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Building Institutional Capacity of Ministry of Electric Power, Myanmar

Institutional Assessment Report

Nay Pyi Taw, Myanmar
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Currency Equivalent as of 10 July 2013
Currency Unit: Myanmar kyat (MK);
1MK = $0.001124
$1 = MK970

Abbreviations

ADB	Asian Development Bank
BOT	built-operate-transfer
CAGR	compounded annual rate of growth
DEP	Department of Electric Power
DHPI	Department of Hydropower Implementation
DHPP	Department of Hydropower Planning
EIA	environmental impact assessment
ESE	Electricity Supply Enterprise
FYP	Five Year Plan (currently 5th FYP, FY2012 – FY2016)
GTD	generation, transmission and distribution
HPGE	Hydropower Generation Enterprise
IAR	Institutional Assessment Report
IPP	independent power producer
JVA	Joint-Venture Agreement
MEPE	Myanma Electric Power Enterprise
MIC	Myanmar Investment Commission
MNPED	Ministry of National Planning and Economic Development
MOA	Memorandum of Agreement
MOAI	Ministry of Agriculture and Irrigation
MOE	Ministry of Energy
MOECAF	Ministry of Environmental Conservation and Forestry
MOEP	Ministry of Electric Power
MOF	Ministry of Finance
MOI	Ministry of Industry
MOST	Ministry of Science and Technology
MOU	Memorandum of Understanding
NEMC	National Energy Management Committee
NTPC	National Thermal Power Corporation Limited, India
PRC	People's Republic of China
REDC	Rural Energy Development Committee
SIA	social impact assessment
TA	technical assistance
YESB	Yangon City Electricity Supply Board

Weights and Measures

GWh	Gigawatt-hour or million kWh
km	kilometer
kV	kilovolt
kWh	kilowatt-hour
MVA	Megavolt-Ampere or million volt-ampere
MW	Megawatt or million watt
tcf	trillion cubic feet

Notes
(i) In this report "$" refers to US dollar.
(ii) The Myanmar fiscal year (FY) ends in March.

INSTITUTIONAL ASSESSMENT REPORT
FOR
MINISTRY OF ELECTRIC POWER, MYANMAR
EXECUTIVE SUMMARY

1. **Introduction.** The Institutional Assessment Report (IAR) has been prepared under a technical assistance funded by the Asian Development Bank (ADB). It builds on the information available in other recent reports on the Myanmar electricity sector prepared by international experts, updates provided by the Ministry of Electric Power (MOEP), and discussions with senior officials.

2. **Background.** An overview of the Myanmar electricity sector is given in the Table E1.

Table E1: Overview of Myanmar Electricity Sector, July 2013

		Installed (MW)	Firm (MW)	Energy (GWh)
Capacity (July 2013)		3,710	1,655	19,271
Peak Demand			1,640	
Capacity under Implementation and Development		3,152		20,466
		FY2011	**FY2012**	**FY2013**
Annual Power Generation	GWh	7,812	10,034	
Annual Power Sale	GWh	6,312	7,696	8,255
Electrification Ratio [a]	%		26%	29%
Per Capita Electricity Consumption	kWh/y		160	
Staff (March 2013)				21,350

Source: *Assessment of Myanmar Power Sector. September 2012.* Data confirmed and updated by MOEP.

3. **Ministries.** MOEP functions with the cooperation of other ministries. i.e., the Ministry of Energy (also the coordinating ministry for all energy matters), Ministry of Environmental Conservation and Forest, Ministry of Agriculture and Irrigation, Ministry of Science and Technology, Ministry of Mines, Ministry of Industry, Ministry of National Planning and Economic Development, and Ministry of Finance. Two high level inter-ministerial committees have been established, the National Energy Management Committee for formulating new energy policy and plans, and the Rural Energy Development Committee for extending energy supply to rural areas.

4. **Electricity law, policy and plans.** Presently, the Electricity Law (1984) and Electricity Rules (1985) govern the electricity sector. The private sector can be licensed to generate, transmit and distribute electricity. Various ministries are presently reviewing a new draft Electricity Law that is expected to align the legislation and regulations to modern practices. MOEP also has a draft electricity policy and action plan.

