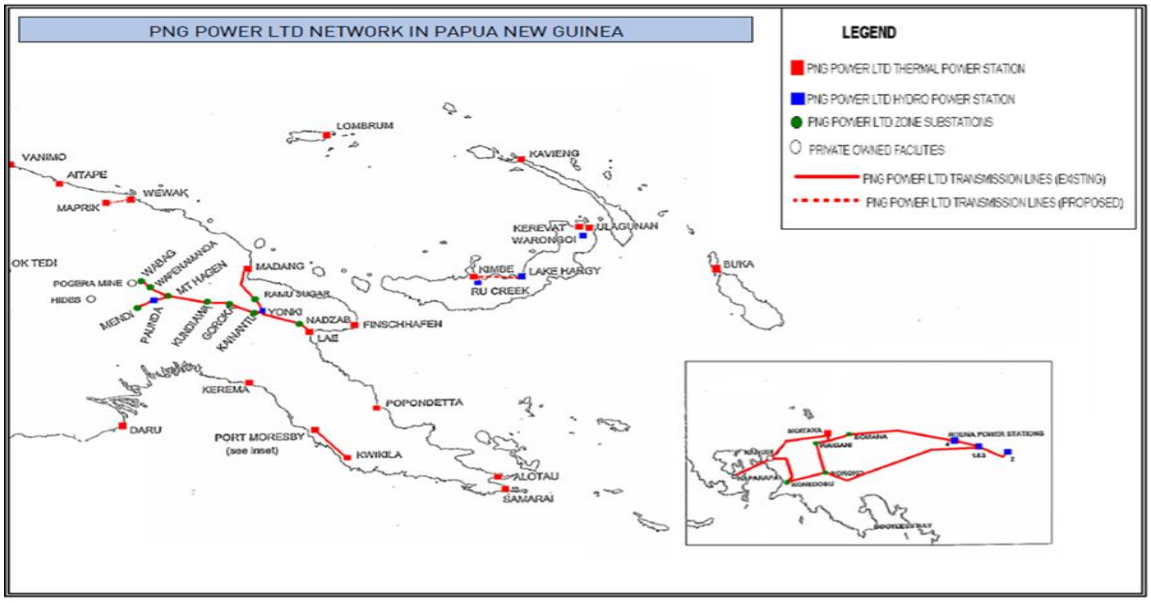
2. Although PNG does not have a clear position on Nuclear energy development and deployment it is recognised as a form of energy used in other developed and developing countries, which PNG could develop in time.

6.5 ELECTRIC POWER TRANSMISSION

6.5.1 BACKGROUND

1. The existing transmission network is currently confined to the three (3) major systems in Port Moresby, Lae (Ramu) and Gazelle respectively as shown in the figure 5 overleaf. This system is anticipated to be extended dramatically in order to improve network coverage, in-line with the proposed National Electricity Rollout Plan (NEROP).

Figure 6 – PPLs existing transmission network



Source: PNG Power Ltd, as at October 2014.

2. This existing transmission system capacity is severely constrained particularly during peak hours. The problem is partly due to inadequate reactive power in major load centres and also transmission constraints particularly in Port Moresby, Ramu and Gazelle systems.

6.5.2 EXTENSION OF THE NATIONAL TRANSMISSION NETWORK

1. As part of its mandate, PPL is currently undertaking new transmission projects aimed at developing a robust grid system to:-
    a. Enable evacuation of the additional transmission lines across existing system, including economic corridor system inter-connections.
    b. Improve quality and reliability of electricity supply throughout the country by ensuring adequate evacuation capacity.

c. Reduce the cost of electricity to the consumer by absorbing the capital cost of transmission lines since they will be fully funded by the National Government.
d. Provide interconnection links with the neighbouring countries in order to facilitate power exchange and develop electricity trade in the region.
e. Reduce transmission losses through upgrading of transmission line from current 60kV to 132kVs for distance greater than 100 kilometres; and up to 400kV for distances greater than 500kilometers.
f. Open up off-grid areas in order to ease connectivity to electricity by constructing transmission lines to link them up to the national grid.
g. As earlier stated, the numerous economic activities springing up in major areas of the country requires a corresponding increase in generation capacity and transmission network. Consequently, the number of transmission lines projected for construction in the next 5 years needs to be substantial to meet this need.

6.5.3 REGIONAL INTERCONNECTION

1. There is a potential for Papua New Guinean transmission network to be interconnected with Australia and Indonesia's system through a 132 kV double circuit transmission line. The arrangement would allow for electrical energy exchange between PNG and a number of Australian cities of the State of Queensland such as Gladstone; thus likewise corroborate to connect electricity systems to neighbouring cities in Indonesia.

2. At this stage, focus of the export of the energy would be between regional areas such as from Papua into the Highlands and onto the Momase Regions respectively via network connections of the main grids.

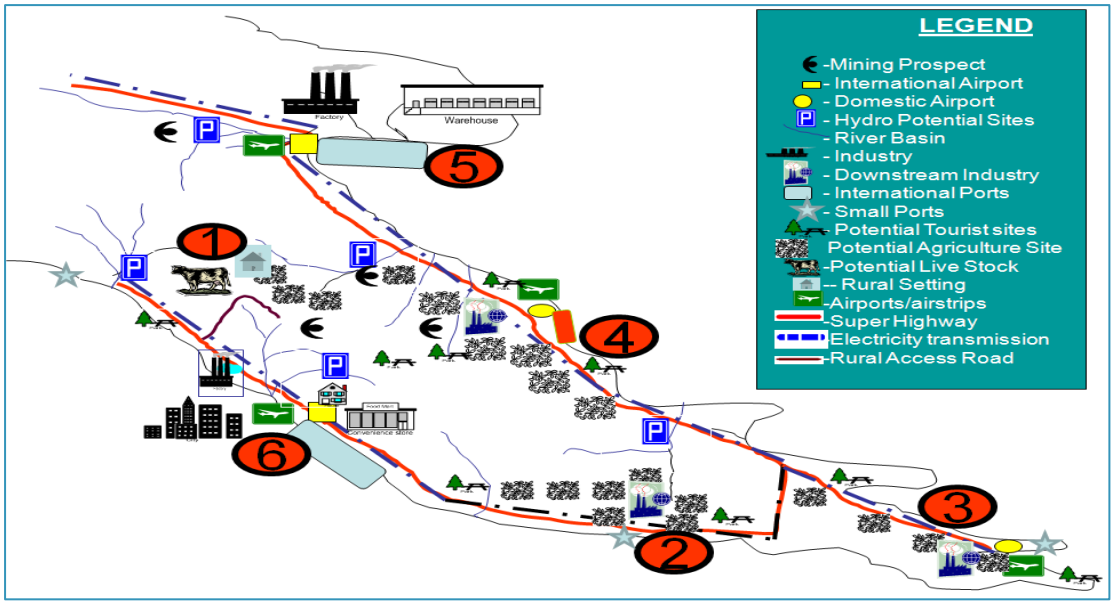
6.5.4 PNG ECONOMIC CORRIDORS

1. Energy development planning will be based on the ten economic corridors as per the PNG SDP 2010-2030.

2. The Ten (10) Economic Corridors are proposed to alleviate poverty, as they will be located in the poorest regions of PNG with the aim of extending the benefits of development to the most disadvantaged regions. This is the region where the government has plans to develop well planned zoning system, comprehensive and effective network of transport and utilities, and quality education and health services.

Within this region, businesses are able to operate at low cost and under well designed incentives, thereby encouraging foreign and domestic private sector investments. By concentrating the construction of essential infrastructure within certain regions the economic corridor approach takes advantage of the substantial economies of scale and scope associated with large service sector infrastructure.

Figure 7. PNG's Economic Corridors

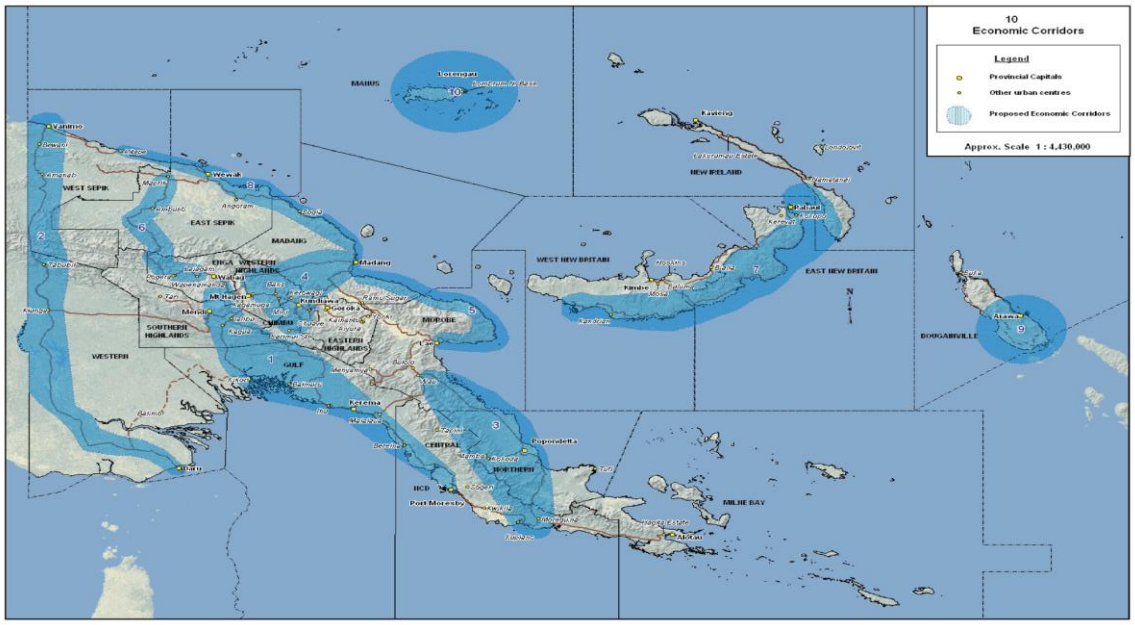


Source: PNG SDP 2010 - 2030

3. The Ten (10) Economic Corridors are:
   - Petroleum Resource Area Economic Corridor (PRAEC): Southern Highlands, parts of Enga, Gulf, and Central provinces. The PRAEC was approved by Cabinet in May 2009.
   - Border Corridor (Western, Southern Highlands and Sandaun Provinces)
   - Central Corridor (Central, Milne Bay, Oro and Morobe)
   - Madang-Baiyer-Karamui-Gulf Corridor (Madang, Simbu, Gulf and Western Highlands)
   - Morobe-Madang Corridor
   - Enga-Sepiks Corridor (Enga and East & West Sepik Provinces)
   - South Coast Corridor (East New Britain and West New Britain)
   - Momase Corridor (Madang, East Sepik, and West Sepik provinces)

- Solomons Corridor (Autonomous Region of Bougainville)
- Free Zone Corridor (Manus, New Ireland, East and West Sepik)

Figure 8. Proposed 10 economic corridors



Source: PNG Medium Term Development Plan

4. The potential demand to be created from the economic corridor concept lies in such economic developments:
    (a) Livestock, crops and an agricultural processing plant;
    (b) Downstream processing facilities and agricultural farms;
    (c) Tourism, service centre and downstream processing;
    (d) Heavy industries and international trading zones; and
    (e) Light industries and international service and trading zones.

6.5.5 BENEFITS OF INTERCONNECTIVITY

1. Security of supply and system stability due to increased generation mix.

2. Increasing national economic efficiency by operating on lower reserve margins.

3. Expanded power market sizes and reduced country specific risks.

4. Capital saving as the country need not invest in new stations.

5. Increases competition by providing options for cheaper power.

6. Electricity access to remote areas.

7. Shared reserve margin.

8. The transmission infrastructure acts as a catalyst for investment in non-conventional renewable energy sources.

6.5.6 CHALLENGES

1. Weak, inadequate and poorly -integrated transmission infrastructure capacity.

2. Displacement, environmental, health and safety issues.

3. Vandalism on transmission network.

4. Inadequate local technical skills especially in HVDC systems.

5. Land and way leaves acquisition.

6. Encroachment of the way leaves trace.

7. Insufficient framework for private participation in development of transmission infrastructure.

8. Inadequate policy, legal and institutional framework for the operationalization of the independent system operator.

6.5.7 STRATEGIES– ELECTRICITY TRANSMISSION

1. The Government shall do necessary amendments to the Electricity Industry Act and other legislations and vests the regulating of the industry with the industry regulator to be known as the Electricity Regulatory Commission.

2. The Government shall review the Electricity Industry Policy as a matter of urgency and align it with this Energy Policy.

3. The Government to provide for a specific SPV and or the SOE involved in this sector of the Electricity Supply Industry.

4. The Government shall support open access of the transmission network taking into account existing contractual commitments and provide a mechanism for determination of wheeling charges applicable to transmission lines.

5. The Government will establish the legal and regulatory mechanisms for competitive electricity market and further support regional integration of the power system to enhance regional power trade.

6. The Government will continue to fund the development of the national transmission system to enhance affordability. The Government will continue to assist transmission licences access credit to enhance capacity, improve reliability and reduce losses in the networks.

7. The Government will designate and provide, legal and institutional framework for an independent system operator (ISO).

8. Ensure adequate and timely national transmission infrastructure is put in place including evacuation of electrical energy from early generation geothermal plants.

9. The Government to ensure transmission reliability by establishing redundancies in transmission system.

10. Increase national and regional transmission network for full regional interconnection.

6.6 ELECTRIC POWER DISTRIBUTION

6.6.1 BACKGROUND

1. The distribution network entails receipt of bulk supply of electrical energy from generation or transmission network and transfer of this energy through distribution lines and distribution substations to consumers.

2. Reliability and quality of supply remains a key area of concern. As such, more focus and emphasis are concentrated to continue giving due consideration to resolving repetitive breakdown cases to reduce the number of incidences and improve repair time. The sharp increase in vandalism considerably contributed to this worsening situation leading to a number of transformer failures and consequential power outages.

3. The technical and commercial losses arising during the transmission and distribution of electricity are as provided in Table 6 below.

Table 6. PNG Power Distribution system

Year	Actual Generation	Fuel Used	System Losses
2007	817,947	3,155,534.00	146,814
2008	849,678	42,672,915.00	85,124
2009	895,706	4,232,449.00	188,785
2010	953,191	5,000,324.00	200,567

Source: [PPL, 2010] NB. Current figures from 2011 onwards not publicly available.

6.6.2 DISTRIBUTION EXPANSION PLAN

1. The objective of the ongoing Energy Access Scale-Up (EAS-U) programme is to increase connectivity countrywide. It involves expansion of the national power distribution grid to connect new customers both in urban and rural areas.

2. In addition, more projects will be initiated to reduce system losses, enhance reliability and quality of supply by enhancing the sub-transmission. By the year 2020, capacities of primary and distribution substations, High Voltage lines and Medium Voltage lines are estimated to increase substantially.

