SECTOR ASSESSMENT (SUMMARY): ENERGY

Sector Road Map

1. Sector Performance, Problems, and Opportunities

1. In Papua New Guinea (PNG), approximately 12% of the population has access to electricity. Where power is available (generally in the main urban centers), 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 centers, and contributing to poverty in rural areas. There are two main separate power grids—Port Moresby, and the Lae–Madang–Highlands areas (Ramu grid)—as well as a number of smaller grids servicing the smaller urban centers. Because of the unreliability of the power supply, there is considerable self-generation and back-up generation capacity in the urban areas, which is expensive and inefficient. Large industrial users, particularly mining sites, also operate off-grid self-generation. PNG has about 580 megawatts (MW) of installed generation capacity, including hydro power (230 MW, or 39.1%), diesel (217 MW, or 37.4%), gas fired (82 MW, or 14.1%), and geothermal (53 MW, or 9.1%). Energy for the Port Moresby grid (140 MW) is mainly supplied by hydro power but increasingly diesel generation is needed to meet rapidly growing demand. PNG has significant underutilized indigenous energy sources such as hydro power, natural gas, geothermal, and solar-based power systems.

2. PNG Power (PPL), the national state-owned corporatized power utility, manages installed generation capacity of about 300 MW, including the two main grids and 26 other smaller urban centers through 19 independent power systems. PPL has entered into power purchase agreements with a number of independent power providers to supply PPL grids. Additional generation and supply occurs through (i) provincial governments, which have responsibility for maintaining a number of stand-alone rural generation facilities (C-centers); (ii) churches, which provide electricity to some off-grid villages; and (iii) mine sites, which sometimes provide power to adjacent communities. The government's ownership in PPL is maintained through the Independent Public Business Corporation. Sector policy formulation is managed by the Ministry of Petroleum and Energy and, specifically, the Energy Division of the Department of Petroleum and Energy. Technical regulation of the sector is currently performed by PPL itself through agreement with the Consumer and Competition Commission; however, it is intended to eventually transfer this function to the Energy Division. Key research activity in the energy sector occurs at the University of Technology, particularly through the Rural Energy Research Group.

3. Power tariffs are independently regulated by the Independent Competition and Consumer Commission and allow full cost-recovery for PPL. Power tariffs are set on a national basis, resulting in uniform tariffs irrespective of local generation costs. The uniform tariff structure cross-subsidizes tariffs for consumers in high-cost centers (provincial centers) through the lower generation costs from the main grids (the Port Moresby and Ramu grids, which are predominantly hydro power based, and therefore relatively low cost). However, the uniform tariff provides a disincentive for PPL to invest in high-cost generating areas, including provincial centers where high reliance on diesel generation and high diesel transport costs have resulted in high generation costs.

4. A number of key development challenges face the energy sector, including (i) improving the quality of the power supply and meeting growing demand on the main power grids (the Port Moresby and Ramu grids), (ii) improving power supply in provincial centers, and (iii) developing suitable models for expansion of power supply into off-grid areas.

(i) **Port Moresby and Ramu power grids**. The robust national economic growth is translating into rapid growth of power demand in the main urban areas. Lack of reliable quality power supply to the main urban areas is constraining economic growth. Investments are required in power generation and the transmission and distribution grids for the Port Moresby and Ramu grids to improve quality of supply and increase capacity.

(ii) **Town electrification**. Poor-quality power supply and lack of generation to meet growing demand is limiting economic growth in provincial urban centers not connected to the main grids.[1] The poor development of the provincial power systems is due to (a) difficult geographic conditions, resulting in isolated load centers with relatively low demand and high operation and maintenance costs; (b) overreliance on high-cost diesel generation which has low upfront investment costs but substantially higher life cycle costs; (c) lack of investment in lower-cost generation sources, such as hydro power, because of high upfront financing requirements (offset by low operation costs); and (d) the single national tariff structure, which serves as a disincentive for the corporatized PPL to invest in high-cost provincial centers (each additional customer on these systems results in increased financial loss).

(iii) **Rural electrification**. The difficult geographic conditions mean that it is not technically feasible to extend the existing power grids to more than a relatively small percentage of the rural population. Where grid extensions are feasible, progress has been slow because of the lack of community service obligation (CSO) assistance provided to the corporatized PPL to undertake financially nonviable grid extensions. Beyond the feasible grid extensions, rural electrification will consist of village-level mini grids and household-based generation systems, such as household solar systems. Currently, the provincial governments are responsible for the management of the village-level power systems (C-centers); however, because of the lack of an operating budget and maintenance capacity constraints, the majority of these systems have ceased to operate. Barriers to an increase in the use of village- and household-based generation systems include (a) the lack of CSO financing to install power systems, (b) the lack of viable operation and maintenance models, and (c) low cash generation in the villages.