5. **Departments and enterprises.** MOEP has assigned its functions to three departments and four enterprises, namely Department of Hydropower Planning, Department of Hydropower Implementation, Department of Electric Power, Hydropower Generation Enterprise (also does coal-based generation), Myanma Electric Power Enterprise

(does transmission and gas-based generation), Electricity Supply Enterprise (does distribution every where except Yangon), and Yangon City Electricity Supply Board (does distribution in Yangon). The departments and enterprises presently give a high priority to adding generation capacity and expanding the transmission system, including the creation of a backbone transmission system (500 kV). Private sector is encouraged to invest in power generation and pilot concession schemes have been started for distribution.

6. In addition to expanding capacity, MOEP needs to address several other issues. The Electricity Law (1984) has to be changed so MOEP gets the complete responsibility for the electricity sector, and the policy and action plans have to be finalized so these get aligned to the new law. The electricity sector now requires subsidies because the tariff is below full cost recovery; the deficit also means that it is unable to invest in new capacity or timely upgrade of the distribution system. There are widespread electricity shortages during summer (about 200 MW or 12% of the peak demand) and 71% of the population lacks electricity connections. The transmission system has low reliability because adequate standby capacity has not been built. Distribution networks are overloaded and losses are high. The number of employees in the enterprises is very high with relations to the electricity sales; there is lack of certain skills and training.

7. **Suggestions for institutional strengthening.** MOEP needs to work towards the following outcomes, (i) elimination of electricity shortages during summer season, (ii) an action plan (with identification of sources of funds) for extending electricity supply to about 6.3 million households, (iii) utilization of new, efficient, clean, and reliable technologies, (iv) increased use of indigenous gas, hydropower and renewable energy resources, and (v) a financially viable electricity sector. Achieving these will require robust institutions and efficient processes, i.e., effective governance through legal and regulatory measures, clear electricity policy (including the market structure to promote competition), good long-term planning (with sources of funds), a national plan for rural energy delivery program (with sources of funds), financial management system with full accountability, and streamlined project development and approval processes. Further, MOEP needs to resolve the technical issues that lead in underperformance, promote use of renewable energy (biomass, wind and solar) and encourage energy efficiency, adopt organization design (corporatization of all revenue earning entities) and progressive human resource policies.

8. **Electricity law.** Inter-ministerial review of the new draft electricity law has to be completed soon and then it will be publically discussed and enacted by the Parliament. Amongst other things, the new law needs to (i) identify MOEP as the nodal ministry for electricity, (ii) enable unbundling of the distinct commercial functions – generation, transmission, distribution and sale of electricity, (iii) assign policy and long-term planning responsibility to MOEP (government), (iv) separate the technical safety (inspectorate) responsibilities, (v) create a unit with adequate expertise for economic regulation (tariff and entry), (vi) require the use of codes (e.g., grid code) and standards, and (vii) clear the way for corporatization of the enterprises that engage in commercial operations.

9. **Electricity policy.** MOEP has to announce the electricity policy. The draft policy may be improved so that prospective investors and other stakeholders clearly understand the objectives and action plan. Some key elements are (i) a basis for determining tariff and

subsidy, and emphasis on economic procurement; (ii) the targets for the extension of energy supply to rural households and how delivery of electricity and cooking fuel will be coordinated; (iii) a clarity regarding participation of the private sector, preferably selected through competitive bidding; (iv) an emphasis on energy efficiency and conservation; (v) a fast-track process for encouraging the development of renewable resources like small hydropower, biomass, wind and solar energy; and (v) introduction of consultative process.

10. **Rural energy.** The task of rural energy delivery appears daunting but is doable. Rural energy supply may not be commercially viable as yet but is essential for environmental and social reasons. Since it involves provision of both electricity and fuel for cooking, MOEP will need to work under a national rural energy delivery program. The Rural Energy Development Committee has to take the lead and develop targets for all entities that can implement rural energy projects, and it has to raise financing from the government and development partners for timely implementation of the projects. Non-Government Organizations, private sector, and electricity enterprises may be assigned targets; feedback from pilot wind and solar projects can be shared so others can scale them up; use of processed biomass has to be encouraged as cooking fuel; natural gas networks can be introduced for more efficient utilization of indigenous supply. The Government needs to consider the creation of a national rural energy fund.

11. **Sustainability.** The sustainability of rural energy delivery systems will require due attention to arrangements for proper maintenance of the equipment and getting rural households to contribute for the costs – initially for the upkeep of the systems, and as household incomes increase with energy use, for the investment cost as well.