6.6.3 CHALLENGES IN DISTRIBUTION

1. High end-user electricity tariffs including standing charges.

2. High electricity connection charges.

3. Vandalism of electric power infrastructure.

4. Lengthy process of way-leaves acquisition.

5. Encroachment of way-leaves trace.

6. Weak distribution network characterized by limited redundancy and aging installations leading to frequent and prolonged supply interruptions.

7. Most of the distribution networks in major cities, urban areas and the coastal strip are overhead and therefore prone to frequent interruptions due to corrosion and climatic changes.

8. High system losses.

9. Illegal power line connections and theft of electricity.

10. Physical plans in most cases do not provide an infrastructure corridor for electricity reticulation.

11. High arbitrary levies charged by the public institutions on power infrastructures.

12. Lack of a legal framework for operationalization of open access.

6.6.4 STRATEGIES– DISTRIBUTION

1. The National Government shall ensure gradual elimination of overhead distribution systems to provide efficient and safe distribution services by duly licensed network service providers, so as to reduce power supply interruptions and improve the quality of supply and service.

2. The Provincial Government may plan and develop distribution networks and transfer them to distributor(s) duly licensed to operate and maintain them in line with the national policy of having only one distributor in a given area at

any particular time for efficiency and technical effectiveness of the national power network.

3. The National Government shall provide a legal framework to support open access of the distribution network taking into account existing contractual commitments and provide mechanism for determination of wheeling charges applicable to distribution lines.

4. The Government will continue funding the development of distribution network in rural areas and continue to support strengthening of distribution network in the rest of the areas through licensed distributors.

6.7 RURAL ELECTRIFICATION

6.7.1 BACKGROUND

1. Energy shortages and supply disruptions coupled with high cost remains serious obstacles to economic activity in PNG. At present 90% of the PNG's population still lack access to electricity services and the progress of rural electrification has lagged over the years.

2. The Provincial Governments have embarked on various rural electrification programs with PPL, unguided by any appropriate policy mechanisms. Making electricity accessible to the masses at the rural levels would require a holistic government approach.

6.7.2 CHALLENGES

1. High costs of connection.

2. Scattered population settlements in the rural areas leading to long distribution lines. The non-controlled sub-division of arable land has escalated this problem.

3. Harsh terrains and inaccessibility due to under developed infrastructure leads to high cost of rural electrification projects.

4. High operating costs of grids in rural areas due to low population density.

5. Acquisition of way leaves due to high compensation demand by public institutions and land owners.

6. Vandalism of power infrastructure

6.7.3 STRATEGIES– RURAL ELECTRIFICATION

1. Develop a rural electrification master plan.

2. Create a rural electricity funding mechanism.

3. Promote off-grid renewable energy technologies.

4. Give impetus to the National Electrification Program Fund (NEPF) to empower the economically unviable areas.

5. Seek funding from development partners for specific programmes especially in areas less attractive to the private sector and complement self-help groups and private sector efforts in rural electrification projects.

6. Build appropriate local capacity for manufacture, installation, maintenance and operation of appropriate energy technologies in rural areas.

7. Provide incentives to both users and producers of energy technologies in rural areas.

8. Package and disseminate information on energy systems in rural areas to create investor and consumer awareness on economic potential offered by these systems.

9. Support the activities of organizations and bodies that deal with rural electrification initiatives.

10. Implement cooperation arrangements with Provincial Governments and Local Level Governments for accelerated implementation of rural electrification programme.

6.7.4 CROSS CUTTING ISSUES

1. Outdated or lack of land use master plans which have made it difficult and expensive to acquire land and way-leaves for power infrastructure development.

2. The policy and decision making processes in public energy sector players are complicated by their corporate governance structures which are influenced by government policy, board appointments, existing laws and regulations.

3. High cost of financing energy infrastructure projects.

4. Insufficient fiscal and other incentives for private sector investment.

5. Lack of adequate port facilities for handling cheaper energy resources including coal and natural gas to support power generation.

6. The restructuring of the sector creates challenges due to existing obligations including Power Purchase Agreements (PPAs), financial covenants and asset ownership.

7. Demand for power in some areas is low due to lack of economic activities as well as poor infrastructure rendering some of the electrification projects unsustainable.

6.7.5 STRATEGIES– ELECTRICITY CROSS CUTTING ISSUES

1. The Government shall:
   (a) provide funds for pre-feasibility and feasibility studies for energy Projects;
   (b) ensure that integrated plans for the electricity supply system are prepared;
   (c) where necessary acquire land and way-leaves for energy infrastructure development;
   (d) develop a resettlement action plan framework policy for energy related projects.

2. The Government will provide fiscal incentives to encourage investors to acquire and develop energy development technologies.

7 UNBUNDLING OF PNG POWER LIMITED

7.1 PNG POWER LIMITED - AT PRESENT

1. PNG Power Limited (PPL) is a fully integrated power authority responsible for generation, transmission, distribution and retailing of electricity throughout Papua New Guinea and servicing individual electricity consumers. PPL services customers in almost all urban centres throughout the country encompassing industrial, commercial, government and domestic sectors. Where possible, the services extend to rural communities adjacent to these urban centres.

2. PPL was established under the Electricity Commission (Privatisation) Act 2000 to be the successor company taking over all assets, liabilities and personnel of the Papua New Guinea Electricity Commission (ELCOM). PPL is also governed by another Act of Parliament, the Electricity Industry (Amendment) Act 2002 which established a regulatory regime for the Electricity Industry.

3. PPL as a corporatized entity operates in accordance with the Companies Act 1997. The Constitution of PPL has been established in compliance with this Act. The Constitution establishes the functions and responsibilities of the Board to the shareholders and the general administrative and reporting requirements.

4. PPL is also undertaking a regulatory role on behalf of the Independent Consumer and Competition Commission (ICCC). These responsibilities include approving licenses for electrical contractors, providing certification for models of electrical equipment and appliances to be sold in the country and providing safety advisory services and checks for major installations.

5. PPL (Company No 1-44680) was corporatized under Section 3 (1) of the Electricity Commission (Privatisation) Act 2002 as the successor company to the ELCOM. All of ELCOM's assets, liabilities, rights, titles and personnel were transferred to PPL.

6. PPL is a State Owned Entity (SOE). The Independent Public Business Corporation (IPBC) holds the shares for corporatized state entities as trustee of the General Business Trust (GBT). The IPBC acts as the sole shareholder on behalf of the Government. The Minister for State Enterprises appoints a Board who report to IPBC.

PPL, through the Board provides regular financial and operational reports and a Five-year Business Plan to IPBC on an annual basis.

7.2 ISSUES, CHALLENGES AND POLICY IMPERATIVES

1. PPL as a state owned enterprise evolved from a government utilities company established as a natural monopoly in the absence of private companies with large power generation capabilities to its current corporatized state but still within government control. As a result PPL suffers legacy issues requiring attention and redress the same as many state power companies and power boards around the world.

   These include:

   (a) Inability to keep pace with the expanding power demand by a rapidly growing economy and the developmental needs of PNG resulting in a huge shortfall in power supply relative to demand.
   (b) The current PPL organizational structures and business processes do not clearly distinguish the major functions/businesses of generation, transmission, distribution and retail.
   (c) Legacy issues amongst employees still retaining Public Service way of doing things.
   (d) Lack of governance and accountability.
   (e) Transmission and distribution losses of over 35%.
   (f) Aging power generating equipment with regular breakdowns.
   (g) Aging power transmission and distribution infrastructure with most of the substations and transformers affected by overloading.
   (h) Lack of appropriate Power System Planning, Marketing and Development Program
   (i) Financing and Refinancing: efficiencies and credit rating
   (j) Insurance: none for IPPs.

2. Numerous studies and reports by learned commentators including the National Research Institute specifically as well as ADB generally have been critical of PPL's operations and capacity to assist Government in delivering on the government's vision. The seminars and reports recommended "Unbundling" of a number of State Owned Enterprises (SOEs) including PPL as the way forward.

2. The recent declaration of Emergency within the Electricity Services by the National Executive Council in its Decision No.357/2014, supports the notion that drastic measures has to be taken to turn the company around, and improve the reliability and availability of power supply throughout the country and communities which entirely depend on the company for their electricity needs.

3. PPL is not only engaging in the electricity business, more so, it is also the technical regulator of the industry, under delegation from the ICCC. This is creating a 'chicken and egg' situation for the company. Such a position unnecessary impedes the company's ability to pursue its commercial objectives, whilst ensuring regulations are enforced and complied.

4. The ICCC has continued to play a key role in the development of various industries it is empowered to regulate. The electricity industry is one such industry. The mandate of the ICCC encompasses protecting the bona fide interest of consumers, promoting and protecting competition, and regulating State Owned Enterprises.

5. As a case in point, the Government's ICT Policy of 2008 had recognised the immense regulatory challenges posed to the transformation of the telecommunications industry and subsequently promulgated the emergence of a new industry specific regulator. Such lessons learnt are useful in informing any reforms initiated into other industries, such as being proposed here for the energy and electricity industry.

6. Moreover, the fact that ICCC has delegated its technical functions to PPL, in the case of electricity industry, indicates the resource and technical capacity constraints inherent in the economic regulator to perform its mandated roles and functions under the Electricity Industry Act 2002 (EIA 2002).

7. Notwithstanding the issues and challenges raise above, there are policy imperatives set by the state in relation to energy that need to be achieved. These include:
    (a) Vision 2050, section 1.17.9.9 states "*Provide 100 percent power generation from renewable energy sources"*; this is achieved through large renewable energy projects to be developed.
    (b) The White Paper on State's Ownership and Participation in Commercial Activities (the White Paper) clearly articulates the policy options that should be pursued in resource development. *In hydro*

dam and geothermal electricity projects the White Paper advocates for landowner equity participations. The land upon which the project sits is their equity contributions per se. As a matter of policy, it is proposed here that landowner equity in hydro dams and geothermal projects is 10%.

8. In view of these challenges being posed to the overall performance of development of energy, in terms of regulation and entrepreneurial initiatives on the one hand and Government Policy Imperatives on the other, this policy proposes to initiate reforms into the State's participation in business through its wholly owned PPL, and the regulatory regime existing at this time. The efforts under this policy would position the industry to develop further into a viable and competitive market, to the benefit of the users of energy and electricity, and the private participants in the industry.

7.3 UNBUNDLING OF PNG POWER LIMITED

1. The State (GoPNG) will unbundle the current PPL into distinct entities operating in the Generation, Transmission, Distribution and Retail and Regulations. The government's competition policy initiative is one component of this effort at unbundling to improve regulatory oversight and competiveness of the company and industry as a whole.

2. The unbundling is predicated on the fundamental principles of:
   (a) Public Private Partnership (PPP);
   (b) Landowner Participation that will be guided by Landowner Participation Policy assuring at least 10% Landowner stake in all major hydro and geothermal projects;
   (c) Ensuring competition in and for the market, through eliminating avenues where exist for potential abuse of market position against market players; and
   (d) Maintain state monopoly in transmission where privatising and competition does not make economic and practical sense.

3. Because of the enormity of the initiative, the unbundling process will be undertaken in two phases. Phase 1 involves the stabilisation and consolidation of PPL Regional Power Business Units. It is intended to stabilise the situation in PPL and then to consolidate the existing business units to optimize efficiency for cost savings and improve profitability. During Phase 1, the major value-chain components of PPL are consolidated into various core

functions at the regional level to ensure preparation for a smooth transition into PPLs future entities. Consolidation of the existing businesses will follow the Regional Model for rehabilitation of the existing regional business units of PPL according to the expert analysis by the PNG Power Sector. These include all aspects of the value chain from generation, transmission, distribution, retail and regulatory functions of the current PPL assets and businesses. Within this phase the core businesses and support services are clearly identified and structures put in place. Research & Development and Commercial functions are now included as vital parts that will drive the direction of PPL in future.

4. Phase 2 involves creation of specialized business entities as part of the National Government's Kumul Consolidation agenda, with a holding company, a trust company and several subsidiary generation companies to be incorporated by the State.

5. The Regional Model will empower regional growth centres to operate on competitive terms to attract and promote regional business initiatives. When the National Transmission Grid is in place then the regional power generation can be supplied to consumers in any part of the country.

6. The Department responsible for Public Enterprises & State Investments, as it relates to the electricity industry, shall cause to be undertaken a review into the current regulatory environment in the energy industry, with a particular focus to secure a more efficient electricity regulatory regime that would relieve PNG Power Limited of its regulatory functions delegated to it under the Electricity Industry Act. This would essentially involve considerations of the mandates of the following regulatory and policy institutions:
    (a) Independent Consumer & Competition Commission (ICCC).
    (b) Department of Petroleum & Energy (DP&E).
    (c) Independent Public Business Corporation (IPBC).

7. The planning implication of the restructure includes: (i) an organization with background experience in company restructure and change management will be required to manage the unbundling of PPL and with oversight by the Minister for Public Enterprises and State Investments' appointed project management team; and (ii) The procedure for PPL unbundling begins with the transfer of PPL assets and liabilities to IPBC or an interim company owned by IPBC through an Assets transfer program, followed by its subsequent transfer

to the new power entity. The new companies start with clean balance sheets after outstanding arrears of the PPL are cleared.

8. In terms of legal implications of the restructure, while the regional power entities will operate as autonomous business units within the existing PPL legislation with internal corporate restructuring; the new power entities will operate as new companies under the Companies Act 1997 and appropriate enabling legislation (Electricity Industry Act (Chapter 78) consolidated to No 10 of 2002) regarding electricity generation, transmission-distribution and retailing require review and amendment. Related Acts include:
   (a) Electricity Industry Act (Chapter 78) consolidated to No 10 of 2002.
   (b) IPBC Act 2002 (Consolidated / Copy of 15th May 2012) 07 August 2012.
   (c) Companies Act 1997 consolidated to No 66 of 2000.

9. The restructuring of PPL is critical in releasing the full potential of the PNG Energy Industry in contributing towards economic growth and prosperity. The measures will not only increase power generation towards the 9000MW, but also make transmission, distribution and retailing efficient and competitive.

10. The Energy Policy is cognisant of the fact that there are many developments that lie beyond this 2 phase restructure following successful models around the world including:
   (a) Trading of power entities on a stock exchange,
   (b) An IPP trading market in Port Moresby and on a smaller scale in Lae to generate competition and provide good power prices for the consumers,
   (c) Independent Regulating Authority in place,
   (d) Retailing business capacity support from power entities,
   (e) Harnessing of other energy sources,
   (f) Use of clean coal technology in the future,
   (g) Carbon Trading bonuses for the Power Entities, and
   (h) Research and Development setting and leading the power entities' businesses focus.