2. Government's Sector Strategy

5. **Sector policies**. The government has recognized the range of issues facing the energy sector and in response approved the Electricity Industry Policy (EIP) in 2011. The policy (i) encourages private sector participation in the energy sector by facilitating competition and developing a clearly defined access regime, (ii) transfers a range of regulation functions from PPL to the government, and (iii) increases rural electrification through government assistance. The EIP will support state financing of CSOs through establishment of an electricity trust fund.

6. **Strategies and plans**. Electrification is important in realizing the agenda of the national Development Strategic Plan, 2010–2030.[2] An expanded, more efficient electricity system will be an integral element of successful economic development in PNG. The government has included the energy sector as a key sector in the Papua New Guinea Development Strategic Plan, 2010–2030. The proposed development of the energy sector in each province is detailed in the PNG Power 10-year power development plan, which lists the status of current infrastructure and a plan of priority investments over a 10-year time frame.[3]

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[1] A majority of the provincial urban centers cannot be connected to the two main grids because of PNG's geography.

[2] Department of National Planning and Monitoring. 2010. *Papua New Guinea Development Strategic Plan, 2010–2030*. Port Moresby (March).

[3] Government of PNG. 2000. *PNG Power National and Provincial Ten Year Power Development Plan, 2009–2018*. Port Moresby (July).

7. **Private sector**. The government and PPL recognize that the private sector will play an important role in providing investment and management capacity for energy sector expansion. The government has passed the Public–Private Partnership Policy, which will support development of private sector participation in the energy sector, along with the EIP.

8. **Tariffs**. The government has recognized the investment disincentive provided by the single national power tariff and proposes to address the issue by (i) allowing flexible tariff setting under the EIP, (ii) establishing a CSO policy[4] to support government financing of power infrastructure that is not financially viable, and (iii) establishing an electricity trust fund under the draft EIP to finance such investments.

3. ADB Sector Experience and Assistance Program

9. The Asian Development Bank (ADB) has a long engagement in the PNG energy sector. During 1970–2000, ADB supported the development of the energy sector through a series of eight technical assistance (TA) projects looking into gas-based power generation,[5] power system planning,[6] institutional assessment of the PNG Electricity Commission,[7] review of electricity tariffs,[8] and hydro power planning[9] as well as specific site assessments at Luwini (Divune) hydro power site[10] and the Ramu–Port Moresby transmission interconnection. ADB also processed loans to support (i) construction of two hydro power sites (Divune and Upper Warangoi),[11] and (ii) reinforcement of the Ramu grid.[12] To address the barriers identified above, ADB is currently assisting the government in the following strategic areas:

(i) **Port Moresby grid**. The Port Moresby Power Grid Development Project[13] was approved in 2013 ($83 million) and will assist in the expansion of renewable energy generation, connect currently unserved customers to the Port Moresby grid, and significantly improve the quality of electricity supply by (a) upgrading and rehabilitating two hydro power plants (Rouna 1 and Sirinumu Toe-of-dam), (b) extending the grid to approximately 3,000 additional households and strengthening the distribution network (11 kilovolt mesh grid), and (c) constructing a new substation (Kilakila) and upgrading the existing substations. Additionally, ADB is currently implementing (a) regional TA on Promoting Energy Efficiency in the Pacific,[14] which is assisting PPL with improving Port Moresby grid efficiencies; and (b) regional TA on Promoting Renewable Energy in the Pacific,[15] which is assisting PPL to improve management and efficiency of the Rouna Hydropower Cascade (which supplies the majority of energy to the Port Moresby grid) through development of a cascade management plan.

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4 ADB is assisting the establishment of the CSO policy through ADB. 2009. *Technical Assistance for Pacific Private Sector Development Initiative Phase II*. Manila.
5 ADB. 1989. *Technical Assistance to PNG for the Gas-Based Power Generation Study.* Manila.
6 ADB. 1989. *Technical Assistance to PNG for the Power System Planning Study*. Manila.
7 ADB. 2007. *Technical Assistance to PNG for Institutional Study of the PNG Electricity Commission*. Manila.
8 ADB. 1989. *Technical Assistance to PNG for the Electricity Tariff Review*. Manila.
9 ADB. 1977. *Technical Assistance to PNG for the Hydrological/Hydroelectric Planning Project*. Manila.
10 ADB. 1986. *Technical Assistance to PNG for the Luwini (Divune) Hydropower Project*. Manila.
11 ADB. 2000. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Papua New Guinea for the Divune Hydropower Project.* Manila; and ADB. 1979. *Report and Recommendation of the President to the Board of Directors: Proposed Loans and Technical Assistance Grant to PNG for the Upper Warangoi Hydropower Project*. Manila.
12 ADB. 1986. *Report and Recommendation of the President to the Board of Directors: Proposed Loan and Technical Assistance to Papua New Guinea for the Ramu Grid Reinforcement Project.* Manila.
13 ADB. 2013. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to Papua New Guinea for the Port Moresby Power Grid Development Project*. Manila.
14 ADB. 2009. *Technical Assistance on Promoting Energy Efficiency in the Pacific*. Manila (RETA-6485 REG).
15 ADB. 2009. *Technical Assistance on Promoting Renewable Energy in the Pacific*. Manila (RETA-7329 REG).