12. **New projects for electricity generation.** MOEP needs to give a high priority to effectively managing the capacity addition. There is considerable uncertainty regarding implementation of most hydropower, coal- and gas-based projects that add up to over 32 GW. Since the project development activities are uncoordinated, the developers would not know when the electricity supply-demand gap would justify their respective project. A reconciliation of the project pipeline is essential.

13. The first task should be to introduce proper expansion planning. Demand projections have to be prepared under various scenarios. Project development by the private sector has to be closely coordinated for preparing a realistic projection when the new capacity will be available. Developers who have not been able to tie up funds may be requested to put the development on hold. The government approval process (the memorandum of understanding, joint venture agreement and issue of concession rights) has to be streamlined for developers who have funding. MOEP's in-house project design capacity needs to improve and they need to closely monitor the construction of project by the private sector so there is certainty regarding the completion dates.

14. **Additional energy.** The de-rating of capacity of the coal- and gas-based power stations has to be examined and remedial measures taken. These offer the least-cost opportunity for addition energy supply. The high share of hydropower in Myanmar creates the opportunity to install wind and solar power capacity that are interruptible. As a late mover, it can leap frog to have a higher share of indigenously available renewable energy

resources, which would increase the export of gas. The implementation of the 500 kV transmission backbone needs to be expedited to utilize the large hydropower capacity in the northern and eastern provinces.

15. **Human resource.** Organizational design and human resource development contribute significantly to performance. It will be advisable for MOEP to engage a human resource-consulting firm to examine the objectives and work processes of the commercial enterprises and suggest suitable organization design and human resource policies. Training will be a key aspect of the human resource policy and development partners may be requested to extend support. Opportunity should also be taken to assign counterpart staff with all international experts that come to Myanmar to implement studies, this would help transfer knowledge and build capacity.

16. **Electricity sector institutions in Asia.** Myanmar can learn from the experience of other Asian countries; the development partners and several international consulting firms work regularly in other countries and recognize the institutional weaknesses and strengths. Some examples of learning are, emphasis on strengthening regulation, corporatization of enterprises engaged in generation-transmission-distribution, establishment of specialized financial institutions for promoting renewable energy and rural energy supply, creating an international division to improve coordination with development partners, and adopting sound institutional systems.

17. **Conclusion.** MOEP has a challenging task of transforming the electricity sector so it is responsive, grows rapidly and becomes financially sustainable. The country has adequate energy resources that is mostly clean (hydropower and gas); the private sector is already investing in electricity generation and distribution; development partners are keen to extend assistance for reducing poverty, which includes extension of energy supply to about 71% of the population; and the Government is strongly committed to the reform process (market-based economy, deregulation, parliamentary processes, press freedom, and gradual resolution of ethnic conflicts). With continued macroeconomic stability, Myanmar has a comparative advantage for foreign direct investments (in the manufacturing, tourism, mining, oil and gas, agro-processing sectors) that can help the economy grow at a rapid pace and large poverty reduction is possible with proper governance. Its geographical location (between several large economies) and large domestic market are also attractive for new investments. By timey transforming the electricity sector, MOEP will ensure that electricity supply does not become a binding constraint for economic growth, something faced by several developing countries.

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Building Institutional Capacity of Ministry of Electric Power, Myanmar
Institutional Assessment Report

I. INTRODUCTION

18. The Institutional Assessment Report (IAR)[1] focuses on institutional capacity of the Ministry of Electric Power (MOEP), Government of Myanmar (the Government), including its three departments and four enterprises under its supervision. The Myanmar electricity data is mostly taken from two previous reports prepared with support from Asian Development Bank (ADB), namely, *Assessment of Myanmar Power Sector*, September 2012 and the *New Energy Architecture: Myanmar*, June 2013. Information regarding rural electrification is taken from *Mission Report Energy Scoping Myanmar*, April and May 2012, prepared by European Union Energy Initiative – Partnership Development Facility. Information has also been taken from other international consultants carrying out various ADB-Funded assignments, including the Financial Management Assessment carried out by Francis Narayan, international expert.