8 INDIGENOUS PARTICIPATION IN THE ENERGY SECTOR

8.1 LOCAL CONTENT IN THE ENERGY SECTOR

8.1.1 BACKGROUND

1. Major energy projects in the country source goods and services both domestically and overseas.

2. Local Content refers to the procurement or sourcing of goods and services from domestic and international sources by a Locally Owned Company engaged by the Energy Project Developer Company.

3. Locally Owned Companies are those companies which are majority owned (51 % +) by the citizens of Papua New Guinea from immediate project area.

4. The concept of Local Content is to enable or encourage more locally owned companies to participate as sub-contractors or otherwise, hence creating more business and employment opportunities within the local/domestic economy.

5. Local content also includes employment of citizens in various skills level in any energy project.

8.1.2 CHALLENGES

1. Absence of a Local Content Plan or Policy.
2. Inadequate capacity and capabilities of Locally Owned Companies for technically complex tasks.
3. Lack of funding and finance for locally owned companies.
4. Lack of compliance and enforcement by major energy project developers and the State on Project Agreements.
5. Ineffectiveness of monitoring agreements by Government.
6. Lack of compliance with Local Purchase Obligations contained in the *Oil and Gas Act.*
7. Lack of tax and fiscal incentives accorded to Locally Owned Companies.
8. Lack of incentives by the State to the Developer to comply with the local content objectives.
9. Lack of understanding of laws and regulations by the Developer's personnel and management.

8.1.3 STRATEGIES

1. The State to immediately formulate a Local Content Policy/Plan with the establishment of a Local Content Policy/Plan Committee, comprising relevant Government Institution such as Department of Commerce & Industry (DCI), Department of Labour & Employment, Industry representatives, and other stakeholders in the Energy Sector, i.e. Mining, Oil & Gas Industry.
2. The State to assist Locally Owned Companies to attain world standards to meet Developer's expectations.
3. The challenge of lack of skills will be addressed under the sub-Chapter on Human Resource Capacity Building in Energy Projects.
4. Government to provide fiscal and monetary assistance to Locally Owned Companies to assist them partake off opportunities available in Energy Projects.
5. Timely release of Business Development Grants (BDGs) to Locally Owned companies well in advance of a project's Development to make them prepared.
6. Ensure adequate monitoring and enforcement of a Developer's Local Content undertakings under a Project Agreement.
7. Ensure no Transfer Pricing arrangements by a Developer and its related subsidiary companies.
8. Ensure good Government Liaisons between Developer and the State.
9. Higher rewards to be granted to Developers for complying with the Local Content objectives
10. Landowner Participation Policy to be developed to assist Landowners structure themselves commercially to participate in Projects.
11. Priority to be given to Locally Owned Companies from the immediate Project Area, then from the respective LLGs, District, Province and finally to Nationally Owned companies (which will be covered adequately below on the sub-Chapter on national Content in the Energy Sector).
12. Creation of Reserved Activities List are depicted below in Tables 7 and 8 as a guide to show the suggested ratio of local content vs overseas content relating to energy projects.

Table 7: Labour and Employment Procurement

Employment Category	**Ratio of Local NC Vs Overseas**	**Ratio of Local NC Vs Overseas**
	Period of 1st 20 years (project life time)	30 to 40 years (project lifetime)
Managerial	20 percent to 80 percent	60 to 40 percent
Skilled	60 percent to 40 percent	80 to 20 percent
Semi-skilled	100 percent	100 percent
Un-skilled	100 percent	100 percent

Table 8: Awarding of Contracts/Sub-contract to locally owned PNG Companies

Large-scale Infrastructure Construction and Building Construction and Marin terminal processing facilities	Outsource abroad or PNG Joint Venture (JV)
Large-scale Facilities Construction/Aero-drome/Pipeline	Outsource abroad or JV
LNG Shipment	Outsource abroad
Large-scale road construction network	Outsource/Joint PNG Venture
Insurance & HSE Provisions	Preference PNG owned or Joint PNG Venture
Catering Contracts	Preference PNG owned Joint PNG Venture
Security Provisions	Preference PNG owned Join PNG Venture
Cleaning Contracts	Preference PNG owned Join PNG Venture
General Roadwork Maintenance	Preference PNG owned Join PNG Venture

8.2 NATIONAL CONTENT IN THE ENERGY SECTOR

8.2.1 BACKGROUND

1. National Content refers to the procurement or sourcing of goods and services from domestic and international sources by a Nationally Owned Company engaged by a Energy Project Developer Company.

2. Nationally Owned Companies are those companies which are majority owned (51 % +) by the citizens of Papua New Guinea or SOEs.

3. The concept of National Content is to enable or encourage more nationally owned companies to participate as sub-contractors or otherwise, hence creating more business and employment opportunities within the domestic/national economy.

4. National content also includes employment of national citizens in various skills level in any (energy) project (which will be covered adequately in the sub-Chapter on Human Resource Capacity Building in Energy Projects).

5. The recent LNG Project participants include some nationally owned companies, SOEs mostly, like Kumul Petroleum Holdings Limited (formerly National Petroleum Company of PNG), Petromin (PNG) Holdings Limited(through its subsidiary Eda Oil limited), Mineral Resources Development Corporation and Oilsearch Limited(10 % owned by IPBC).

6. Most major hydro projects in the country are owned by the SOE PNG Power Limited.

7. The Mineral Resources Development Corporation (MRDC) participates through the collection of landowner royalties.

8. The National Gas Corporation was statutorily created to provide for all provinces equal participation in major hydrocarbons development but has been under capitalised to date resulting in lack of its participation in Projects.

8.2.2 CHALLENGES

1. Absence of a National Content Plan or Policy.

2. Inadequate capacity and capabilities of Locally Owned companies for technically complex tasks.

3. Lack of funding and finance for nationally owned companies to participate in energy projects.

4. Lack of funding and finance for locally owned companies.

5. Lack of compliance and enforcement by major energy project developers and the State of Project Agreements.

6. Ineffectiveness of monitoring agreements by Government.

7. The lack of compliance with Local Purchase Obligations contained in the *Oil and Gas Act.*

8. The lack of tax and fiscal incentives accorded to Nationally Owned Companies to participate in Energy Projects.

9. Lack of incentives by the State to the Developer to comply with the national content objectives.

10. Lack of understanding of laws and regulations by the Developer's personnel and management.

8.2.3 STRATEGIES

1. The State to immediately formulate a National Content Policy/Plan with the establishment of a National Content Policy/Plan Committee, comprising relevant Government Institution such as Department of Commerce & Industry (DCI), Department of Labour & Employment, Industry representatives, and other stakeholders in the Energy Sector, i.e. Mining, Oil & Gas Industry.
2. The State to assist Nationally Owned Companies to attain world standards to meet Developer's expectations.
3. The Challenge of lack of skills will be addressed under the sub-Chapter on Human Resource Capacity Building in Energy Projects.

4. Government to provide fiscal and monetary assistance to Nationally Owned Companies to assist them partake off opportunities available in Energy Projects.
5. Ensure adequate monitoring and enforcement of a Developer's National Content undertakings under a Project Agreement.
6. Ensure no Transfer Pricing arrangements by a Developer and its related subsidiary companies.
7. Ensure good Government Liaisons between Developer and the State.
8. Higher rewards to be granted to Developers for complying with the National Content objectives.
9. Landowner Participation Policy to be developed to assist Landowners structure themselves commercially to participate in Projects.
10. Priority to be given to SOE's (Kumul Petroleum Holdings Company and National Gas Corporation in oil and gas sector) to participate for the collective benefit of the nation.

8.3 DOWNSTREAM PROCESSING IN THE PETROLEUM SECTOR

8.3.1 BACKGROUND

1. Papua New Guinea is strategically located in a region where both oil and gas reserves are abundant, i.e. within the Asian/Pacific region which comprises countries such as Australia, Malaysia, Brunei, and Indonesia. These countries have established world class petroleum and associate industries such as LNG, Methanol and Petrochemicals by effectively utilizing their petroleum resources. They also compete against each other in order to secure as much market share in the region and at the global scenario. In the Asia Pacific region buyers are driving hard bargain in price to take advantage of the increase of supply in the LNG markets Products such as Compressed Natural gas (LNG) and Dimethyl ether (DME) are expected to increase in competition with other well established fuel. Competitiveness in costs and environmental factors are key factors to securing products markets, and attracting by investors.

2. In order for PNG to be able to be competitive and secure leadership in such highly competitive Asia/Pacific regional markets and also attract potential investors, it is of critical importance that the Government formulates an

attractive policy directive targeting investments in Downstream Processing in the Petroleum Sector (Oil & Gas).

3. PNG Petroleum Sector must support the growth of a vibrant downstream sector which will in turn provide a strong foundation for large-scale downstream processing. This will in turn enhance Gas-based activities in a sustainable and environmentally friendly and safe approach, hence:
    a) Building a foundation of strong revenue base hence maximises economic benefits;
    b) Secure energy security;
    c) Enhance growth and experience to the natural economy;
    d) Reduce high dependence on expensive imported fuel and petro chemical products and encourage local cheap substitutes (refer also to Domestic Market Obligation-DMO);
    e) Attract the interest of Investors in the increase of exploration in the upstream hydrocarbon industry;
    f) Creation of more job in the hydrocarbon industry for our citizen (refer also to local content); and
    g) Address poverty alleviation.

4. The current Government's focus to promote investments in the local content in downstream activities is more than monitoring direct monetary benefits. The promotion of downstream processing support the Overarching National Energy Policy to grow the economy as reflected in the Government's Development Strategic Plan (DSP) and Vision 2050. This will encourage the procurement of products and services and utilising local sub-contractors for the purpose of provision of goods and services to the projects and act as a major boost to the economy. This will maximise the Government's gains as a result of the economy multiplier effects triggered by the (Energy) Project's downstream activities.

5. The current low price for LNG which will persist for foreseeable future.

8.3.2 CHALLENGES

1. The lack of a Downstream Processing Policy/Plan for (Energy) Projects.

2. The lack of reliable infrastructure and associated works to supply energy to power industrialisation/downstream processing of hydrocarbons.

3. The lack of trained and skilled manpower/personnel.

4. The lack of finance and fiscal incentives for potential developers to downstream process.
5. The lack of a Domestic Market Obligations Policy /Plan to secure gas reserves for downstream processing. (see sub-Chapter on Domestic Market Obligations below)

8.3.3 STRATEGIES

1. Formulation of a Downstream Processing Policy/Plan to address downstream processing.

2. The Overarching Energy Policy will itself address issues relating to reliable energy supply.

3. The sub-Chapter on Human Resource Capacity Building chapter will address the lack of trained manpower/personnel.

4. Formulation of good fiscal regime/incentives for potential developers.

5. Use joint venture arrangements between reputable developers/proponents and nationally owned companies to downstream.

6. Formulation of a Domestic Market Obligations Policy/Plan to address downstream processing.

7. Ensure that Domestic Market Obligations component is factored into every (Energy) Agreement into between the State and Developers.

8. Enforcement of Domestic Market Obligations component in the Oil and Gas Act and if possible to increase the amount of petroleum available for Domestic Market Obligations.

8.4 DOMESTIC MARKET OBLIGATIONS IN THE ENERGY SECTOR

8.4.1 BACKGROUND

1. Domestic Market Obligation is used to assign/reserve a certain percentage of processed petroleum for local/domestic consumption.

2. It is vital in that higher end products may be manufactured from gas secured under the Domestic Market Obligations.

3. Almost all the gas recovered under the PNGLNG Project was committed under long- term sales arrangements with international consumers leaving little available for Domestic Market Obligations. As a result, there are none available for Domestic Market Obligations to be utilised in electricity generation and petrochemical production.

4. It is hoped that a more robust system be in place to enforce what is already contained in the Oil and Gas Act.

8.4.2 CHALLENGES

1. The lack of a Domestic Market Obligations Policy.
2. The lack of enforcement of what is provided for under the Oil and Gas Act.

8.4.3 STRATEGIES

1. Formulation of a Domestic Market Obligations Policy for Petroleum.
2. Enforcement of Domestic Market Obligations component in the *Oil and Gas Act.*

8.5 ENERGY PROJECT REHABILATION

8.5.1 BACKGROUND

1. Projects involving Energy use varying amounts of finite resources like water and land. For instance, drilling and exploring for oil and gas uses less land than say coal or uranium mining.

2. Likewise producing energy from Geothermal plants uses less land/space and water than a hydro dam and its reservoir.

3. Some may cause minimal disruption to the local ecosystem like solar and wind turbines. Some may be eco-friendly in that they uses waste products to produce energy like biofuels from cooking oil whereas some are not like producing of energy from nuclear plants and the accompanying hazardous wastes.

4. All in all, the rehabilitation of the environment after these projects have come to the end of their life is crucial.

5. In Papua New Guinea, most petroleum projects leave little environmental footprint. There are no major mining of coal and uranium as yet. Experience from mining projects especially Ok Tedi, Panguna and Misima leave a lot to be desired. Mining of coal and uranium, if they do happen, must not follow this path.

6. Rehabilitation of hydro reservoirs has not yet been experienced since these projects are currently operational.

7. Solar and wind are harnessed but on a much smaller scale and not industrial.

8. Biofuel is yet to take off on a large scale. Its production from plantations, smallholders, etc. then needs to be taken into account as they will leave an environmental footprint.

9. Biomass is also one sector that leaves a big footprint. The Forests Act and levy uses funds to rehabilitate the forest and grow plantation timber.

8.5.1 CHALLENGES

1. No regulatory framework to cover rehabilitation of energy projects

8.5.1 STRATEGIES

1. Legislations and regulations to be enacted to better regulate the rehabilitation of energy projects.

8.6 HUMAN RESOURCE CAPACITY BUILDING FOR ENERGY PROJECTS

8.6.1 BACKGROUND

1. All facets of energy development, production, usage and conservation need a trained pool of people to manage.

2. Technical people like Petroleum and nuclear engineers, geologists are needed mostly in the operational areas of energy.

3. In addition, good quality energy policy analysts, etc. are needed.

4. PNG currently has no specific training related directly to energy. However, there a recent moves by the UPNG to introduce the Bachelor of Sustainable

Development which contain aspects of climate change and energy conservation.

5. There were recent moves by the WNBP Governor to send mothers to India for Solar Academy training.

6. Most projects are required to produce a Training and Localisation Plan prior to developing a resource. Most do not comply with this Plan.

8.6.2 CHALLENGES

1. Developers lack of compliance with the Training and Localisation Plan.
2. Lack of trained researchers and academics specialised in Energy Development and use.

8.6.3 STRATEGIES

1. Robust enforcement and inspection by State Agencies to ensure that a developer adheres to a training and localization plan that it submits.

