

## SECTOR ASSESSMENT (SUMMARY): ENERGY<sup>1</sup>

### A. Sector Performance, Problems, and Opportunities

1. **Overview.** Myanmar has abundant energy resources, particularly hydropower and natural gas. The hydropower potential of the country's rivers, which drain the four main basins of Ayeyarwaddy, Chindwin, Thanlwin, and Sittaung, is estimated to be more than 100,000 megawatts (MW). Myanmar has identified 92 large hydropower potential projects with a total installed capacity of 46,101 MW. Proven gas reserves total 11.8 trillion cubic feet with huge potential for discovery. Offshore gas is the country's most important source of export revenues, currently supplying Thailand with a new gas pipeline planned to the People's Republic of China (PRC). A third of the country's \$13.6 billion in foreign direct investment is in the oil and gas sector (as of September 2011). Myanmar is one of the five major energy exporters in the region, particularly of natural gas.

2. **Energy demand and supply.** Despite sitting on huge energy resources, Myanmar's commercial consumption per capita is one of the lowest in Southeast Asia. Low per capita income and insufficient energy infrastructure, as reflected by the country's total electrification rate of only 26%, are the main causes of the small energy demand. In 2007, according to the International Energy Agency, Myanmar's total primary energy supply was about 15.6 million tons of oil equivalent, 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, hydropower, and biomass. Energy from biomass accounted for 66.3% of the total energy supply, followed by gas at 19.6%, and oil and petroleum at 11.3%. Hydropower accounted for only 2.0% of the total, while coal accounted for just 0.8%. Final energy consumption grew at an average of 3.3% per year from 2000 to 2007. The fastest growth was 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 FY2011, 692,000 tons of coal were produced. Cement and steel companies used 52% of the coal, while 42% was used for power generation, and 6% for others. Since 2010, the private sector has produced all of the country's coal and the price has been set by the market.

4. **Oil and gas.** A total of 105 blocks are demarcated onshore (53) and offshore (52) for oil and gas exploration and development. Proven oil reserves total 160 million barrels (mmbbl). Proven gas reserves total 11.8 trillion cubic feet with huge potential for discovery. Gas production in FY2011 was about 1,232 million cubic feet per day (MMCF/D). Myanmar's onshore oil production is estimated to have reached 7,600 barrels per day in 2011. In addition, offshore gas fields produced 11,600 million barrels per day of condensates. In FY2011, the total demand for petroleum products was 8.15 mmbbl, comprising 3.70 mmbbl of gasoline, 3.38 mmbbl of diesel, and 0.60 mmbbl of aviation oil and 0.47 mmbbl for others. Three refineries with a total capacity of 51,000 barrels per day produced the petroleum products by blending onshore oil and offshore condensate; 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, domestic gas demand was about 400 MMCF/D and is expected to increase to 700 MMCF/D by FY2013. Gas is used for 10 power plants (60%), fertilizer (12%), and compressed natural gas (10%). About 2,093 miles of gas pipeline were

<sup>1</sup> This summary is based on *Myanmar: Energy Sector Assessment, Strategy, and Road Map*, prepared by the Southeast Asia Department. Available upon request.

constructed onshore and 431 miles offshore in various diameters ranging from 6 to 24 inches. In 1986, a compressed natural gas and natural gas vehicle program was initiated to expand the use of domestically produced natural gas and to respond to climate change concerns. A total of 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, and solar. Hydropower is the only renewable energy resource that is being exploited and utilized commercially; the others remain in research and development or the pilot stage. Biomass such as fuelwood, charcoal, agriculture residue, and animal waste supplies almost 66% of the primary energy in Myanmar. Bioethanol, produced from sugar cane, molasses, and starchy materials, is used as transportation fuel to substitute for gasoline or to mix with gasoline. In 2005, the government launched the ambitious Jatropha Plantation Project for biodiesel production, aiming for 32,375 km<sup>2</sup> plantations (65% of which had been achieved as of September 2011). Because of the low yield from Jatropha seeds, biodiesel production is low. Myanmar has developed 26 micro- and 9 mini-hydropower projects, with installed capacity ranging from 24 kilowatts to 5,000 kilowatts, to reach remote border areas. The country is only starting to use of wind and solar energy.

6. **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 private diesel generators and mini-hydropower plants. In 2010, about 5,661 gigawatt-hours (GWh) were available to the Myanmar grid from all its grid-connected hydropower plants, which was only 68% of the installed capacity. The country's first coal plant, the 120 MW Tigyit facility completed in 2002, is operating at an average of 31% of its capacity. Off-grid power supply is provided for by Electric Supply Enterprises (ESE) and by community and district authorities; the supply is intermittent and electricity is provided for only 2 hours a day in some remote areas. In 2011, the total installed capacity of the system was 3,361 MW consisting of 2,526 MW of hydropower capacity (76%), excluding 31 MW of off-grid mini-hydropower generation; 715 MW of gas-fired capacity (21%); and 120 MW of coal-fired capacity (4%). Although the installed capacity exceeded the 2011 peak load by about 130%, the available capacity of the gas power plants is low because some are offline for maintenance and the gas pipeline lacks compression. During the dry season, the hydropower plants cannot generate their full capacity because of the lack of water. Hence, Myanmar's power grid experiences load shedding during the dry season of up to 500 MW. The capacity of the transmission lines and transformers is limited. The network also suffers from high transmission and distribution losses that need to be addressed urgently. Comprehensive least-cost generation planning for the whole country is lacking.