19. MOEP faces considerable challenges in fulfilling its responsibilities, i.e., providing electricity for economic growth and a reasonable quality of life for over 61 million people in Myanmar, particularly extending commercial energy to about 71% of the people who presently rely on traditional firewood for cooking, and ensuring environmental sustainability. Government budget resources are constrained so it is already seeking investments by the private sector even as it builds its own capacity to plan new projects, carry out competitive bidding, and negotiate agreements.

20. The IAR has five chapters; Chapter I is the Introduction; Chapter II provides the background information of the electricity sector, including the policies, and responsibilities of the departments and enterprises under MOEP; Chapter III considers the reforms needed in the medium-term (about 5 years) and provides suggestions for building MOEP's institutional capacity to meet the challenges ahead; Chapter IV provides brief description of electricity sector institutions in some other Asian countries and includes some lessons for MOEP; and Chapter V is the conclusion.

21. The Power Sector Advisor greatly appreciates the information shared and assistance extended by officials of MOEP, the guidance provided by the Minister and Deputy Ministers, and the regular dialogue with ADB staff.

[1] The IAR has been prepared by Anil Terway, who was appointed as Power Sector Advisor in the Ministry of Electric Power under Asian Development Bank-funded TA-8244 MYA: Capacity Development and Institutional Support - Power Sector Advisor.

II. BACKGROUND

A. Overview

1. Operational Data

22. An overview of the Myanmar electricity sector is given in Table 1.

Table 1: Overview of Electricity Sector, Myanmar

			Installed (MW)	Firm (MW)	Energy (GWh)
1	Capacity (July 2013)				
	Hydropower		2,780	986	13,268
	Coal-Based Power		120	27	600
	Gas-Based (MOEP-Owned)		715	427	3,946
	Gas-Based as BOT		215	215	1,457
	Total		3,710	1,655	19,271
2	Peak Demand			1,640	
	Reserve (calculated)	%		0.91%	
			Installed MW	**Energy GWh**	
3	Capacity Addition (Completion by 2016 or earlier)				
	Hydropower		491	1,930	
	Gas-Based (BOTs)		64	441	
	Gas-Based (MOEP-Owned)		240	1,577	
	Gas-Based (IPPs)		2,357	16,518	
	Total		3,152	20,466	
			FY2011	**FY2012**	**FY2013**
4	Annual Power Generation	GWh	7,812	10,034	
5	Energy Transmitted	GWh	7,614	9,812	
6	Energy Received for Distribution	GWh	7,042	9,041	
	Transmission Losses	GWh	572	771	
	As percentage of Generation	%	7.52%	7.86%	
	Self Consumption and Losses	GWh	1,500	2,338	
	As percentage of Generation	%	19%	23%	
7	Annual Power Sale	GWh	6,312	7,696	8,255
	General Purpose	%		33%	44%
	Industry	%		48%	32%
	Commercial	%		18%	20%
	Others	%		1%	3%
8	Electrification Ratio [a]	%		26%	29%
	Rural	%		16%	
	Yangon	%		67%	
	Mandalay	%		31%	

			FY2011	FY2012	FY2013
9	Per Capita Electricity Consumption	kWh/y		160	
10	Transmission line		**Route**	**Circuit**	
	230 kV	km	3,187	3,983	
	132 kV	km	2,053	2,289	
	66 kV	km		3,614	
11	Grid Substations		**Installed MVA**	**Load MVA**	**Loading %**
	230 kV / 132 kV		780	285	37%
	230 kV / 66 kV		960	348	36%
	230 kV / 33 kV		1,840	692	38%
	132 kV / 66 kV		521	122	23%
	132 kV / 33 kV		549	162	29%
	132 kV / 11 kV		49	26	53%
	66 kV / 33 kV		55	27	50%
12	Staff (March 2013)				21,350
13	Tariff		**Connections** Dec 2012	**Tariff MK/kWh**	**Tariff $/kWh**
	General and Domestic [b]		2,547,714	35	0.036193
	Foreigners			116.4	0.12
	Small – three phase		53,105	75	0.0773
	Bulk supply		7,784	75	0.0773
	Purchase from Hydropower			20	0.0206
	Purchase from Shweli			CNY0.189/kWh	0.0307 [c]
14	Transfer price to distribution			37	0.0381
	Average sale revenue for ESE [d]	approx		40	0.0412