(ii) **Town electrification**. ADB is supporting development of the power supply for provincial urban centers through the Town Electrification Investment Program,[16] which was approved in 2010. The program is a $150 million multitranche financing facility to support PNG Power construct renewable energy (hydro power) capacity to supply provincial centers. Tranche 1 includes the Divune Hydropower Plant, Ramazon Hydropower Plant, and Lake Hargy Hydropower Interconnection.

(iii) **Rural electrification**. In 2012, ADB approved a $5 million grant project, the Improved Energy Access in Rural Communities Project, to provide access to electricity to an estimated 4,500 households in three targeted provinces.

(iv) **Support for sector policy**. In 2009, ADB completed TA for preparing the national Power Sector Development Plan, which provided strategic assistance to the energy sector through preparation of the power demand forecast and least-cost supply development plan.[17] ADB is currently implementing policy and advisory support that is assisting in design for expansion of the electricity grid.

(v) **Private sector**. Since 2009, ADB has also been assisting the energy sector through its Private Sector Development Initiative. This initiative is helping PNG to (a) improve business laws to encourage business formalization; (b) leverage digital technology to reduce red tape and make it easier to do business; (c) improve access to finance for businesses in the region; (d) improve the efficiency of state-owned enterprises resulting in better public service delivery, more private sector opportunities, and better corporate governance; (e) improve the framework for competition in the region; and (f) promote the economic empowerment of women.

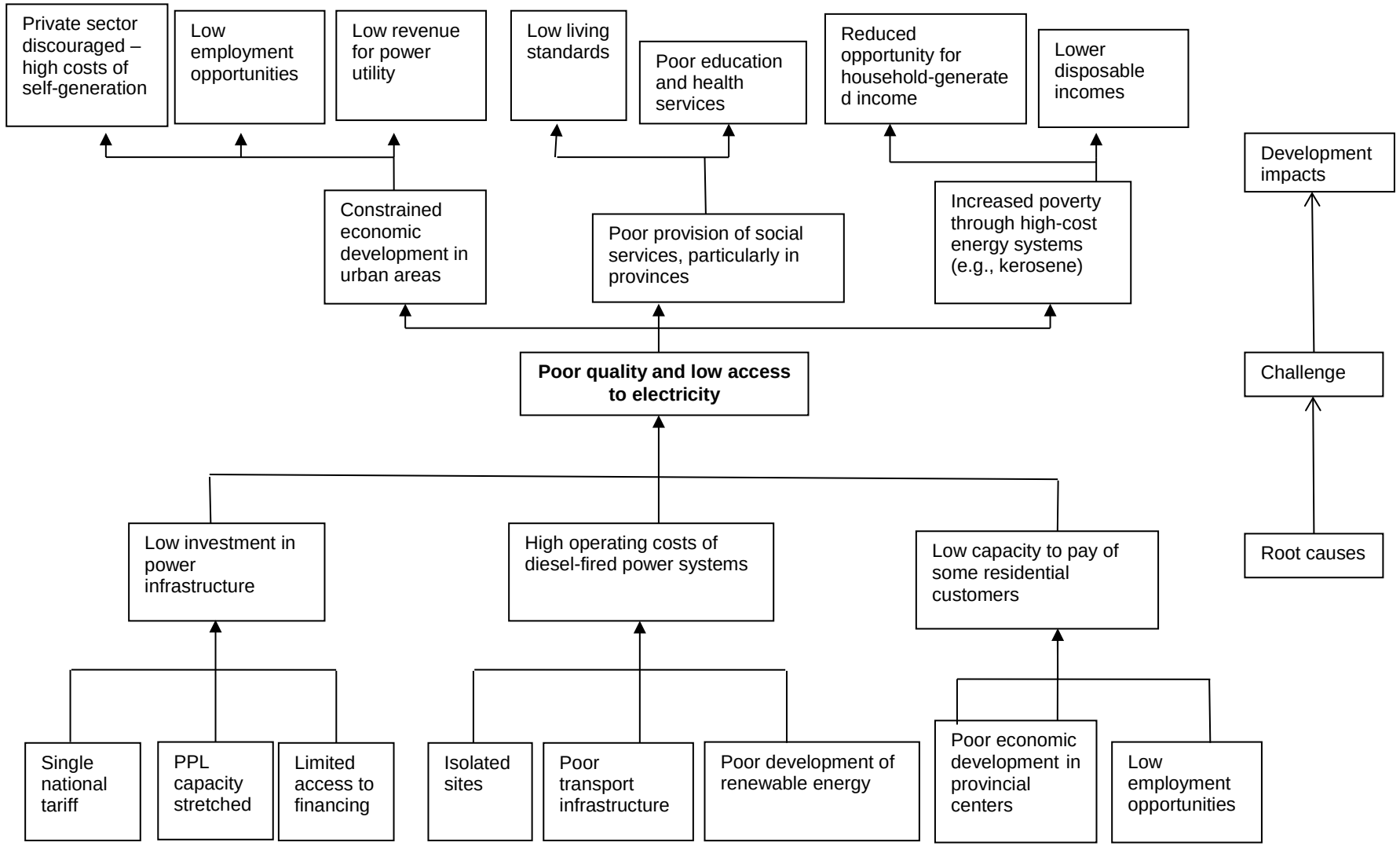
10. PNG's development partners have traditionally focused on policy support in the energy sector and development of small off-grid power supply projects with direct poverty alleviation benefits. The World Bank has supported rural electrification programs and has trialed innovative household renewable energy financing schemes. More recently, the World Bank has supported development of the proposed Naoro Brown Hydropower Plant and implementation of the Electricity Industry Policy. The Government of Japan is currently financing strengthening of the Ramu grid through construction of transmission lines.