2. Skills transfer by Developers to citizens should be made mandatory.

3. Adequate funding and training by the state for energy related training overseas.

9 ENERGY FINANCING, TRADING, PRICING AND SOCIO-ECONOMIC ISSUES

9.1 BACKGROUND

1. The funding required for the energy sector is substantial. New investments are needed for exploration, utilization, generation, transmission and distribution activities. Long-term financing options that involve both foreign and domestic financing resources are required. However, foreign investment capital and national foreign earnings provide the greater proportion of needed funds.

2. The Government shall continue to encourage private sector investment in the energy sector through Public Private Partnership (PPP).

3. To attract foreign investment in the energy sector, certain necessary conditions would have to be met. Experience has shown that Independent Power Producers (IPPs) require incentives to mitigate the perceived political and economic risks.

9.2 CHALLENGES

1. Inadequate funding for the energy sector.

2. Lack of continuity in the funding of projects in the energy sector.

3. Low foreign investment from a highly competitive international finance market.

4. Partial adoption of the most cost-effective energy supply options for the country.

5. Low foreign exchange earnings through export of energy.

6. Inadequate local development of energy technologies.

7. Lack of energy trading mechanism for spot and long term markets.

8. Foreign exchange fluctuations.

9.3 STRATEGIES–FOR ENERGY FINANCING

1. The Government shall explore and adopt all viable financing options from local and international sources to ensure cost effective utilization of all its energy resources and in so doing shall endeavour to maintain a competitive fiscal investment climate in the country.

2. The Government shall continue to provide financial support for energy infrastructure development. Such support may include:
   (a) Specialized tax concessions for domestic energy producers of petroleum products such as tax credits, deductions, exemptions and allowances and particular incentives on clean burning petroleum products thus encouraging adoption of clean and efficient refining technologies, following the discovery of commercially viable crude oil in Papua New Guinea.
   (b) Fiscal incentives for the refining sector similar to that provided to refineries by governments in the Middle East and Asia. This recognizes the investment in infrastructure that is commonly accessed by the industry and benefits the entire economy.
   (c) Provision of incentives for renewable energy projects so as to reduce the reliance on expensive petroleum based energy in the long term.

3. The national government shall grant appropriate fiscal incentives for energy expansion projects from time to time.

4. Provide for high import duty for non-efficient energy technology while zero rating efficient technologies.

5. Allow procurement of equipment for exploration, exploitation and development of energy sources related spares and accessories free of duty and taxes.

6. Allow procurement of plant, equipment and related accessories for generation and transmission projects free of duty and taxes during project implementation. Procurement of major parts for the power plants, transmission and distribution systems and materials shall also be exempted from duty and taxes.

7. Support public generators in joint venture partnerships in situations where the IPPs will be unwilling to participate in development of energy production projects without Government participation due to perceived project risks.

8. Grant tax holiday to investors in exploration, production and processing of coal and petroleum for a period of between 5 and 10 years depending on size of investment.

9. Dedicating a certain percentage of the nation's income from conventional energy sub-sector to support training, research, development demonstration and technology acquisition.

10. Providing fiscal incentives for prospective investors in energy.

11. Reviewing the existing laws and regulations for the operation of energy sector industries so as to increase private sector participation in the industries.

12. Ensuring a reasonable return on investments through cost-effective energy pricing.

13. Establishing guaranteed and dependable repayment schemes for loans invested in energy projects.

9.4 ENERGY FINANCING OPTIONS

1. Establishing a favourable investment climate to attract investments in the energy sector.

2. Providing adequate infrastructural facilities to enterprises involved in the development of the energy sector.

3. Encouraging energy firms to source development funds from alternative sources.

4. Expanding the scope of venture capital financing to embrace investments in the energy sector.

5. An Electrification Trust Fund is proposed to solicit and fund rural electrification project proposals across the country. This will make rural electrification an active national policy, and will ensure equity, effective coordination and sustainability.

6. Review the Income Tax Act 1959, Goods Act 1951, the Goods & Services Tax Act 2003 and other relevant legislations, to provide fiscal incentives in the energy sector.

7. Develop a National Energy trading market in the country including spot and long term markets for energy products.

8. Encourage development partners to establish financial facilities for financing energy related projects at minimal interest rates especially for renewable energy and energy efficiency projects.

9. Provide incentives to attract investment in petroleum retail networks in the remote areas of the country.

10. Seek financing of clean energy projects through carbon credits under clean development mechanism green energy through relevant government agencies.

11. The provincial governments will be encouraged to source for their own funding for energy projects within their mandate according to Organic Law and National Government support.

12. Encourage public private partnerships in energy projects including strategic petroleum reserves infrastructure development and power generation projects.

9.4.1 PUBLIC PRIVATE PARTNERSHIPS

1. The Government will support Public Private Partnership (PPP) as provided for in the PPP Policy document. Systems have been set for participation of private sector in financing, construction, development, operation, or maintenance of infrastructure or development projects through concession or other contractual arrangements and the establishment of institutions to regulate monitor and supervise project agreements or infrastructure or development projects.

2. Apart from market-driven competition, the Government recognizes private sector participation to occur in the form of service contracts lasting between 1 – 2 years, management contracts of a 3 - 5 year term, leases from 8 - 15

years, concessions which duration range from 25 - 30 years and other forms (models) of public-private partnerships (PPP) such as service-operate-transfer (SOT) or build-operate-transfer (BOT) that should have a term between 20 – 30 years.

3. All PPP's formed shall be the outcome of a competitive bidding process, and vetted by the relevant regulator. The State currently has a National PPP policy to guide such decisions, and the National Energy Policy will be implemented in a manner consistent with that policy.

9.4.2 CONSOLIDATED ENERGY FUND

1. The Government shall set up a Consolidated Energy Fund (CONSEF) under the National Energy Authority to cater for the following: -
   (a) Acquisition of strategic petroleum reserves and the construction of the appropriate infrastructure.
   (b) Assist in energy sector environmental disaster mitigation, response and recovery.
   (c) Hydro risk mitigation during times of prolonged drought.
   (d) Promotion of renewable energy initiatives.

2. The sources of the money for this energy fund will be as below:

   (a) Levies and license fees in the energy sector except those with specific purposes.

   (b) Contribution from energy sector player.

   (c) Contribution from public institutions for the discharge of their mandates.

   (d) Raising funds through the stock market (bonds and bills).

3. The fund shall be managed by the proposed National Energy Authority.

9.5 ENERGY TRADING

1 Electricity is a commodity capable of being bought, sold and traded in an electricity market. However Electricity unlike other products is by its nature difficult to store and has to be available on demand. Therefore there is a physical requirement for a controlling agency, the transmission system operator, to coordinate the dispatch of generating units to meet the expected

demand of the system across the transmission grid. Under this policy, it is envisaged that the ENERCOM will perform that role.

2 National Electricity Market involves both wholesale generation that is transported via interconnected grid of high voltage transmission lines to electricity distributors, who deliver it to consumers (homes and businesses).

3 The transport of electricity from generators to consumers is facilitated through a 'pool', or spot market, where the output from all generators is aggregated and scheduled at five minute intervals to meet demand.

4 The pool is not a physical thing but a set of procedures that ENERCOM will manages in line with National Electricity Law and National Electricity Rules.

5 The market uses sophisticated systems to send signals to generators instructing them how much energy to produce each five minutes so that production is matched to consumer requirements, spare capacity is kept ready for emergencies, and the current energy price can be calculated.

6 The scope of each electricity market consists of the transmission grid or network that is available to the wholesalers, retailers and the ultimate consumers in any geographic area.

7 A wholesale electricity market exists when competing generators offer their electricity output to retailers. The retailers then re-price the electricity and take it to market. Large end-users seeking to cut out unnecessary overhead in their energy costs are beginning to recognize the advantages inherent in such a purchasing move.

9.6 ENERGY PRICING AND SOCIO-ECONOMIC ISSUES

9.6.1 ENERGY PRICING

9.6.1.1 ELECTRICITY

1. Electricity pricing shall base on the principles of Long Run Marginal Cost of supply. The End-User-Tariff incorporates all prudent costs in the value chain and a fair return to the investors. The bulk tariffs are negotiated between producers and the off-taker, however, the Power Purchase Agreement is

subject to approval by ICCC. The retail tariffs are regulated by the Commission and may be subject to review at least every five years.

2. Fuel costs and exchange rates gains/losses are pass-through costs in the current regime. These account for power cost variations in the event of fluctuation in the international crude oil prices as well as instability with PNG Kina against foreign currencies, mainly the US Dollar.

3. PNG imports some petroleum products from overseas. The international price of crude oil and petroleum products has been on a steady increase and has had an impact on the cost of petroleum and associated products.

4. The impact of crude oil price increases lead to inflationary pressure in the economy which is translated to increases in prices of goods and services. This tends to depreciate the exchange rate and increase interest rates. An increase in diesel prices leads to an increase in farming costs, the cost of inputs in the manufacturing and transport sectors and subsequently an increase in consumer prices making PNG products uncompetitive. With the income of consumers remaining relatively constant, these increases lead to erosion of purchasing power of the consumers in addition to reducing monies for other needs.

9.6.1.2 AFFORDABLE ENERGY PRICE

1. The reliability of energy services enjoyed by the urban energy users is unreliable by international standards because of the way the energy sector is structured in the country. The condition of modern energy infrastructure in PNG is in a deplorable state and needs to be maintained, upgraded or replaced to ensure that these facilities perform to the highest expectations to deliver the energy services required by the end users.

2. Demand for production and utilization of energy is a function of price. It is important to take into consideration the low ability of paying energy users amongst large sections of the population.

3. When developing or constructing modern energy infrastructure it is essential that the developers must consider imposing affordable energy price to the consumers. The developers must consider appropriate cost savings in the designs of the energy infrastructure through improved operating efficiencies and minimizing on unnecessary expenditure.

4. Incentives that make energy developers seek efficiency measures to minimize their costs and an enforceable and suitable price mechanism should alleviate the situations that bring about unaffordable prices of energy services.

9.6.1.3 COMPETITIVE ENERGY MARKETS

1. To improve reliability of energy services competition will be promoted and introduced in the energy sector. Competition in energy supply provides choice to consumers, places downwards pressure on prices and incentivizes efficient investment.

2. The government will push for reforms and initiate programmes for ensuring energy markets continue to work effectively and competition is promoted.

3. Create an open market by way of withholding two quarter (2/4) of fossil fuels exporting overseas and refines it within the country so as to meet its energy demand.

4. Tariff regulation, as a second best option to competitive markets would continue to play an important role in ensuring an affordable and reliable energy to end users.

9.6.1.4 OVERSEEING OIL MARKET

1. The petrol and diesel prices are largely determined by international oil markets. However the government will oversee oil markets to ensure petrol and diesel prices at the pump fairly reflect industry costs as per international oil market.

2. Similar to the gas sector, oil commercialization and development will be promoted in PNG in the near future to reduce reliance on fuel imports and promote energy security.

9.6.2 OTHER SOCIO-ECONOMIC ISSUES

1. Investment in property relating to exploitation of natural resources for energy production must benefit the local communities and their economies as well as future generations. Therefore there is need to provide:

a. A framework to ensure that local communities benefit from energy resources within their region.

b. A funded, national coordinated rural electrification program is required.
A National Electrification Consolidated Trust Fund (NECTF) is proposed to solicit and fund rural electrification project proposals across the country. This will make rural electrification an active national policy, and will ensure equity, effective coordination and sustainability.

9.7 THE TARIFFS AND PRICING MECHANISMS

9.7.1 BACKGROUND

1. Papua New Guinea (PNG) has a low electrification rate compared to other similar developing countries whilst the sector has a vertically integrated monopoly with a few independent power producers. Given such a scenario, PNG has developed and now had in place its own electricity sector policies. Since there are provisions in the regulatory licencing framework for private sector participation, these arrangements can be combined with some elements by learning through the reformed experiences of other developing countries that could be considered for the way forward in reforming the sector's regulation, thus encouraging competition to improve efficiency in the provision of electricity services.

2. As such, given that there are potential for more competition in the electricity sector with increasing number of interest shown by the private sector to participate on the back end of high demand for electricity due to increase economic activities, the regulatory arrangements and tariff structuring will provide provisions for continuous restructuring and adjustment overtime, concurrent with the development in the electricity industry.

3. Therefore, to accommodate the increasing interests shown by the private sector to participate in all or any of the segments of the electricity sector, certain form of pricing mechanism or tariff structure need to be set in place to provide and or administer the returns on the value of investments.

4. The ERC must be encourage through the existing regulatory framework to implement a robust price mechanism that is conducive to and or favourable for all entrants into the different segments of the industry, to gain a positive return on their investments thus promoting accessibility, affordability and reliability in the industry.

5. Furthermore, ERC must consider the different areas of operations, in terms of the urban and rural settings, and the respective low and high cost areas; and apply different charges at those varying connection(s) points with those parties, albeit set an appropriate price mechanism and or tariff structure that will drive efficiency.

6. More so, in order to achieve the overarching objectives of this policy; apart from other strategies, there is considerable need for structuring and setting of pricing mechanism. Any proposed price mechanism should be reviewed and structured concurrently with the phase of the restructuring or defragmentation of the electricity industry.

7. Currently there exists a Tariff structure that is applied specifically by the regulated retailer. PNG Power Limited, being the regulated retailer applies a uniform tariff across its entire network.

8. Distinctively, there are some price mechanisms currently applicable through third parties access that are covered by the Third Party Access Code (TPA). However, in observing how the current pricing mechanism in the industry

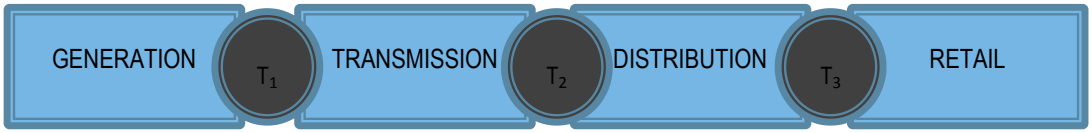
works, it may not be fully reflective of the different structure of the restructured electricity industry.

9. Therefore, the different tariff structure for different settings of the defragmented sectors of the electricity industry must be established. In essence the policy is making provision for the establishment of different tariff structure for different defragmented sectors of the industry and provides provision for adjustment and review of the tariff structures to be on par with the structuring of the industry overtime.

9.7.2 TARIFF IN ELECTRICITY

1. In consideration of the complexity involved in the tariff calculation and design, especially in regards to obtaining of relevant efficient costs inputs of the firms in question, and the asymmetry of information between the regulator and the regulated entity; an efficient market tariff price cannot be easily determined. Nonetheless, regulation of price to mimic the competitive market has continued to be adopted worldwide as the second best option.

2. The current Papua New Guinea electricity tariff setting arrangements can be best illustrated in the following diagram hereunder.



3. 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.

