

SECTOR ASSESSMENT (SUMMARY): ENERGY¹

1. Sector Performance, Problems, and Opportunities

1. **Overview.** Myanmar has abundant energy resources, particularly hydro and natural gas. The hydropower potential of the country in its rivers which drain the four main basins of Ayeyarwaddy, Chindwin, Thanlwin and Sittaung is estimated to be more than 100,000 MW. There are 92 large scale hydropower projects with a total installed capacity of 46,101 MW that have been identified. Proven gas reserves total 11.8 trillion cubic feet (tcf) with huge potential for discovery. Offshore gas are the country's most important source of export revenues, including current supplies to Thailand and a new planned gas pipeline to the People's Republic of China (PRC). A third of foreign direct investment totaling \$13.6 billion is attributable to the oil and gas sector. Myanmar is one of the five major energy exporters in the region, particularly natural gas.

2. **Energy Demand and Supply.** Despite sitting on huge energy resources, Myanmar has one of the lowest commercial per capita consumption in Southeast Asia. This low energy demand is due to its low per capita income and insufficient energy infrastructure, as reflected by its total electrification rate of only 26%. In 2007, according to the International Energy Agency, Myanmar's total primary energy supply was around 15.6 million tons of oil equivalent (MTOE), with an average annual growth rate of 3.3% from 2000 to 2007. The country's primary energy supply mix consisted of coal, oil, gas, hydro and biomass. Energy from biomass accounted for 66.3% of total energy supply, followed by gas with 19.6%, and oil and petroleum with 11.3%. Hydro and coal accounted for only 2% and 0.8% of total energy supply. Final energy consumption grew at an average of 3.3% from 2000 to 2007, with the highest growth being in the industrial sector followed by the commercial and transport sector. Residential energy consumption grew the slowest, although it is the largest consumer of energy, mainly using biomass.

3. **Coal.** The coal reserves are estimated at 489 million tons. In FY 2011, 692 thousand tons of coal were produced. Among them 52% was used for cement and steel companies and 42 % for power generation, and others. Since 2010, all coal production has been made by the private sector and coal price is set by the market.

4. **Oil and Gas.** A total of 105 blocks were demarcated in onshore (53) and offshore (52). Proven oil reserves total 160 million barrels (mmbbl). Proven gas reserves total 11.8 tcf with huge potential for discovery. Gas production in FY2011 was about 1,232 MMCF/D. Myanmar's onshore oil production is estimated to have reached 7.6 thousand barrels per day (m b/d) in 2011. In addition, condensates of 11.6 m b/d were produced from offshore gas fields. In FY2011, the total demand for petroleum products was 8.15 mmbbl comprising 3.70 mmbbl of gasoline, 3.38 mmbbl of Diesel, 0.60 mmbbl of aviation oil and others. The petroleum products were produced from three refineries (total capacity of 51 thousand b/d) using blending of onshore oil and offshore condensate and the shortage, mainly Diesel was imported. Of the total gas production, 95% came from the offshore Yadana and Yetagun fields while the remaining 5% came from onshore fields. In FY2011, the domestic gas demand is about 400MMCFD and expected to increase to 700MMCFD by 2013. Gas is used for 10 gas power plants (60%), fertilizer (12%) and compressed natural gas (CNG) (10%). About 2,093 miles of gas pipeline was constructed for onshore and 431 miles offshore in various diameters ranging from 6 to 24 inches. The CNG and natural gas vehicle program was initiated in 1986 to expand the use of domestically- produced natural gas and respond to climate change concerns and a total of

¹ This summary is based on Myanmar: Energy Sector Assessment, Strategy and Roadmap. Manila. (<http://serd-mya.adb.org/>).

27,472 vehicles were converted and 44 refueling stations were constructed around the country in 2011.

5. **Renewable energy.** Myanmar has abundant renewable energy resources such as hydro, biomass, wind, solar and other types of renewable energy. Among these resources, hydropower is the only renewable energy resource that is being exploited and utilized on a commercial scale, while other resources remain under research and development or pilot stage. Almost 66% of the primary energy in Myanmar is being supplied in the form of biomass such as fuelwood, charcoal, agriculture residue and animal waste. Bioethanol is produced from sugar cane, molasses and starchy materials, and is used as transportation fuel to substitute for gasoline or to mix with gasoline. The government has launched the ambitious Jatropha Plantation Project in 2005 for biodiesel production aiming 8 million acres (achieved 5.2 million acres as of September 2011). Due to low yield from Jatropha seeds, actual biodiesel production is low. 26 micro- and 9 mini-hydro power projects were developed, with installed capacity ranging from 24 kW and 5,000 kW, reaching remote border areas. The use of wind and solar energy is at its very initial stage.