BOT = build-operate-transfer; CNY = yuan (Chinese yaun); ESE = Electricity Supply Enterprise; FY = financial year, e.g., FY2013 ends in March 2013; GWh = Gigawatt-hour; IPP = independent power producer; km = kilometer; kVA = kilovolt-ampere; kWh = kilowatt-hour; MD = Managing Director; MK = Myanmar kyat; MVA = Megavolt-Ampere; MW = Megawatt

[a] Electrification Ratio is number of households with electricity connections (2,556,714) ÷ total number of households in Myanmar (8,905,674)

[b] The total number of households is estimated as 8,905,674. The general purpose consumers have single phase connections and domestic have three phase connections; both are for households

[c] $1 = CNY6.337 (July 2013)

[d] The average collection includes a MK1,000/month charge for maintenance fee and kVA-based capacity fee for large consumers

Source: Assessment of Myanmar Power Sector. September 2012. Data confirmed and updated by MOEP during discussions.

2. Ministries in Energy Sector

23. MOEP functions with the cooperation of other ministries and institutions that have responsibilities of fuel supply, environmental sustainability, renewable energy, off-grid electrification, and industrial and commercial consumer connections.[2]

[2] The information regarding the responsibilities of the ministries is taken from the report titled *New Energy Architecture: Myanmar*. June 2013. Officials reviewed and confirmed the information.

(i) **Ministry of Energy (MOE)** is the coordinating body for all types of energy and responsible for the oil and gas sector. It oversees three state-owned enterprises, (a) Myanmar Oil and Gas Enterprise, which is responsible for oil and gas[3] exploration, production and domestic gas transmission; (b) Myanmar Petrochemical Enterprise, which operates three refineries, five urea fertilizer plants and a number of other processing plants; and (c) Myanmar Petroleum Products Enterprise, which is responsible for retail and wholesale distribution of petroleum products. No other private company presently does downstream business, i.e., the retail of gasoline or diesel.

(ii) **Ministry of Environmental Conservation and Forestry (MOECAF)** is responsible for firewood,[4] climate change, and environmental standards and safeguard requirements.

(iii) **Ministry of Agriculture and Irrigation (MOAI)** is responsible for biofuels and micro-hydropower for irrigation purposes. The water discharge from some of the multi-purpose dams is also regulated for irrigation by MOAI.

(iv) **Ministry of Science and Technology (MOST)** is responsible for research and development related to renewable energy technologies; a large number of pilot and small projects have been implemented for wind and solar power.

(v) **Ministry of Mines (MOM)** is responsible for coal production and exploration.[5]

(vi) **Ministry of Industry (MOI)** is responsible for electrical inspection, energy efficiency and off-grid rural energy access, as well as approving electrical connections for businesses and industries.

(vii) **Ministry of Finance (MOF)** allocates budget funds for new capacity and day to day functioning of the electricity sector, it also receives all the collection from electricity sales.

24. Considering the key role of the energy sector (including oil, gas, coal, electricity, and renewable energy) in the ongoing reform program of Myanmar, the Government has established the National Energy Management Committee (NEMC) and the Energy Development Committee (EDC). NEMC is a minister-level committee under the Vice-President No. 2 that is formulating the new energy policy and plans, and EDC, at the deputy minister level, will help

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[3] Myanmar proven natural gas reserves are 12.2 trillion cubic feet (tcf) (EU Energy Initiative, *Energy Scoping Myanmar*, April-May 2012); it is a key export commodity as well as resource for expanding the domestic consumption of energy. If all of it is used for domestic power generation, it will support about 6,000 MW capacity of combined cycle power plant for 30 years.

[4] Biomass provides 75% of the primary energy use, 90% of it is from natural forests.

[5] The domestic coal production was 1.4 million ton in 2011. The calorific value is about 3,900 kilo-calorie per kg (7,000 British thermal units per pound). If all of it is used in a modern coal-based sub-critical power plant (with 39% efficiency), it will support a capacity of only 350 MW (assumed specific coal consumption of 0.565 kg/kWh).

implement them. NEMC Secretariat is in MOE and the Deputy Minister for Energy is supervising its daily activities (unofficial translation notification is in Appendix 1).[6]

25. In June 2011, the Government established the inter-ministerial Rural Energy Development Committee (REDC) chaired by the Minister of Industry. While the mandate is to extend energy supply in rural areas, there is still a lack of leadership and coordination among various ministries.