4. A large proportion of tariff differentials occur at T_3, under price discrimination and segmenting due to the varied customer segments - such as industrial,

household and residential and public institutions. A similar price differentials occur at T_1, due to the varied costs structures of the generating firms resulting in different tariff rates. This is the case given that all firms operating in the industry would not necessarily have similar cost structures.

5. The current electricity tariff pricing regime administered by the Independent Consumer Competition Commission (ICCC) under its own Act (ICCC Act, No 6 of 2002), the economic regulator of the electricity industry focuses on tariffs charged at point T_3 with an oversight on T_1. The principle behind it, is for the firm to recover its efficient costs of investment, with a reasonable return on its investments.

6. Tariff between the IPPs and Off-taker in T_1 remains negotiable between the parties, through a Power Purchase Agreement (PPA). However, the ICCC does have an oversight in setting of the Reference Price, agreed to it by the Regulator, based on information supplied to it by the regulated entity (Retailer). This is consistent with the pricing arrangements provided for under the Third Party Access Code (TPA Code).

9.7.3 PRICING MECHANISM UNDER THE TPA CODE

9.7.3.1 THE THIRD PARTY ACCESS CODE

1. The Third Party Access Code and Grid Code was developed through the Electricity Industry Policy. The TPA Code was released by ICCC and became effective on the 1st of January 2014. The objective of the TPA was to facilitate improved access, reliability and affordability of electricity throughout PNG by:

    - Improving the reliability of electricity supply by supporting entry by Independent Power Producers (IPPs) to ensure sufficient generating capacity is available for dispatch.
    - Helping to ensure that power is more affordable for customers by increasing the range of potential generation options and, thereby, offering more opportunities for the System Operator to select least-cost generation options.
    - Helping to ensure that power is more affordable for customers by increasing the range of potential retailers and, thereby, offering more opportunities for Large Load Customers to select a least-cost option.

9.7.3.2 KEY COMPONENTS OF THE ACCESS CODE

1. There are three key components of the TPA Code in relation to tariff settings; these are:
    (a) ***Reference Prices*** - which set out the maximum price a regulated retailer will pay for electricity generation;
    (b) ***Wheeling Arrangements*** - which set out the conditions and charges under which third parties can access PNG Power Limited's transmission networks; and
    (c) ***Connections arrangements*** - which set out the conditions and charges for connection to PNG Power Limited's transmission networks by third parties.
2. The TPA Code, once implemented is expected to:

(a) Improve transparency with regards to power purchase contracting between IPPs and Regulated Retailers.
(b) Constrains the ability of Regulated Retailers to unfairly discriminate against potential competitors.
(c) Protect Transmission Network Operators' commercial interests by clarifying how they are remunerated by Third Parties connecting to and wheeling power through their network.
(d) Constrains the ability of Transmission Network Operator/s that performs System Operator functions from unfairly discriminating against Third Parties.

9.7.3.3 PRICING MECHANISMS UNDER THE TPA CODE

1. The TPA Code and its Pricing Mechanism aligned to the National Energy Policy are expounded as:

i. **Power Purchase Reference Pricing and Power Purchase Agreement**

The Power Purchase Reference Price (PPRP) provides for purchasing power at a prudent and efficient cost for the retailer to pass-through to consumers. The power purchase price sets the upper bound for and as a benchmark for retailers purchasing from power producers.

It is required under the TPA Code that regulated retailers must submit a statement of power purchase reference price to the regulator for approval. The regulator will assess, approve and do publication of the approved power purchase reference prices for the participants in the industry to apply these references accordingly to the different energy sources.

ii. **Wheeling Arrangement and Charges**

According to the TPA Code, the Transmission Network Owner must provide non-discriminatory rights to use or access its transmission network to third parties for the purpose of supplying large load customer. Third

parties wheeling power through the transmission network must pay wheeling charges to the transmission network operator.

The transmission network owner or the regulated retailer is also required under the TPA Code to submit a Statement of Wheeling Arrangements and Charges to the regulator to approve before the regulated retailer of the third party is allowed to use transmission network for wheeling.

iii. **Connection Procedures and Charges**

According to the TPA Code, the Transmission Network Owner must provide non-discriminatory connection to its transmission network to any including but not limited for IPPs for the purpose of;

(a) Third party to supply power to the regulated retailer or network owner in order to effect the power purchase agreements between third party and the regulated retailer;
(b) Third party to wheel power through the transmission network to a large load customer with in the exclusive service areas of the regulated retailer.

2. Before connecting any third party, a Statement of Connection Service (SoCS) procedures and charges must be prepared by the regulated retailer and presented to the regulator for approval.

3. Thus, any third party willing to connect to the network must pay for the connection charges and connection services charges in accordance with the approved SoCS procedures and charges.

9.7.3.4 CHALLENGES FACING PAPUA NEW GUINEA IN TARIFF SETTING

1. Acute shortage of generation capacity;
2. Transmission constraints and inadequacies;

3. Inadequate generation mix e.g. solar, wind, coal, etc;
4. Unacceptable technical and non-technical loss levels; and
5. Information Asymmetry between regulator and regulated entity
6. Lack of publicly available data and information.
7. Lack of institutional capacity and resources.

9.7.3.5 TARRIF SETTING PRINCIPLES

1. That the proposed National Energy Authority of Papua New Guinea (NEA) upon setting the tariff, should have regard to ensure that the prices charged by licensees are fair to consumers and sufficient to allow the licensees finance their activities and to allow for reasonable earnings for efficient operation.

2. The proposed NEA, must design an appropriate tariff structure, and set out multiyear tariff for the electricity industry, subjecting it to review at appropriate terms, as it sees fit.

3. An open and transparent public process of consultation is adopted, with a holistic and scientific approach to balancing electricity tariffs to ensure a fair and cost-reflective tariff regime capable of supporting the growth of the industry, whilst attracting new investment into the sector.

4. The key principles that the National Energy Authority of Papua New Guinea (NEA) need to be cognisant of in terms of setting the tariffs for each of the generation, transmission and distribution (including retail) sectors, are:
    (a) **Cost recovery / financial viability** – regulated entities should be permitted to recover their (efficient) costs, including a reasonable rate of return on capital.

(b) **Signals for investment** – prices should encourage an efficient level and nature of investment (e.g., location) in the industry.

(c) **Certainty and stability** of the pricing framework is also important for private sector investment.

(d) **Efficient use of the network** – generally, this requires "efficient" prices that reflect the marginal costs that users impose on the system and the reduction of cross-subsidies.

(e) **Allocation of risk** – pricing arrangements should allocate risks efficiently (generally to those who are best placed to manage them).

(f) **Simplicity and cost-effectiveness** – the tariff structure and regulatory system should be easy to understand and not excessively costly to implement (e.g., facilitate metering and billing).

(g) **Incentives for improving performance** – the way in which prices are regulated should give appropriate incentives for operators to reduce costs and/or increase quality of service.

(h) **Transparency / fairness** – prices should be non-discriminatory and transparent. Non-discriminatory access to monopoly networks is also a key prerequisite for effective competition in the contestable sectors.

(i) **Flexibility / robustness** – the pricing framework needs to be able to cater for unforeseen changes in circumstances.

(j) **Social and political objectives** – the pricing framework needs to provide for the achievement of social policy goals such as universal access, demand-side management and user affordability.

9.7.4 FEED IN TARIFF

9.7.4.1 OVERVIEW

1. FiT is a convenient tool for many countries, that is strongly recommended for PNG to encourage renewable energy generation.

2. **Feed-in tariffs** (FIT) are fixed electricity prices that are paid to renewable energy (RE) producers for each unit of energy produced and injected into the electricity grid. The payment of the FIT is guaranteed for a certain period of time that is often related to the economic lifetime of the respective RE project (usually between 15-25 years). Another possibility is to calculate a fixed maximum amount of full-load hours of RE electricity production for which the FIT will be paid. FIT are usually paid by electricity grid, system or market operators, often in the context of Power Purchasing Agreements (PPA).

3. Most RE support schemes, the level of FIT is determined on the basis of a calculation of the levelized cost of electricity (LCOE) produced from RE. This allows the RE investor to recover the different costs (capital, O&M, fuel, financing) while realizing a return on his investment that depends on the assumed financing costs. In some cases, FIT have been calculated on the basis of avoided costs for the electricity system or the society, including e.g. environmental externalities. Thirdly, it is also possible to determine the FIT level by means of a tendering mechanism.

9.7.4.2 DESIGN OPTIONS

1. FIT are usually differentiated by technology to reflect the differences in generation costs between the various RE technologies. A second differentiation is also often done for the size of the RE project in terms of installed capacity, reflecting the higher generation costs of small and medium scale RE projects. Thirdly, FIT can be differentiated according to the RE resource quality (e.g. average wind speed) at different project locations. In this case, FIT for sites with lower RE potential are higher than those for sites with a better RE potential. In general, these options for FIT differentiation can lead to a more heterogeneous mix of different RE projects (in terms of technologies, size and location) but carry the risk of increasing the overall costs of the support scheme (NREL 2010).

2. In many FIT schemes, RE investors are also eligible for the payment of additional bonuses (i.e. an increase of the basic FIT) for the use of certain biomass fuels (e.g. liquid manure), combined heat and power generation (CHP), repowering of older RE installations, provision of ancillary services to the electricity system or specific innovative applications (e.g. enhanced geothermal systems). On the one hand, these bonuses can be useful to achieve certain policy objectives (e.g. technological innovation), on the other hand they also increase the costs of the support scheme.

3. FIT are usually stable during the whole guaranteed payment period after the commissioning of a RE project. In some cases, a higher FIT is paid in the first years of operation and a lower FIT for the remaining years. This “front-loaded” FIT can facilitate the financing of capital-intensive RE projects. In other cases, FIT are increased on an annual basis to compensate for the inflation of operation and maintenance costs.

4. The levels of FIT are usually determined by means of RE legislation or by national regulatory authorities. This means that a revision of the FIT would normally require an additional administrative act. Therefore, many RE support schemes have included an automatic degression mechanism that is applied to the FIT in regular intervals. This degression can be pre-determined (e.g. a fixed annual percentage reduction of the FIT) or it can be responsive, taking into consideration the market development for a specific RE technology.

5. For the calculation of the degression of the RES remuneration rates, data from international studies with projections about the technological progress, market development and the evolution of the technology costs (“learning curves”) are being used. The determination of the right degression rate can be challenging due to uncertainties concerning the technology development and other important factors such as financing costs.

9.7.4.3 ADVANTAGES AND DISADVANTAGES OF FEED-IN TARIFFS

1. Feed-in tariffs are a relatively simple RES policy instrument that provides however the possibility to be combined with specific design elements (in particular tariff differentiation) that allow a fine-tuning of the support and the achievement of different policy objectives (e.g. innovation, climate protection, regional development, etc.). For RES investors and financing institutions, the existence of FIT combined with long-term contracts guaranteed by the government provides transparency, predictability and security and therefore contributes to lowering investment risks and financing costs. The existence of FIT generally also contributes to a more continuous and stable RES market development. FIT provide an incentive to maximize the production of RES electricity because they are output-based. In many countries, they have proven their ability to stimulate rapid and large-scale RES market development as well as the development of less mature RES technologies and the participation of small and medium scale RES electricity producers.

2. The main challenge with FIT has been the definition of remuneration levels which are neither too low to be attractive for investments, neither too high in order to avoid overcompensation (“windfall profits”) and a market development that leads to the escalation of costs of the RE support scheme or to technical problems with the electricity system. Therefore, a good knowledge and monitoring of the actual costs of RE projects is required. In many cases, FIT have not been set at the right levels due to the problem of information asymmetry between the public and private sector as well as political influence during the FIT determination.

3. FIT schemes without degression have proven to have a rather slow reaction time to rapid changes in RE costs (e.g. the cost reductions of photovoltaic systems during the past few years). Even if there is a degression mechanism, the degression might be set at a level that does not reflect the actual development of RE costs. FIT also do not provide any incentive for RE operators to respond to

price signals of the electricity market. Therefore, FIT schemes do not allow for an effective market integration of RE.

4. Feed-in tariffs have proven to be very effective in stimulating rapid and large-scale development of RES. Feed-in tariffs (FIT) and feed-in premiums (FIP) remain the most widely adopted renewable power generation policy employed at the national and state/provincial levels. As of early 2014, 73 countries and 28 states/provinces had adopted some form of FIT/FIP policy (REN 21 Renewables 2014 Global Status Report). This has been mainly attributed to the high investment security that long-term guaranteed FIT is providing.

5. Papua New Guinea could start with a relatively simple design, such as a technology-specific FiT that is based on power generation costs. Thereby, over certain time period, harness with technological advancement and in consideration of the economies of scale, more sophisticated design options could be added

9.7.5 ENBEDDED GENERATION

1. The concept of Embedded Generation in the transmission of renewable energy leads to the idea of exploiting all possible renewable resources at a particular site i.e. the build environment, in an attempt to meet the demand load. They consists of two generating components, Active and Passive renewables.

2. Active renewables involves the direct conversion of renewable energy to electricity or heat i.e. wind turbines, photovoltaics, hydroelectric, geothermal, etc.

3. Passive systems on the other hand is the *second-hand* energy, obtained from waste heat off of PV cells, daylighting or generally, energy obtained through any indirect means.

4. Some of the advantages of Embedded Generation include:

   (a) ***Reduction in Transmission Losses.***

   Transmission of electricity over distances can incur transmission losses in the range of 5-7%. This figure includes losses from the transmission lines as well

as substations and the associated electrical components. This is seen as a savings when the distance of transmission is reduced in embedded generation

(b) ***Reduction in Construction Cost.***

When the transmission distances are reduced, the construction cost of Substation, Transmission Towers and Right of Way would also be reduced or eliminated altogether. Especially in city centres where transmission is achieved through underground cables, there could be substantial savings involved as the cost of these cables can be 10 -20 times that of overhead lines.

(c) ***Environmental Concerns.***

The environmental benefits associated with embedded generation are related to the reduced construction in long distance transmission (substation buildings and transmission towers) as they involve the clearing of land and trees.

Also a benefit of embedded generation is the Corona Effect which is associated with overhead transmission lines. This involves noise disturbance and transmission interference to the surrounding population.

(d) ***Avoid Supplying Excessive Amounts of Electricity to the Grid.***

The national electricity grid is saturated with supplies from existing power generators and by adding in extra amounts of electricity from renewable sources, this would only be wasted in the form of heat. It would be better if this generated electricity is used to satisfy a demand load as in an embedded generation scheme and the total energy consumption is reduced at the point of demand.

(e) ***Stability and Reliability.***

The issue of stability and reliability of supply from the power electronics point of view can be improved in an embedded generation scheme as opposed to the supply of electricity over long distance. This is attained through shorter response time and better controls over the embedded systems.