7. **Power Sector.** The power sector is governed by the Electricity Act 1948 (as amended in 1967), the Myanmar Electricity Law (1984) and Electricity Rules (1985). Before 1960, the generation system consisted mainly of isolated grids supplied by diesel generators and mini-hydro by the private sectors. In 2010, about 5,661 GWh were available to the Myanmar grid from all its grid-connected hydropower plants, only 68% of the installed capacity. The 120 MW Tigyit coal power plant completed in 2002 was the first coal power plant, operating at an average capacity factor of 31%. Off-grid power supply is provided for by ESE and by communities and district authorities; supply is intermittent and electricity is only provided up to two hours per day in remote areas. Total system installed capacity in 2011 was 3,361 MW consisting of 2,52MW (76%) hydropower capacity (excluding 31MW of off-grid mini hydropower generation), 715 MW (21%) gas-fired capacity and 120 MW (4%) coal-fired capacity. Although the installed capacity exceeds the 2011 peak load by about 130%, the available capacity of the gas power plants are low due to maintenance and lack of compression of the gas pipeline. During the dry season, the hydropower plants cannot generate the full capacity due to lack of water. Hence, Myanmar's power grid is experiencing significant load shedding during the dry season of up to 500MW. The inadequate transmission capacity has not help matters much as it is difficult increase transmission capacity when the transmission lines and transformer capacity is limited. The network also suffers from high transmission and distribution losses that need to be addressed urgently. Similar to demand projection, there has been no comprehensive least cost generation planning for the whole country.

8. **Future power development.** MOEP1 will build another 13 HPPs up to 2020 with a total capacity of 2,572 MW. Local enterprises will develop 580 MW (9 HPPs). Many hydropower projects are planned to be developed by joint venture with foreign investors (44 projects totaling 42,150 MW). MOEP1 has identified three coal-fired power plants with an installed capacity totaling 876 MW in 2012 and 2013. It is proposed to built a 500MW gas-fired power generation in Thaketa by the Korean consortium and a 800-1,000 MW coal-fired power plant in Thilawa Special Economic Zone by Japanese consortium. Once determined feasible, the parties will enter into negotiation of the joint-venture agreement. Currently, in each joint venture, Myanmar will be entitled to free share and free power (equivalent to royalties), in addition to commercial and income taxes.

9. **Transmission and Distribution Systems.** Myanmar has a unified interconnected transmission and distribution network covering some parts of the country. There are also some off-grid distribution systems. Transmission network is under the responsibility of the MEPE. As power is transmitted over long distances, the 220 kV transmission system suffers from high

voltage drop, in some case exceeding 10%. Therefore, MOEP2 is planning to build a 500 kV transmission system. MEPE has prepared a five-year expansion plan for the transmission network (2011–2016). The plan envisages building a total of 44 new transmission lines with total investment requirements estimated at \$660 million and 46 new substations with requirement of about \$320 million. Two distribution companies provide electricity to all grid connected consumers: YESB and ESE. At present, ESE operates a network of 33 kV (5,745 km), 11 kV (11,533 km), 6.6 kV (510 km), and 400 V (12,000 km). ESE is able to serve 1,420,000 consumers in 17 States and Divisions. Between 2012 and 2013, ESE will expand the 33 kV network by 400 km (~10% increase); 360 km of 11 kV and 250 km at 6.6 kV. Significant new substation capacity will also be added. In parallel with expansion, ESE also carries out system improvement works aiming at reducing losses and improving quality of supply. Both technical and non-technical losses were significantly reduced from as high as 30% in 2003–2009 to 25% in 2011.