7. **Future power development.** Ministry of Electric Power (MOEP) will build an additional 13 hydropower plants up to 2020 with a total capacity of 2,572 MW. Local enterprises will develop 9 hydropower plants with a total capacity of 580 MW. Joint ventures with foreign investors are planned for the development of 44 hydropower projects totaling 42,150 MW. MOEP has identified three coal-fired power plants with an installed capacity totaling 876 MW for development in 2012 and 2013. The government proposes to build a 500 MW gas-fired power plant in Thaketa by a consortium from the Republic of Korea and a 800–1,000 MW coal-fired power plant in the Thilawa Special Economic Zone by consortium from Japan. Once these projects are deemed feasible, the parties will negotiate joint-venture agreements. In each joint venture, the government will be entitled to free share of equity and free power (equivalent to royalties), in addition to commercial and income taxes.

8. **Transmission and distribution systems.** Myanmar has a unified, interconnected transmission and distribution network covering some parts of the country, as well as some off-grid distribution systems. The Myanmar Electric Power Enterprise (MEPE) is responsible for the transmission network. As power is transmitted over long distances, the 220-kilovolt (kV) transmission system suffers from high voltage drop, in some case exceeding 10%. Therefore, MOEP is planning to build a 500 kV transmission system. MEPE has prepared a 5-year expansion plan for the transmission network (2011–2016). The plan envisages building 44 new transmission lines with total investment requirements estimated at \$660 million, and 46 new substations at a cost of about \$320 million. Two distribution companies provide electricity to all grid-connected consumers: The Yangon City Electric Supply Board (YESB) and ESE. ESE operates a network that includes 33 kV (5,745 km), 11 kV (11,533 km), 6.6 kV (510 km), and 400 volt (12,000 km) lines. ESE serves 1.42 million consumers in 17 states and divisions. From 2012 to 2013, ESE will expand the 33 kV network by 400 km, the 11 kV network by 360 km, and the 6.6 kV network by 250 km. Significant new substation capacity will also be added. In parallel with this expansion, ESE will also carry out system improvements to reduce losses and enhance the quality of the supply. Technical and nontechnical losses have been reduced from as high as 30% in 2003–2009 to 25% in 2011.

9. **Power demand, planning, and tariffs.** With a population of about 60 million, Myanmar's per capita electricity consumption was 100 kWh per year in FY2011—the lowest among members of the Association of Southeast Asian Nations (ASEAN). Total electricity consumption in FY2011 was 6,312 GWh, nearly double the consumption of 3,268 GWh in 2001. The most rapid growth in power consumption was in the industrial sector over that period (an average annual growth rate of 6.9%), followed by commercial sector (4.9%), and the 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. Department of Electricity Planning (DEP) prepared the most recent demand projection in 2001, and it has not been systematically revised since then. 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. Future demand projections, resource availability, technical specifications, and cost parameters are not explicitly linked in this approach. Electricity produced by hydropower and coal-fired power stations is sold to MEPE at a constant price of MK20 /kWh, well below the generation cost of MK60/kWh for coal and MK130/kWh for combined cycle gas turbines. The electricity tariff is MK35/kWh for households, street lights, and government office; and MK75/kWh for domestic power and industry users from January 2012.<sup>2</sup>

10. **Energy efficiency.** Energy efficiency and conservation are key sector objectives of the government. In line with the ASEAN target, the government aims to save 5% of primary energy consumption by 2020 and 8% by 2030 compared with the baseline in 2005. The Ministry of Energy (MOE) is the focal point for energy sector coordination. The Ministry of Industry handles energy efficiency activities. Myanmar does not have a legal and regulatory framework for energy efficiency, or a central and dedicated organization for those activities.

11. **Core sector issues and constraints.** The main issues and constraints facing the energy sector, especially the power subsector, include (i) persistent power supply shortages in Yangon; (ii) high technical and nontechnical losses because of poor maintenance of power transmission and distribution systems, and gas pipeline networks; (ii) the lack of technical capacity of staff; (iv) the lack of a planning function, e.g., no long-term supply and demand

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<sup>2</sup> The tariff for foreigners is \$0.12/kWh.

projections, and no analysis of alternative supply options; (iii) the government-controlled pricing policy; (iv) the absence of policies on energy efficiency and climate change; (v) the absence of legal safeguard requirements; and (vi) the need to consolidate the responsibilities of eight ministries within the energy sector, with a limited overall planning mandate of MOE.