(f) ***Supply and Demand Matching.***

The ability to design the supply to match the demand as in an embedded generation scheme, again, would reduce unnecessary wastage as the demand profile is better defined for a smaller load than it is for supplying a whole region or country via the grid.

5. Embedded generation offers an excellent option for the transmission of energy at the local level and coupled with the growing interest/research in renewable energy within the build environment, it would make a good combination in the way energy is generated and transmitted in the future.

10 ENERGY EFFICIENCY AND CONSERVATION

10.1 BACKGROUND

1. Energy efficiency and conservation refers to measures aimed at reducing energy consumption without sacrificing productivity or increasing costs. Energy efficiency and conservation measures have the potential to scale down capital investments needed to provide additional supplies and reduce overall resource use. It also has the potential of reducing cost of production at the end user level.

2. Energy efficiency and conservation reduces energy demand, improves energy security, improves competitiveness and helps to mitigate climate change by lowering GHG emissions.

3. A number of factors have highlighted the importance of, and urgency for, energy efficiency and conservation:
   (a) High energy prices – the continuing increase in the price of energy has significantly contributed to increased interest in energy efficiency and conservation.
   (b) Insecurity of supply – expressed in the growing discomfort about the vulnerability and uncertainty of future energy supplies as well as the volatility of their prices.
   (c) Adverse environmental and health impacts – there is increasing concern about spiralling degradation of the environment as exemplified by increased local air pollution and acid precipitation from ever growing fossil fuel combustion. Associated with this are global issues such as climate change as a result of GHG emissions.
   (d) Depletion of energy resources – there is growing unease at the rate of depletion of major energy resources. The most used energy resources such as fuel wood and fossil fuels are becoming scarce as demand rises.

4. From the consumer's point of view, energy efficiency and conservation measures yield direct savings on the energy bill. From the national stand point, adoption of such measures would significantly reduce the foreign exchange costs of oil imports. It would also serve to defer additional investment in power generation capacity. Ultimately, improved energy efficiency would boost the competitiveness of Papua New Guinean products owing to reduced input costs.

10.2 CHALLENGES

1. Inadequate awareness of the potential benefits from efficient use and utilization of energy efficiency and conservation practices, technology and appliances.

2. Consumer apathy. There is a tendency for consumers not to embrace energy efficiency and conservation best practices as long as there is good supply of energy for current use.

3. Limited use of available conservation tools / new technology with increased efficiency leads to energy wastage.

4. High technical losses in the generation, transmission and distribution systems.

5. Limited technical capacity, training and expertise in energy management and conservation.

6. Lack of comprehensive, reliable energy audit data and information covering various sectors and sub-sectors.

7. Slow adoption of conservation opportunities and measures due to socio-economic factors.

8. Inadequate financing owing to challenges in sourcing funds and credit mobilization for energy efficiency and conservation projects are impediments to investment in this area.

9. Insufficient standardized equipment and appliances that would benefit from tax rebates and fiscal incentives.

10. Low awareness of existing fiscal, legal, regulatory incentives, frameworks and mechanisms such as tax holidays, generation plant and equipment tax rebates, emerging credit facilities such as green energy facility grants and loans and carbon credit from the Clean Development Mechanism (CDM).

11. High cost of optimisation technologies in energy development and consumption.

10.3 STRATEGIES– ENERGY EFFICIENCY AND CONSERVATION

1. The Government shall do necessary amendments to legislations governing fuel use, environment, and transport and building to regulate energy use and vests it in the Energy Efficiency and Conservation Authority (EECA).

2. The Government shall formulate an EECA Policy as a matter of urgency and align it with this Energy Policy.

3. The Government to setup an Energy Efficiency and Conservation EECA Program.

4. Recognize energy efficiency and conservation as a high-priority energy resource.

5. Promote energy efficiency and conservation initiatives in all sectors including schools.

6. Enhance the provision of energy audits and advisory services in the provinces.

7. Promote the establishment of laboratories for energy efficiency testing.

8. Disseminate information on energy efficiency and conservation to consumers.

9. Provide for incentives and penalties to reduce high losses in generation, transmission and distribution systems.

10. Provide appropriate fiscal and other incentives to enhance uptake of energy optimisation technologies.

11. Review energy intensity in all sectors and international best practices so as to enable process improvement.

12. Broaden the scope of energy efficiency and conservation efforts by government agencies responsible for environment and energy matters.

13. Introduce the concept of green design in buildings. This includes solar water heating, natural lighting, ventilation, and open office design among others.

14. Promote development of standards and codes of practice on energy efficiency and conservation.

15. Develop and enforce standards for fuel economy through speed limits, efficiency of motor vehicle engines as well as adopting good driving and maintenance practices.

16. Promote mass transportation of passengers and cargo so as to encourage economies of scale and the attendant fuel efficiency.

17. Promote the introduction of new and efficient technologies such as hybrid engines, compressed natural gas (CNG), liquefied petroleum gas (LPG), fuel cell and electric vehicles through demonstration, research and training.

18. Prepare a National Energy Efficiency and Conservation Plan in consultation with relevant stakeholders.

19. Promote efficiency in oil refining in line with modern practices which minimize wastage and encourage heat recovery.

20. Promote efficiency and improvement in conservation, generation, transmission distribution and consumption of energy including incentives to encourage assembly and manufacture of energy efficient equipment.

21. Promote research and development in the field of energy efficiency and conservation.

22. Support preparation of education curriculum on efficient use of energy and its conservation for education institutions and coordinate with them for inclusion of such curriculum in the syllabus.

23. Implement international co-operation programmes relating to efficient use of energy and its conservation.

24. Provide financial incentives for any investment made to replace or additional capital investment to improve energy efficiency.

11 LAND, ENVIRONMENT, HEALTH AND SAFETY

11.1 BACKGROUND

1. Land is a critical resource in the development of energy infrastructure. However, due to competing interest in land utilization, the sector faces challenges in developing its infrastructure.

2. Environmental Management in the energy sector is key to ensuring sustainability in the energy chain. Energy production, transportation and use pose various dangers to human life and the environment. The challenge for players in energy sector is the provision of affordable, competitive, reliable and sustainable energy whilst upholding people's rights to land, environment, health and safety.

3. The Environmental Act 2000 (EA 2000) is the umbrella legal framework in respect to environmental management in Papua New Guinea. Its implementing agency is the – Conservation and Environmental Protection Authority (CEPA). It recognizes a "Lead Agency" as any Government institution in which any law vests functions of control or management of any element of the environment or natural resource. Lead Agencies therefore play an important role in enforcing compliance with laws and regulations.

4. Environmental Impact Assessment Regulations require that mitigating measures be put in place to minimize the adverse impact of energy projects. Comprehensive environmental impact assessments are conducted for all projects prior to their implementation to ascertain the level of potential environmental damage, the required mitigation measures and associated costs.

5. Other authorities that have regulatory mandate in the energy sector in terms of environment, health and safety under the auspices of the Occupational Health and Safety Services (OHSS) under the National Health Administration Act 1997, Public Health Act 1973 and thus the Industrial Safety, Health and Welfare Regulation of 1965, and the Water PNG Limited respectively under the Water Resource Act of 1982, National Water Supply & Sewerage Act 1986 and the National Maritime Safety Authority (NMSA) under the Merchant Shipping Act 1975 and Merchant Shipping (Safety) Regulations of 1975.

6. Vision 2050 acknowledges that land is a vital factor of production in the economy together with its aesthetic, cultural and traditional values. Some key

initiatives envisioned to address environmental problems which relate to the energy sector are:

(a) Sustainable management of natural resources.
(b) Pollution and waste management.
(c) Disaster risk management.
(d) Use of incentives for environmental compliance.

7. The National Constitution of Papua New Guinea under Section 53 offers protection of right to property in which citizens are protected from unjust deprivation of their properties. Energy sector players, to whom land access and utilization is critical in their operations, must be alive to this fact. In addition, Section 61 provides basic rights and freedom whereby every person have a right to a clean and healthy environment, thus the Constitution also declares that sustainable development among the values and principles of governance which bind all State organs, officials and any person implementing public policy.

8. The trans-boundary impact of environmental pollutants has necessitated international cooperation in order to prevent, minimize and mitigate pollution. A substantial portion of the risks arise from operations in the energy sector, amongst them transportation of petroleum products, disposal of hazardous waste, handling and management of radioactive materials. Several multilateral environmental agreements/treaties have been developed globally with Papua New Guinea ratifying and domesticating a number of them. The Constitution provides that any treaty or convention ratified by Papua New Guinea forms part of the laws of Papua New Guinea. It is necessary to develop guidelines to ensure the application and compliance of the relevant conventions in the energy sector.

11.2 ENERGY SUPPLY SIDE ENVIRONMENTAL CONCERNS

11.2.1 FOSSIL FUELS

11.2.1.1 EXPLORATION AND PRODUCTION

1. Exploration and production activities can have negative environmental impacts and therefore should be conducted in a way that protects the environment. Offshore and onshore exploration effects can be minimized by limiting the exploration duration and activities as well as employing newer technologies.

11.2.1.2 PETROLEUM

1. Major environment, health and safety concerns in the petroleum industry are fire outbreaks and oil spills. In other countries, incidences has occurred, which a number of incidents involving petroleum products has led to loss of life and property. However, Papua New Guinea can such accidents addressed through adoption of international best practices in handling safety concerns in the sub-sector and ensuring strict compliance and enforcement of the regulations.

2. Personnel handling petroleum products are exposed to the risks associated with inhalation of product fumes and dermal contact. These concerns can be addressed through use of high standard equipment and repeated use of personal protective equipment.

11.2.1.3 COAL

1. Concerns in the coal industry as experienced by coal-producing countries include emissions which contribute to global warming and acid rain. However, if Papua New Guinea harness and develop it, modern technologies, such as, among them the Clean Coal Technology (CCT) can be applied to reduce pollution significantly.

2. Clean coal energy can be harnessed chemically without combustion with air by capturing 99% of Carbon Dioxide (CO2).

11.2.1.4 RENEWABLE ENERGY

1. Generally, renewable energy is considered as an environmentally friendly option for energy development. However, some concerns exist raising the need for mitigation measures to be incorporated in projects to ensure minimal impact and also ensure sustainability.

11.2.1.5 GEOTHERMAL

1. Geothermal power generation involves drawing fluids at high temperature from deep in the earth. These fluids carry a mixture of gases which contribute to global warming, acid rain, and noxious smells if released.

2. To mitigate these, the plants are equipped with emission control systems to reduce the exhaust. In addition, the practice of re-injecting these fluids into the earth in order to stimulate production helps to reduce the environmental risk. Other mitigation measures include extraction of excess materials for industrial use.

11.2.1.6 LARGE HYDRO

1. The major concern for hydros is the displacement of people and wildlife where a reservoir is located. Large reservoirs result in submersion of extensive areas upstream, destroying ecologically rich and productive land, riverine valley forests, marshlands and grasslands.

2. Dams also have an impact on aquatic ecosystems both upstream and downstream by disrupting the reproductive cycle, e.g., fish whose spawning grounds are normally upstream. Submerged vegetation - decomposes anaerobically producing methane, a potent greenhouse gas. Other risks of hydros include dam failure which may be caused by sabotage, or structural failures, and siltation. Appropriate mitigation measures should be adopted to counter these and other potential negative effects.

11.2.1.7 BIOMASS

1. A supply-demand imbalance in the use of biomass has negative environmental impact in the form of deforestation such as those experienced by other biomass-producing countries. It has been established that charcoal production leads to the depletion of woodlands at the rate of 0.5 hectare per annum, however, Papua New Guinea will adopt appropriate mechanism to avoid such imbalance occurring when its biomass industry fully integrates and is in operation. This is mainly because of the inefficient charcoal kilns used. In addition, the cost of the raw material (e.g. tree replacement) is generally not considered and the wood is regarded as a free good.

11.2.1.8 ELECTRICITY

1. The construction and operation of electricity projects have a direct impact on the quality of the environment either by the emission or discharge of pollutants, poor waste handling, or by changing the ecological systems. The degree of pollution and other ecological impacts are dependent upon the nature of the technology in use as well as the size and the general location of the plant.

2. A health and safety concern with electricity grid systems and consumer installations is the danger of electrocution and electric shocks.

11.2.1.9 NUCLEAR ENERGY

1. The global, traditional challenge of nuclear energy remains the management of radioactive waste. However, as a result of continued research in the area, radioactive waste management is now well within manageable levels. Spent fuel rods can either be safely stored until the radioactive levels reduce to non-toxic levels or be reprocessed and reused in generation of nuclear energy. The waste also requires special handling and storage facilities to reduce the risk of exposure to employees, the public and the environment.

2. A nuclear meltdown may cause release of radioactive materials which can have a negative impact to environment, health and safety of persons. However, further research has led to development of advanced reactors with enhanced security and safety mechanisms that greatly diminish the possibility of a nuclear accident.

11.3 DEMAND SIDE ENVIRONMENTAL CONCERNS

1. Solid fuels or biomass fuels are less efficient than oil, natural gas or propane. It takes larger quantities of peat, wood, or coal to do the job and they will produce larger quantities of smoke when they are burned. Solid fuels produce less heat for the amount of fuel consumed and produce more pollution. This is described as the energy ladder.

2. The solid fuels lead to increased indoor air pollution which leads to Upper Respiratory Tract Infections (URTI). The challenge is to move consumers up the energy ladder recognizing that biomass, which is at the bottom of energy ladder provides 60% of cooking energy needs in Papua New Guinea.

3. Kerosene is widely used in households for lighting and cooking, mainly by rural masses in Papua New Guinea. In 2008 about 300 thousand cubic metres were used, up from 200 thousand cubic metres consumed in 2003 according to the UN Human Development Indictor. However, this causes indoor air pollution leading to cases of URTI, in addition to the risk of explosions of lamps and stoves leading to injuries, loss of lives and property.

There is need to move consumers from the consumption of kerosene to LPG and natural gas.

11.4 CLIMATE CHANGE ISSUES

1. Papua New Guinea is a signatory of the Kyoto Protocol, a treaty signed in 1997, to lower anthropogenic emissions of Carbon Dioxide (CO2). However, Papua New Guinea is not among the Annex I countries, which have emission reduction targets since its emissions are low - compared to emissions from developed (Annex I) countries and MDCs and LDCs. However, under the protocol, there are opportunities to benefit by selling Certified Emission Reductions (CERs) through the Clean Development Mechanism (CDM). Papua New Guinea has developed a National Strategy on Climate Change.

2. Although Papua New Guinea has ratified the Kyoto Protocol, it has not benefited much from the CDM since potential projects may have not been approved, developed or fully made operational, though, the projects proposals may have been submitted for consideration under CDM.

3. With such results of whether, there are investments and or not being proposed, approved and developed, on a scale of between 100 points (highest) and 0 points (lowest) Papua New Guinea is rated to have an 'inadequate' climate for CDM investment. It however needs to move from 'Satisfactory' to 'Good' categories to improve opportunities to attract investments.