B. Laws and Regulations

1. Electricity Law

26. The Electricity Law (Law No 7 of 1984)[7] and Electricity Rules (1985)[8] govern the electricity sector. Electricity Law allows different types of organizations, including cooperatives and private sector, to develop, generate, transmit and distribute electricity after obtaining a license (permit). However, the license to private sector can be revoked if it is decided that the state will have exclusive responsibility (similar to expropriation). Licensed electricity generating companies require the cabinet's permission to work as partners, or divest (even mortgage) their assets. Electricity generation license holder has the right to charge the consumers and is allowed to disconnect supply if not paid in time.

27. The Electricity Law 1984 elaborates the responsibilities of the Inspector for ensuring safety in electricity GTD. It includes the testing of all electrical goods produced domestically or imported. If safety is at risk, the inspector has the right to disconnect supply to any consumer. All licenses are to be issued by the Inspector General. His other duties include determining the responsibility for any injury or death (caused by electricity), issuing electrician registration certificates, and establishing standards. The Inspector General is also the arbitrator between a generator and consumer in case of dispute related to equipment. Presently, the electricity inspectorate is part of MOI, along with the factory and boiler inspectorates.

28. Procuring, wasting, or using electricity illegally or in an improper way is considered theft and punishable under the criminal law. Similarly, cutting power lines and destroying generation facilities are also a criminal offence. In addition to imprisonment and fine, the detractor has to pay compensation if the property is state-owned, and if the fine remains unpaid, it can be collected as arrears of land revenue.

29. The cabinet can create an advisory board to consider matters related to the electricity sector. The Electricity Law does not explicitly state which ministry will be responsible for the electricity sector; presently, the Inspector General is under MOI but limits the role to safety

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6 The Notification is taken from the first draft Financial Management Assessment Report (March 2013) prepared by another ADB consultant.

7 The last clause of the Electricity Law vacated the Electricity Act of 1948.

8 An English translation was not available for the Electricity Rules (1985), it is understood that its scope is technical and safety aspects.

aspects of residential connections and small consumers, the inspection of larger installations (MOEP's, independent power producers [IPPs] and consumers) is carried out by a department under MOEP.

3. Policies and Action Plan

30. To be effective, an electricity policy needs to indicate the objectives and list specific outcomes that will enable the sector departments and enterprises achieve the objectives. MOEP has prepared a draft policy, which also has two parts, i.e., policy and objectives that broadly correlate to objective and outcomes (Appendix 2).

31. As illustration, New Zealand issued a Government Policy Statement on Electricity Governance that was fairly simple; there were only two objectives: (i) to ensure that electricity was produced and delivered to all classes of consumers in an efficient, fair, reliable, and environmentally sustainable manner; and (ii) to promote and facilitate the efficient use of electricity. This is followed by a list of outcomes, which include efficient use of energy and other resources, management of risks, minimum barrier to competition, non-discriminatory (between public and private) incentives for investments and energy conservation, signal the long-range marginal cost of electricity, a downward pressure on electricity cost, alignment with the government's climate change policies.

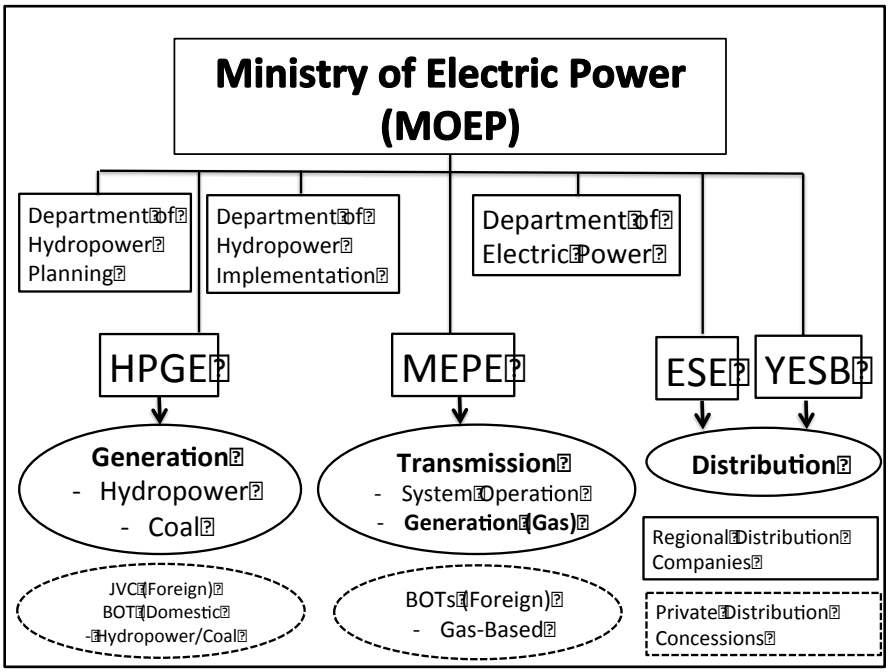
32. MOEP's draft electricity policy (objective) is fairly simple, it includes efficient use of existing electricity generation resources and addition of new ones for meeting present and future demand, expansion of infrastructure, adoption of environment-friendly technologies for GTD, promotion of public-private partnerships and encouragement to clean and renewable energy. The outcomes include expansion of the infrastructure during the Fifth Five Year Plan, knowhow for alternative energy (biodiesel), diesel generators and mini-hydropower plants for off-grid supply, skills improvement of staff (foreign training), use of wind and solar power, greater village electrification, timely project implementation and rehabilitation of existing power plants to full capacity. It focuses on high priority issues of the sector, i.e., lack of infrastructure, low firm capacity, low electrification ratio, and need for skills development.