10. **Power Demand, Planning and Tariffs.** Electricity consumption in the fiscal year 2010–2011 was 6,312 GWh. With a population of about 63 million, Myanmar's per capita electricity consumption was 100 kWh per year, the lowest among ASEAN countries. Electricity consumption grew from 3,268 GWh in 2001 to 6,312 GWh in 2011, almost doubled within a 10-year period with an average annual growth rate of about 7%. The most rapid growth in terms of power consumption was from the industrial sector, at an average annual growth rate of 6.9%, followed by commercial sector (4.9%) and transport sector (2.3%). Yangon City has the highest electrification ratio (67%), followed by Nay Pyi Taw (54%), Kayar (37%) and Mandalay (31%). The remaining rural areas are still poorly electrified as reflected in ESE's average ratio of 16% for these areas. The most recent demand projection was prepared in 2001 by DEP. It has not been revised in a systematic manner since then though some updates have been carried out. Currently, power system planning in Myanmar is carried out based on supply availability and the assumption that all power that will be generated will be consumed or exported. The links between future demand projection, resources availability, technical specification and cost parameters are not explicit in this approach. Electricity produced by hydropower and coal-fired power stations is sold to MEPE at a constant price of 20 kyats/kWh, compared with a generation cost of 60 kyats/kWh from coal and 130 kyats/kWh from combined cycle gas turbines. The tariff of the electricity is 35Kyats/kWh for household, street light and government office and 75Kyats/kWh for domestic power and industry users from January 2012.³

11. **Energy Efficiency.** Energy efficiency and conservation program is one of main objectives of the Myanmar Energy Policy. In line with ASEAN target, the government aims to save 5% of the total energy primary energy consumption in year 2020 and 8% for year 2030 compared to the base year 2005. MOE is the focal point for energy sector coordination. The Ministry of Industry is handling energy efficiency activities in Myanmar. There is no legal and regulatory framework for energy efficiency and no central and dedicated organization.

12. **Core sector issues and constraints.** The main issues and constraints facing the sector, especially the power sector in Myanmar include (i) persistent power supply shortage in Yangon; (ii) high technical and non-technical losses due to poor maintenance of existing power transmission and distribution systems, and gas pipeline networks; (iii) lack of technical capacity of staff; (iv) lack of planning function, e.g., there are no long-term supply and demand projections and no analysis of alternative supply options; (v) government controlled-pricing policy; (vi) absence of energy efficiency and climate change-related policies; (vii) absence of legal safeguard requirements; and (viii) need to consolidate responsibilities within the energy sector, with 8 ministries being responsible for energy matters and limited overall planning

³ The tariff for foreigners is 12 cents/kWh.

mandate of MOE.

2. Government's Sector Strategy

13. There are eight concerned Ministries in Myanmar who are responsible for energy matters. The MOE is a focal point for overall energy policy and policy coordination with concerned Ministries. Concerned Ministries and their responsibilities are (i) Ministry of Energy—overall energy policy, oil and gas sector; (ii) Ministry of Electric Power No. 1—hydro and coal power generations; (iii) Ministry of Electric Power No. 2—power transmission and distribution, gas-fired generation, and mini-hydro; (iv) Ministry of Mines—coal; (v) Ministry of Agricultural and Irrigation—biofuels and micro-hydro for irrigation purposes; (vi) Ministry of Science and Technology—renewable energy; (vii) Ministry of Environmental Conservation and Forestry—fuelwood, climate change, and environmental safeguards requirements; and (v) Ministry of Industry—energy efficiency. The Energy Planning Department within MOE has the overall responsibilities for energy and policy formulation and for coordinating the energy development programs, particularly the oil and gas sector. MOGE is responsible for the exploration, production and transportation of oil and gas. Myanmar Petrochemical Enterprise is responsible for the operation of refineries, urea fertilizer plants, methanol, LPG plants. Myanmar Petroleum Products Enterprise is responsible for the marketing and distribution of petroleum products. Updated energy policies and strategies will help the country to develop these energy resources, and these strategies include (i) inviting foreign technical expertise and foreign investment for its oil and gas sector, (ii) expanding the capacity of existing liquefied petroleum gas plants and implementing new liquefied natural and petroleum gas production projects, and (iii) substituting the use of liquid fuel in the transport sector with compressed natural gas. Myanmar's energy policy framework include (i) maintaining the status of independence, (ii) promoting the wider use of new and renewable sources of energy, (iii) promoting energy efficiency and conservation, and (iv) promoting the use of alternative fuels in household.