11.5 DISASTER PREPAREDNESS AND MITIGATION

1. Natural disasters may be triggered by adverse weather and climate conditions, whereas manmade disasters may be due to sabotage, human error or technological failure. Government therefore recognizes the need to establish appropriate disaster preparedness and mitigation mechanism within the energy sector.

2. The following hazards are a constant threat that must be taken into consideration in planning and management of the energy sector:
    (a) Climate and weather hazards including floods and droughts.
    (b) Geophysical hazards including earthquakes, faults, volcanic eruptions, subsidence, landslides, blowouts and mud flows.
    (c) Environmental hazards including soil erosion, siltation and desertification.

(d) Industrial accidents, oil spills, human negligence, sabotage can occur through terrorism and other deliberate acts and infrastructural systems failure.

3. The challenges are mainly in setting up and making operational capacity for disaster preparedness, management and mitigation. However, this can be addressed through proper disaster preparedness and management mechanisms and practices.

11.6 LAND AND SOCIO-ECONOMIC IMPACTS

11.6.1 BACKGROUND

1. Energy development projects have various impacts on communities where the projects are implemented. Key among these is both economic and physical displacement. Physical displacement of project affected people is particularly prevalent in projects such as hydro power plants requiring water reservoirs, acquisition of way leaves during construction of transmission lines and pipelines. Others include the concern by local communities that they will not benefit from these projects.

11.6.2 CHALLENGES

1. **Absence of a Resettlement Action Plan (RAP) Framework:** Currently, all projects receiving support by World Bank or IFC are required to develop RAPs. These should be replicated for all projects and a national framework developed. The State shall develop Resettlement Plan Framework for all hydro projects that causes shifting and relocation of settlements.

2. **Access to and acquisition of land:** Difficulty in the acquisition of sites, way leaves, rights of way and easements to facilitate energy infrastructure development is an impediment to fast tracking the improvement and upgrading of the energy systems. Further, legal and regulatory provisions in the energy sector governing land acquisition and access are inadequate. The State shall pursue all avenues to secure land through outright purchase or long term lease from the landowner for purposes related to the projects including right of way and establishment of infrastructures of the hydro projects.

3. **Absence of a comprehensive and fair compensation mechanism** for local communities in line with the national constitution. The State shall promote equity and benefits sharing with the State, the Developers and the landowners.

4. **Vandalism of energy sector infrastructure** continues to cause immense losses as well as supply interruptions.

5. The **need to enhance regional, gender and environmental considerations** in energy planning and development. The State shall promote equal gender participation across all age group and the vulnerable communities.

6. **Land access and permit** where exploration blocks fall on private land or cultural heritage areas including game parks and reserves. The developer shall take all necessary precaution to minimise collateral damage to neighbouring property including all reserves area in the cause of its operation. The State shall promote good stewardship and protection of reserved areas and exercising environment rehabilitation and restoration measures.

7. The State shall ensure the right way and access thereof, and all natural corridor to be kept open at all times.

11.7 STRATEGIES– LAND, ENVIRONMENT, HEALTH AND SAFETY

11.7.1 LAND AND SOCIO-ECONOMIC ISSUES

1. Align all energy projects with the National Land Policy, which provides a framework for access to planning and administration of land in the country. The National Land Commission and the Land Titles Commission is to ensure that planning for utility services and public private infrastructure under Land Act 1996 and Physical Planning Act 1989 for State Leases and Land Titles Commission Act 1962 and Land Group Incorporation Act 1974 respectively on customary land, includes planning for energy utility services namely way-leaves, infrastructure development, transmission, distribution and pipeline corridors.

2. Make provision for waivers in respect to any charges for utilization of resources owned by other public bodies critical to the development of energy infrastructure and service provision such as way-leaves, easements and

rights of way. Any compensation for interest in land under the Land Act 1996, Land Group Incorporation Act 1974 and Section 54 of the Constitution shall be at market rate as determined by a registered Land Valuer, where there is no dispute. The Government shall initiate compensation within a reasonable period. However, where there is a dispute, the Government Valuer(s) shall provide opinion to ensure uniformity and fairness.

3. National Government to determine rates payable for compensation in respect of damage caused by the energy sector players including clearing way leaves among others.

4. Seek for amendment/repeal of any legislation that impact negatively on the energy sector.

5. Make provision to allow the right of access to survey and use of land for energy infrastructure development purposes including but not limited to prospecting for petroleum, gas and coal, storage, transmission, laying of petroleum pipelines and electricity supply infrastructure, dams and geothermal development to its

6. Provide that where energy infrastructure and ancillary apparatus are removed, the surface of the land shall forthwith be restored to its former condition as far as possible and in default thereof, the owner of the land may carry out the restoration, and the costs thereof shall be recoverable from the licensee.

7. Empower communities and landowners to manage the infrastructure including provision of security and participate in any spinoff benefits. Details of this is captured under the chapter on indigenous participation.

11.7.1.1 STRATEGIES-LAND AND SOCIO-ECONOMIC ISSUES

1. Provide for in legislation the following;

   (a) Provide for restoring, repairing damage or making good loss caused by a licensee's operations in respect to laying of energy infrastructure or extraction of energy resources in accordance with the Constitution and other legislations covering the regulatory aspects of developments.

   (b) The National Executive Council (NEC) may gazette or de-gazette all land held by public entities for energy infrastructure.

(c) A licensee may erect, install, break up or lay energy infrastructure and ancillary apparatus upon, under, over or across any public streets, road, railways, tramways, rivers, canals, harbours, game parks, water ways, forests or Government property, in the manner and on the conditions as will be provided from time to time. A licensee may repair, alter or remove any such infrastructure and ancillary apparatus so erected, laid or constructed, provided that the person having the control of such street shall have a prior right to break up and repair such street with reasonable dispatch upon payment to him of a reasonable charge by the licensee.

(d) Where a licensee faces constraint in accessing any natural resource including land and water for development of energy infrastructure, the licensee may prevail upon the national government to access the State own resources or to mediate access to traditional landowners resources or access portions of existing water bodies for such purposes.

(e) Whenever a licensee carries out any work authorized his licence or permit, he shall comply with the regulations of the Provincial Governments concerned and shall complete that work within reasonable time and reinstate the street broken up and remove any debris or rubbish occasioned thereby and shall, while the street is broken up or obstructed, cause the works to be, at all times, fenced and guarded and during the night, adequately lit.

(f) Where a public institution in the energy sector requires the compulsory acquisition of land for use, the institution may apply to the NEC to acquire the land on its behalf.

(g) Provide for the right in cases of emergency to clear obstructions to infrastructure installations by any licensee in the energy sector. Where necessary, the entity can obtain an order from the National Energy Arbitration Tribunal (NEAT) under the auspices of the NEA, thus allowing for access to the area.

2. Provincial Governments shall set aside suitable land for energy infrastructure development purposes, including but not limited to projects recommended in the indicative National Energy plans.

3. Provide for the following offenses:

   (a) Illegal acquisition of interest in public land set aside for energy infrastructure projects through encroachment or grabbing and include punitive penalties for either offence;
   (b) Trespass on or encroachment of energy installations, infrastructure and way-leaves, way-leaves trace
   (c) Infringement in respect of blasting, quarrying, dumping of materials, structures erection and any other activity that compromise distribution services.
   (d) Develop a Resettlement Action Plan (RAP) Framework for energy related projects; including livelihood restoration in the event of physical displacement of communities not in compliance thereof.
   (e) Provide for access to land where exploration blocks fall on private land, community land and cultural heritage areas including game parks and reserves.
   (f) Full acquisition of all project sites and way leaves to prevent occupation and potential disaster including relocation of existing occupants to prevent encroachment.

11.7.2 ENVIRONMENT HEALTH AND SAFETY

11.7.2.1 STRATEGIES-ENVIRONMENT, HEALTH AND SAFETY

1. Provide a procedure for enforcement of environmental rights under Environment Act 2000 and specifically provide for notification of breach and giving time to remedy the breach.

2. Provide a mechanism for management of oil spills including clean-up and penalties in consultation with other statutory authorities.

3. Promote sustainable development as provided for under National Goals & Directive Principles (NGDP) of the Constitution be incorporated in the Proposed Energy Bill.

4. Develop and implement Environmental Impact Assessment (EIAs) and other guidelines for the energy sector. Monitor their implementation through Environmental Management Plans (EMP).

5. Facilitate the development of standards for equipment, products, protective equipment, facilities and operating practices in the energy sector to ensure safe operations. Where there are no local standards, international standards shall apply.

6. Provide for measures which act as a catalyst for consumers to move up the energy ladder including fiscal incentives on LPG appliances, construction of import handling facilities for LPG, and introduction of cleaner fuels and technologies.

7. Develop guidelines to ensure the application and compliance of relevant conventions in the Energy Sector.

8. Enhance sectoral, regional, gender and environmental considerations in energy planning and development.

9. Strengthen ERC's capacity to provide leadership and enforce environmental health and safety requirements, environmental disaster risk management and response in the energy sector in consultation with other statutory authorities.

10. Enhance and strictly enforce penalties for vandalism of energy sector infrastructure, equipment and materials.

11. Establish a competent data monitoring, processing and management facility within an institution for all data and information relating to water and environment.

11.7.3 CLIMATE CHANGE MITIGATION

11.7.3.1 STRATEGIES-CLIMATE CHANGE MITIGATION

1. Support the development of the national position on climate change and participation in international climate change negotiations to improve the investment climate for CDM projects.

2. Collaborate with other stakeholders on climate change on energy issues to address the challenges.

11.8 SECTOR SPECIFIC EHS STRATEGIES

11.8.1 ELECTRICITY

11.8.1.1 STRATEGIES-ELECTRICITY SECTOR EHS CONCERNS

1. Put in place mechanisms to mitigate negative effects of generation transmission and distribution of electricity.

2. Introduce proper public walkways in metropolitan areas and encourage the use of bicycles, motorcycle, scooters and other energy efficient transport systems and designs.

11.8.2 FOSSIL FUELS

11.8.2.1 STRATEGIES-ENVIRONMENT, FOSSIL FUELS EHS CONCERNS

1. Carry out rapid urban air quality assessments on energy sector emissions and identify key problem sectors/areas that need to be prioritized in tackling air pollution by energy sector emissions.

2. Develop strategies to reduce transport emission, including:
   (a) Adoption of low sulphur fuels and clean vehicles programs within the timelines agreed by Ministers at the Better Air Quality Regional Policies and Strategies Fossil Fuels EHS Concerns.
   (b) Setting up and or revamping vehicle emission inspection and maintenance programs for existing vehicle fleets.

3. Continuously update and enforce the specifications standards for supply of clean fuels.

4. Ensure that all energy generation plants adhere to emission standards and further employ more efficient technologies. The Government shall ensure dissemination of standards, provide public sensitization on dangers of vehicle emissions and promote choice towards clean fuels and vehicles, public transport and non-motorized transport.

5. Provide incentives for acquisition of fuel efficient technologies in motor vehicles.

6. The Government to develop and promote alternate energy source in households as a means for elimination of kerosene in households by 2030.

11.8.3 RENEWABLE ENERGY

11.8.3.1 STRATEGIES- NUCLEAR ELECTRICITY EHS CONCERNS

1. Actively support and promote the uptake of renewable energy technologies.

2. Ensure sustainable production and use of wood fuel resources.

3. The Government shall ensure promotion of modern production technologies, introduce a regulatory framework for wood fuel and support commercial woodlots.

4. The Government shall support the national tree cover policy aimed at increasing the national tree cover to 10% and above.

5. Promote the development, commercialization and widespread utilization of renewable energy technologies. In addition, the price of charcoal and wood should also reflect the cost of replenishing raw materials.

6. Ensure compliance with international standards for plant siting construction operation and decommissioning and waste management to ensure proactive preventive approach to managing the environment health and safety risks.

11.8.4 CONSERVATION OF CATCHMENT AREAS

11.8.4.1 STRATEGIES-CONSERVATION OF CATCHMENT AREAS

1. Support conservation initiatives and ensure proper coordination of all relevant statutory authorities.

2. Ensure effective management of the catchment areas to safeguard both the installed capacity and potential power generation sites.

3. Identify and map out water catchment areas boundaries and gazette them as protected areas.

4. Support hydro power generators in catchment area conservation initiatives through both fiscal and other mechanisms.

5. The Government shall declare hydro dams and reservoirs as controlled catchments. By this provision all activities in the catchment are regulated.

6. Empower the institution that administers controlled catchment regulating to prosecute personnel or agencies that contravene the controlled catchment provisions.

7. The Government shall make it mandatory that Cumulative Impact Assessment be undertaken by developers of small hydros to minimise and mitigate destruction to catchment areas.

11.8.5 DISASTER PREVENTION AND MANAGEMENT

11.8.5.1 STRATEGIES-DISASTER PREVENTION AND MANAGEMENT

1. Strengthen existing emergency institutions to specifically deal with Energy disasters.

2. Using climate, weather information and data, the maximization of safety factor for hydro dams, power stations, geothermal power stations, fuel oils depots, and petroleum production areas should be taken on board in all future developments. This is especially so in areas with high risk and/or high hazard rating.

3. Mainstreaming weather, climate and environment data and information particularly hydrology to the sector's core activities.

4. Develop mechanisms for provision of security for all energy installations including weather, climate and environment monitoring installations, which shall be treated as national protected zones.

5. The sector will develop information and database on weather, climate and hydrological factors at national level and at specific site levels.

6. The following broad policy measures will be undertaken by all the energy sector entities:
   (a) Incorporation of disaster preparedness and mitigation into energy policy and management planning.
   (b) Establishment of early warning systems in all energy production and delivery systems and networks.

7. Develop mechanism for provision of security for all energy installations, which shall be treated as national protected zones.

8. The following strategies will be used for risk reduction and adoption:
   (a) **Information Base**: The sector will develop information and a database on weather and climate factors at national level and at specific site levels. Specific sites here refer to sites that continually understudy the interaction between weather and climate on the system and other stress monitors that relay vulnerability. One important factor here is accuracy of information and reliability.
   (b) **Risk zoning**: Zoning and mapping helps to enhance of evaluation risk and vulnerability. Risk mapping shall be a continuous exercise updating risk assessment results in the maps and subsequent zoning.
   (c) **Disaster response plans**: Using the information on climate and weather and risk prone points of a system, detailed disaster response plans will mitigate vulnerability. The plans shall include rapid reaction activity plans and initial attack or emergency steps.
   (d) **Disaster plans and costing centres**: Update to date disaster management plans are key in reducing risk and vulnerability.

9. Promote the concept of resilience: that is the ability at every relevant level to detect, prevent, and, if necessary, to handle disruptive challenges while minimizing damage to humans, infrastructure and the environment.