## **B. Government's Sector Strategy**

12. Seven ministries in Myanmar are responsible for energy matters: (i) MOE—overall energy policy and coordination, and the oil and gas sector; (ii) MOEP—electric power; (iii) Ministry of Mines—coal; (iv) Ministry of Agricultural and Irrigation—biofuels and micro-hydro for irrigation; (v) Ministry of Science and Technology—renewable energy; (vi) Ministry of Environmental Conservation and Forestry—fuelwood, climate change, and environmental safeguard requirements; and (vii) Ministry of Industry—energy efficiency. The Energy Planning Department within MOE is responsible for energy and policy formulation, and for coordinating the energy development programs, particularly for the oil and gas sector. The Myanmar Oil and Gas Enterprise is responsible for the exploration, production, and transportation of oil and gas. The Myanmar Petrochemical Enterprise is responsible for the operation of refineries, urea fertilizer plants, methanol, and liquefied petroleum gas plants. The 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 its energy resources. These strategies include (i) inviting foreign technical experts and foreign investment into the oil and gas sector, (ii) expanding the capacity of 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 includes maintaining independence, promoting the wider use of new and renewable sources of energy, promoting energy efficiency and conservation, and promoting the use of alternative fuels in households.

13. To promote and enhance energy efficiency activities, the government has identified the following needs: (i) a strong commitment by the government, (ii) central and dedicated energy efficiency organization and confirmed roles, (iii) an energy efficiency policy and guidelines, (iv) detailed information on energy use, (v) institutional strengthening and capacity building, (vi) increased awareness and of energy conservation through training, (vii) good energy management practices for the industrial and commercial sectors, (viii) a labeling program for appliances and energy service companies, (ix) greater interest of financial institutions, and (x) higher energy prices. Although Myanmar has not issued a specific climate change policy statement, a number of pertinent policy announcements by senior government officials apply. A climate change policy will be developed under the National Environmental Conservation Committee, which was formed in April 2011.

## **C. ADB Sector Experience and Way Forward**

14. Since joining ADB in 1973, Myanmar has received from ADB five energy sector loans totaling \$31.8 million<sup>3</sup> and three technical assistance (TA) projects totaling \$1.27 million.<sup>4</sup> ADB

<sup>3</sup> Five loans include (i) ADB.1973. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the Socialist Republic of the Union of Burma for the Power Transmission Project*. Manila (Loan 0160/0161-BUR, \$6.1 million); (ii) ADB. 1975. *Report and Recommendation of the President to the Board of Directors on a Proposed Supplementary Loan to the Socialist Republic of the Union of Burma for the Power Transmission Project*. Manila (Loan 0242-BUR, \$6.1 million); (iii) ADB. 1979. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the Socialist Republic of the Union of Burma for the Sedawgyi Hydropower Project*. Manila (Loan 0395-BUR, 14.6 million); and (iv) ADB. 1980. *Report and*

continues to monitor energy sector activities and economic developments in Myanmar. The country has been a member of ADB's Greater Mekong Subregion working group on energy and regional power trade since 1992. Much of ADB's information and data on Myanmar's energy sector originates from the working group's regional power trade coordinating meetings on the power system, planned generation, and transmission expansion plans. ADB has not undertaken any analytical work on the energy sector to determine the sector needs.

15. On the basis of ADB's initial assessments, there is a near-term need for (i) a detailed energy sector assessment, including demand projections and supply options, and investment requirements for meeting the growing energy demand; (ii) advisory TA for institutional strengthening and coordination in the energy sector and capacity building; (iii) rehabilitation of power generation, transmission, and distribution facilities; and (iv) capacity building in environmental and social safeguards in the Environmental Conservation Department within the Ministry of Environmental Conservation and Forestry.

16. Medium-term needs include (i) tariff and structural reforms in the sector; (ii) assessment and promotion of renewable energy and energy efficiency; (iii) hydropower development policy and planning; (iv) rural electrification (expansion of transmission and distribution line projects and off-grid renewable energy options); and (v) rehabilitation and expansion of natural gas pipeline networks.

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*Recommendation of the President to the Board of Directors and Appraisal Report on a Proposed Program Loan to the Socialist Republic of the Union of Burma for the Petroleum Refining Industry.* Manila (Loan 0491-BUR, \$5.0 million)

<sup>4</sup> The three TA projects are (i) ADB. 1980. *Technical Assistance to the Socialist Republic of the Union of Burma for the Mini-Hydropower Project.* Manila (TA 0385-BUR, \$220,000); (ii) ADB. 1987. *Technical Assistance to the Socialist Republic of the Union of Burma for Institutional Strengthening within the Ministry of Energy.* Manila (TA 0886, \$600,000); and (iii) ADB. 1987. *Technical Assistance to the Socialist Republic of the Union of Burma for the Oil and Gas Development Project.* Manila (TA 0934-BUR, \$500,000).

### PROBLEM TREE