11. During the 2016–2020 country partnership strategy period, ADB will (i) continue to support investments in generation expansion (particularly large-scale hydro power) and improved transmission and distribution efficiencies on the main power grids; (ii) support investments through PPL in expansion and rehabilitation of provincial grids, particularly for conversion to least-cost renewable energy systems; (iii) increase access to electricity through expansion of the existing power grids to peri-urban areas and promote innovative models for off-grid power delivery; (iv) support the Department of Petroleum and Energy to implement the Electricity Industry Policy; and (v) promote private sector delivery of energy sector infrastructure financing.

[16] ADB. 2008. *Report and Recommendation of the President to the Board of Directors: Proposed Multitranche Financing Facility to Papua New Guinea for the Town Electrification Investment Program*. Manila.

[17] ADB. 1989. *Technical Assistance to PNG for the Power Sector Development Plan*. Manila.

Problem Tree for Energy Sector



Source: Asian Development Bank. PPL = PNG Power Limited.

Sector Results Framework (Energy, 2016–2020)

Country Sector Outcome		Country Sector Outputs		ADB Sector Operations	
Outcomes with ADB contributions	**Indicators with Targets and Baselines**	**Outputs with ADB Contributions**	**Indicators with Incremental Targets**	**Planned and Outgoing ADB Interventions**	**Main Outputs Expected from ADB Contributions**
Improved conditions for commercial activity through consumption of reliable, sustainable, and more affordable power supply in urban areas Improved access to and utilization of power supplies for households in rural areas	20% of households have access to grid-connected electricity by 2020 (2014 baseline: 12%)	Improved power supply for the Port Moresby grid Improved power supply in provincial towns Increased private sector investment in energy sector Increased number of households connected to power supply Trial of innovative rural electrification delivery models	20 GWh per annum additional hydro power generation in five provincial urban centers by 2020 (2014 baseline: 0) 8 GWh per annum additional power generation capacity for the Port Moresby grid by 2020 (2014 baseline: 0) Reduced system transmission losses to 8.0% by 2020 (2014 baseline: 9.5%)	**Planned Key Activity Areas** Generation expansion and rehabilitation (hydro power) and improved supply on main grids (47% of funds) Increased power access to peri-urban areas (49% of funds) Support DPE to implement the EIP, promote private sector investment and innovative off-grid supply models (4% of funds) **Pipeline Projects:** Power Development Project ($60 million) Town Electrification Investment Program Tranche 2 ($62.7 million) **Ongoing Projects** Port Moresby Power Grid Project ($67 million) Town Electrification Investment Program Tranche 1 ($57 million) Improved Energy Access to Rural Communities Promoting Energy Efficiency in the Pacific (TA 6485-REG, $1 million) Promoting Renewable Energy in the Pacific (TA-7329 REG, $1 million) Implementation of the Electricity Industry Policy (TA-8264, $1 million)	**Planned key activity areas** Upgraded power distribution systems (15%) Expanded clean energy generation (75%) Provision of power and lighting services to unserviced households (5%) **Pipeline projects** Town electrification Improved power supply to poor communities Power grid expansion **Ongoing Projects** Rollout of the national grid expansion plan

ADB = Asian Development Bank, DPE = Department of Petroleum and Energy, EIP = Electricity Industry Policy, GWh = gigawatt-hour, REG = regional, TA = technical assistance.
Source: Asian Development Bank.