12 PROPOSED INSTITUTIONAL ARRANGEMENTS

12.1 OVERVIEW

1. Since PNG achieved its Independence in 1975 a coherent National Energy Policy was either non-existent or was in a fragmented form. The National Energy Policy was eventually has workshopped in March 2006, this followed on from an AusAid funded technical assistance (TA) facility called AusAid Advisory Service Facility (ASF) II and was part of the GoPNG ongoing Public Sector Reform in September 2003.

2. Despite several such reviews in the past by various organizations such as AusAid, (2006) Secretariat of The Pacific Community (SPC) in 2009, and DPE in 2006 very little progress occurred. The aim of the National Energy Policy was to merge all aspects of energy planning and delivery in a rationale and coordinated manner. The long term objective now is to establish an overarching National Energy Policy with and Energy Plan in order to deliver the Governments aspirations on national development. This will consistent with the MDG, the DSP 2010 to 2030, and Vision 2050.

3. While the SPC study reviewed the PNGs Energy Security, the ASFII reviewed the following objectives:
    a. to Evaluate and review current energy policies with the view to identifying issues and priorities associated with policy development and implementation;
    b. to Evaluate Capacity building including the establishment of an overall mission statement for the Energy Division in the Department of Petroleum and Energy;
    c. Assessment of specific short, medium and long-term objectives of Energy Division,
    d. Develop indicative strategies and draw up a Twenty-year work plan for policy review, development and implementation support ; and
    e. Review several policy issues relating to midstream and downstream petroleum processing of the Energy Division.

4. The Division of Energy had also gone through three (3) decades of transition and transformation to what is now the Energy Wing of the Department of Petroleum and Energy. It was established in 1992 as Department of Energy Development with the following mandate;

a. Promote a nation-wide program of rural electrification through improvement of existing rural electrification facilities as well as implementation of our projects using environmentally sound energy conversion technologies.

5. The Department of Energy Development (DED) however, was abolished in 1995 and transformed into an Office of Energy Development within Department of Mining and Petroleum (DMP). When the Department of Petroleum and Energy was established after the abolishment of the Department of Mining and Petroleum in August 1997, the Office of Energy Development was renamed as Division of Energy but retained most of its function of 1992 with additional functional responsibilities such as the formulation and implementation of the National Energy Policy as well as promotion of non-fossil and renewable energy.

6. Following the National Executive Council (NEC) Decision No. NG 141 of 2011 endorsement of the Electricity Industry Policy (EIP) these led to the establishment of Energy Wing, which was then mandated to undertake the technical regulatory functions of the electricity industry in the country. This will require the establishment of four (4) Regional office located in Port Moresby (Southern Region), Lae (Momase), Mt. Hagen (Highlands Region), and Kokopo (NGI Region). This will enable the transfer of the technical regulatory functions of PPL to DPE Energy Wing, with consultations from the Independent Consumer Competition Commission (ICCC). Furthermore the Energy wing has been directed to formulate and implement the National Electrification Rollout Plan (NEROP) for the country in an endeavours to meet the 70 percent electrification access by households by year 2030 under the Development Strategic Plan (DSP) and Vision 2050.

7. Several additional responsibilities of the Energy Wing are as follows :

a. Monitor, review and provide recommendations on fuel pricing, electricity tariffs , and Government charges and subsidies, in order to ensure that the full and correct prices signals are conveyed to consumers when convenient ; and

b. so as to negotiate and Develop and maintain the capacity to monitor and evaluate the equivalent landed price of petroleum products, the petroleum company costs elements, the pricing formula, and Government charges so as to negotiate and maintain equitable pricing and proper contractual arrangements for petroleum products.

8. These therefore indicate and highlight the fact that the Energy Wing's responsibilities covers both midstream to downstream aspects of petroleum production, supply and consumption to PNG.

12.2 PROPOSED INSTITUTIONS

1. The institutional arrangements of the energy sector will be streamlined to encourage efficiency, access and affordability. The energy regulatory functions both technical as well as economic will be brought under the proposed National Energy Authority of PNG.

2. Note: NEC Decision 145 of 2013 of 3rd of May directed the abolishment of the Department of Petroleum & Energy and creation of the Petroleum & Energy Authority not implemented).

3. To meet the challenges and demand, and scope of these functional responsibilities involving the hydrocarbon industry and other cross-sectoral areas, and energy sectors such as electricity, the Department of Petroleum & Energy must be re-structured in order to build institutional capacity to manage the midstream to downstream activities of the Petroleum sector, as part of the overall Natural Energy Policy and Rural Electrification.

4. The Department of Petroleum and Energy will be restructured into the following entities:
    a. National Energy Authority of PNG (NEA)
    b. Petroleum Resources Authority (PRA).
    c. Energy Regulatory Commission (ENERCOM).

5. The structure of these institutions are provided as an attachment.

12.3 FUNCTIONS

	Institutions	Core functions
1.	National Energy Authority (NEA)	**Mandate:** To regulate and promote the development, dissemination of information, regulation and licensing, relating to all forms of energy, including renewable energy sources; and to do all things necessary and desirable for the achievement of its objectives and functions. **Purpose:** NEA will be the over-arching body responsible for all energy related matters, so far as it involves the development, conversion and transportation of energy for direct uses, and for further downstream processing of the resources. It will also be responsible for encouraging the development of all renewal resources for conversion into consumer and industry uses. It will report to the Minister for Petroleum And Energy. **Function:** i. Develop and implement the National Energy Policy, sub-policies and plans. ii. Maintain register of all players in the energy industry. iii. Promote and encourage R&D into all forms of energy sources, including coal and nuclear energy research. iv. Collect and disseminate data on energy sources and encourage downstream development of the resources. v. Plan and support the rollout of electricity throughout the country, through National Energy Consolidation Funds. vi. Technology researching and prototype tests. vii. Any other things necessary to the achievement of its objective.
2.	Energy Regulatory Commission (ENERCOM)	**Mandate:** To promote a competitive energy industry, enforce safety standards in electricity supply and consumption, setting tariffs, including safety of electrical appliances for consumers, and to do all things necessary and desirable for the achievement of its objectives and functions. **Purpose:** ENERCOM will be created to regulate and issue licenses to players in the Electricity Services Industry, setting tariffs for the electricity enforce electrical standards and compliance, in consultation with the ICCC in so far as consumer electrical goods are concerned. **Function:** i. Registering industry participants. ii. Developing, administering, monitoring and enforcing the Electricity Industry Participation Code. iii. Monitoring compliance with the national electricity law,

		national electricity rules and national electricity regulations. iv. Establishing service standards for transmission and distribution networks. v. Setting tariffs for generation, transmission and distribution. vi. Monitoring the electricity market and jointly promote competitive conduct, including, instituting and conducting enforcement proceedings for breaches of the law. vii. Investigating breaches or possible breaches of provisions of the national electricity law, rules and regulations. viii. Facilitating market performance through information, best-practice guidelines and related services; and ix. Undertaking energy sector reviews. x. Any other things necessary to the achievement of its objective.
3.	Petroleum Resources Authority (PRA)	**Mandate** To promote and regulate the hydrocarbon industry at the upstream and midstream level of the industry, specifically Oil and Gas resources, and to do all things necessary and desirable for the achievement of its objectives and functions. **Purpose** The Petroleum Resources Authority (PRA) will be to maximise the commercial development of the Oil and Gas resources in PNG through licensing and regulatory oversight. **Function:** i. Maintain the resource inventory for the Oil and Gas energy reserves and assets. ii. Identify and maintain a register of all industry players in PNG. iii. Oversee the issuance and enforcement of regulations and licensing. iv. Identify areas and declare reserve zones for energy security and related purposes. v. All other responsibilities it is currently undertaking vi. Any other things necessary to the achievement of its objective. vii. Conduct exploratory work on petroleum blocks, undertake research and into development of the industry's best practises and technology and also for related purpose. It will report to the Minister for Petroleum and Energy. viii. Regulate and issue licenses to players in the non-renewable energy sector.

13 ACRONYMS / GLOSSARY OF TERMS & LEGISLATIONS

i. Organizations (Existing and proposed)

- APEC - Asia Pacific Economic Cooperation
- CEPA - Conservation & Environmental Protection Authority *(formerly Department of Environment & Conservation)*
- COADEVCO - Coal Development Company *(SOE)*
- CONSEF - Consolidated Energy Fund
- DLPP - Department of Lands & Physical Planning
- DMP&GM - Department of Mineral Policy & Geo-Hazards Management
- DNPM - Department of National Planning & Monitoring
- DPE - Department of Public Enterprises
- DP&E - Department of Petroleum & Energy
- EECA - Energy Efficiency & Conservation Authority
- EITI - Extractive Industries Transparency Initiative
- ENERCOM - Energy Regulatory Commission
- GEODEVCO - Geothermal Development Company *(SOE)*
- GoPNG - Government of Papua New Guinea
- IAEA - International Atomic Energy Agency
- ICCC - Independent Consumer & Competition Commission
- IFC - International Finance Corporation
- IPPs - Independent Power Producers
- IPBC - Independent Public Business Corporation
- JICA - Japanese International Cooperation Agency
- KPL - Kumul Power Limited
- MRA - Mineral Resource Authority
- NBPOL - New Britain Palm Oil Limited

- NDOC - National Disaster Operations Centre
- NEA - National Energy Authority of Papua New Guinea
- NEDC - National Energy Data Centre
- NEDRU - National Energy Disaster Response Unit
- NELECTA - National Electrification Authority
- NEPF - National Electrification Program Fund
- NGDP - National Goals & Directive Principles *(PNG Constitution)*
- NISIT - National Institute of Standards & Industrial Technology
- NMSA - National Maritime Safety Authority
- NPCP - National Petroleum Company of Papua New Guinea
- OCCD - Office of Climate Change & Development
- PPL - PNG Power Limited
- PNG EDL - PNG Energy Development Limited
- PNG SDP - PNG Sustainable Development Program Limited
- NEC - National Executive Council
- RERC - Renewable Energy Research Centre
- RERAC - Renewable Energy Resources Advisory Committee
- RPNGC - Royal Papua New Guinea Constabulary
- UNITECH - PNG University of Technology

ii. Others

- BOT - Built Operate & Transfer
- CBM - Coal Bed Methane
- CCGT - Combined Cycle Gas Turbines
- CCfS - Capturing Carbon for Storage
- CCT - Clean Coal Technology
- CERs - Certified Emission Reductions
- CDM - Clean Development Mechanism(s)

- CNG - Compressed Natural Gas
- CO2 - Carbon Dioxide
- 3D - 3Digital
- CSG - Coal Seam Gas
- DGR - Domestic Gas Reservations
- EAS-U - Energy Access Scale-Up
- EBR - Energy Balance Report
- EIA - Environment Impact Assessment
- EMP - Environmental Management Plan
- ERNADOR - Economic Regulation, Negotiated Access & Operational Regulation
- ESI - Electricity Supply Industry
- FTG - Full Tensor Gradiometer
- FID - Final Investment Decision
- FiT - Feed in Tariff
- FLNG - Floating Liquefied Natural Gas
- GDP - Gross Domestic Product
- GHG - Green House Gas
- GtL - Gas to Liquids
- HVDC - Hides Valley Development Corporation
- ICT - Information Communication & Technology
- ISO - Independent System Operator
- JV - Joint Venture
- LNG - Liquefied Natural Gas
- MCC - Mining Code for Coal
- MDC - Mining Development Contract(s)
- MMDC - Model Mining Development Contract(s)
- MW - Megawatts

- NETF - National Electrification Trust Fund
- NEROP - National Energy Roll-Out Plan
- NNGB - North New Guinea Basin
- NW - North West
- OHSS - Occupational Health & Safety
- OIEP - Oil Exploration & Production
- OMC - Oil Marketing Companies
- OPEC - Organization of Petroleum Exporting Countries
- PB - Papua Basin
- PSC - Production Sharing Contracts
- PRoF - Pacific Ring of Fire *(a seismically active zone)*
- PGK - Papua New Guinea Kina
- PNG - Papua New Guinea
- PPA - Power Purchase Agreement
- PPF - Petroleum Processing Facilities
- PPP - Public Private Partnership
- PRAEC - Petroleum Resource Area Economic Corridor
- RAP - Resettlement Action Plan
- RD&D - Research, Development & Dissemination
- REMC - Renewable Energy Mapping Centre
- REP - Rural Electrification Program
- RES-E - Renewable Energy Sources – Generated Electricity
- SE - South East
- SMR’s - Small & Medium Size Reactors
- SOE - State-Owned Enterprise
- SOT - Service Operation Transfer
- SPV - Special Purpose Vehicle

• SPV	-	Solar Photo Voltaic
• SWF	-	Sovereign Wealth Fund
• TPNG	-	Telikom Papua New Guinea Limited
• UNHDI	-	United Nations Human Development Indicator
• URTI	-	Upper Respiratory Tract Infections
• USA	-	United States of America
• USD	-	US Dollars

iii. Constitution

- The National Constitution of Papua New Guinea

iv. Principal Legislations

• CA 1997	-	Companies Act 1997
• EIA 2002	-	Electricity Industry Act 2002
• ESA 2002	-	Essential Services Act 2002
• MA 1992	-	Mining Act 1992
• ICCC Act 2002	-	Independent Consumer & Competition Commission Act 2002

v. Other Legislations

• EA 2000	-	Environment Act 2000
• EC(P)A 2002	-	Electricity Commission (Privatization) Act 2002
• ECR 1966	-	Electricity Commission Regulation 1966
• ES(GPS)A 1970	-	Electricity Supply (Government Power Stations) Act 1970

• ES(GPS)R	-	Electricity Supply (Government Power Stations) Regulation
• GA 1951	-	Goods Act 1951
• GSTA 2003	-	Goods & Services Tax Act 2003
• IPBC Act 2002	-	Independent Public Business Corporation Act 2002
• ITA 1959	-	Income Tax Act 1959
• LA 1998	-	Lands Act 1998
• LGIA 1974	-	Land Group Incorporation Act 1974
• LRA 1998	-	Land Registration Act 1998
• LTCA 1962	-	Land Titles Commission Act 1962
• MDA 1955	-	Mining Development Act 1955
• MRA Act 2005	-	Mineral Resource Authority Act 2005
• MSA 1977	-	Mining (Safety) Act 1977
• NCDC Act 1990	-	National Capital District Act 1990
• NCDC Act 2001	-	National Capital District Act 2001
• NISITA 1993	-	National Institute of Standards & Industrial Technology 1993
OGA 1996	-	Oil & Gas Act 1996
• OLPLLG	-	Organic Law on Provincial & Local Level Government
• PFMA 1995	-	Public Finance (Management) Act 1995
• PSMA 2014	-	Public Service (Management) Act 2014
• PPA 1989	-	Physical Planning Act 1989