14. To promote and enhance energy efficiency activities, the government has stated that the following is needed: (i) strong commitment of the government; (ii) central and dedicated energy efficiency organization and confirmed roles; (iii) energy efficiency policy and guidelines; (iv) detailed information on energy use; (v) institutional strengthening and capacity building; (vi) increased awareness and dissemination of energy efficiency and conservation through trainings; (vii) good energy management practices for industrial and commercial sectors; (viii) labeling program for appliance and energy service company, (ix) enhanced interest of financial institution; and (x) increased energy price. Although Myanmar has not issued a specific climate change policy statement, there are some provisions and ministerial policy statements which contain policy related to climate change. The development of climate change policy will be under the National Environmental Conservation Committee, which was reformed in April 2011.

3. ADB Sector Experience

15. Since joining ADB in 1973, Myanmar has received 5 energy sector loans totaling \$31.8 million⁵ and 3 TAs totaling \$1.27 million.⁶ ADB continues to monitor energy sector activities and economic developments in Myanmar. Myanmar has been a member of ADB's GMS working group on energy and regional power trade since 1992. The information ADB has on Myanmar's energy sector is the data that has been provided at the GMS regional power trade coordinating meetings on the power system, planned generation, and transmission expansion plans. ADB

⁵ Five loans include (i) Loan 160–161: Power Transmission for \$6.1 million, 1973; (ii) Loan 242: Power Transmission (Supplementary) for \$6.1 million, 1975; (iii) Loan 395: Sedawgyi Hydropower for \$14.6 million, 1979; and (iv) Loan 491, Petroleum Refining Industry Program for \$5 million, 1980.

⁶ The three TAs are (i) TA 385: Mini Hydropower for \$220,000, 1980; (ii) TA 886: Institutional Strengthening within the Ministry of Energy for \$600,00, 1987, and (iii) TA 934: Oil and Gas Development for \$500,000, 1987.

has not undertaken any analytical work on the energy sector in determining sector needs. Based on limited information available, ADB's future possible support for the energy sector is as follows.

a. Near term-needs

16. **Detailed energy sector assessment.** Since there is no medium- and long-term planning activities for each subsectors and energy sector as a whole, demand projection and its supply options have to be assessed for power, petroleum, coal and other sources of energy, including investment requirements for meeting growing energy demand. Advisory technical assistance for institutional strengthening and coordination in the energy sector and capacity building is needed.

17. **Rehabilitation work in power generation, transmissions and distribution** are needed, especially in Yangon areas where frequent black outs prevail. As a medium-term solution, a 500- kV transmission line from Northern areas to Yangon may be considered. Rehabilitation and upgrading of existing one coal-fired power generation plant and 10 gas-fired power plants is needed.

18. **Strengthening the capacity and capability of the environmental and social safeguards** in the Environmental Conservation Department within the Ministry of Environmental Conservation and Forestry are needed, which will be established with the promulgation of the Environmental Protection Law.

b. Medium term-needs

19. **Tariff and Structural reforms.** For efficient energy supply systems, the pricing mechanism for electricity and petroleum products has to be reviewed. The corporatization and privatization of 8 energy enterprises may be considered (currently all enterprises are within the Ministries) in line with a larger public sector reform program in Myanmar.

20. **Renewable energy and energy efficiency.** There is a need to continue collecting necessary information on the latest developments in renewable energy and energy efficiency. It is also necessary to undertake a pre-feasibility study for solar power generation (solar park type) in the Central Dry Zone for grid connection.

21. **Hydropower Development.** 66 potential hydro projects were identified, including 22 by MOEP1 and local entrepreneurs, and 44 by foreign investors. There is a need for an integrated study for a comprehensive development plan applying the least-cost principle. Based on the findings of the integrated study, appropriate hydropower development projects in the tribute could be considered for support.

22. **Rural electrification.** To increase electrification ratio and energy access in rural areas, expansion of transmission and distribution line projects is needed, and off-grid renewable energy options are to be considered.

23. **Rehabilitation and expansion of natural gas pipeline networks.** Since the existing natural gas pipelines are very old, rehabilitation of existing gas pipelines are necessary. The expansion of distribution networks and the construction of gas transmission pipeline from offshore to near Yangon should be considered.

PROBLEM TREE

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