33. The MOEP draft Action Plan (outputs) include several technical steps for expanding GTD, including preparation of feasibility studies for wind power, implementation of IPPs as in neighboring countries (i.e., competitive bidding), preparation of Energy Development Plan and Energy Security Policy, efficient and environment friendly use of energy resources, "prescribe" pricing (tariff) structure for electricity (and petroleum products and metals), and preparation of transmission and distribution codes. Importantly, it seeks the establishment of Energy Policy Committee for updating it from time to time, and the creation of a regulatory body that ensures all ministries, organizations and private sector are functioning according to the instruction (guidance) of the NEMC.

C. Enterprises Under MOEP

34. The organization chart of MOEP is in Figure 1. Information about the operations of the enterprises is provided in following sections.

Figure 1: Organization Chart of Ministry of Electric Power



BOT = build-operate-transfer; ESE = Electricity Supply Enterprise; HPGE = Hydropower Generation Enterprise; IPPs = independent power producers; JVC – Joint Venture Company; MEPE = Myanma Electric Power Enterprise; YESB = Yangon City Electricity Supply Board
Source: Present & Future Power Sector Development in Myanmar (MOEP, Feb27/2013)

35. All investment proposals of MOEP and its enterprises need approval from the Ministry of National Planning and Economic Development (MNPED) before MOF considers budget allocation. According to the present accounting practice, receipts from the sale of electricity are deposited in a Government bank account and MOF transfer funds every quarter for MOEP's use according to its annual budget for both revenue and capital expenses.[9]

36. Although the three enterprises – Hydropower Generation Enterprise (HPGE), Myanma Electric Power Enterprise (MEPE) and Electricity Supply Enterprise (ESE) – are called "state-owned enterprises, these function as government departments – fund transfers from the Government support its daily activities and there is little autonomy in decision making. A Managing Director heads each enterprise. Yangon City Electricity Supply Board (YESB) was created under an act of the parliament. A chairman heads it. According to the organization chart, it has a chief engineer and three directors responsible for administration, finance and

[9] Details of the financial management practices can be seen in the *Financial Management Assessment Report* prepared by Francis Narayan, ADB-Funded international consultant.

materials planning; they are members of the YESB board. MOEP provides technical guidance and oversight.

37. MOEP has engaged two engineering consultants on a long-term basis, AF-Consult, Switzerland and New JEC Engineering Consultants, Japan. These provide inputs in project development and implementation.

1. Electricity Distribution

a. Electricity Supply Enterprise

38. ESE is responsible for electricity distribution in all of Myanmar, except Yangon. It has taken several initiatives that are helping improve its performance.

(i) **Digital energy meters.** Off-site digital meters have been installed in about 30,000 residences in Mandalay, Nay Pyi Taw and Yangon; these are mounted on the distribution poles and the reading can be read from remote. Based on results during the first 3 months, the "losses" reduced from 26% to 16% because of the better accuracy compared to analog meters that do not register the full consumption when current is low (because of friction). The payback period for the new meters is estimated as about 2 years.

(ii) **Distribution contract.** About 4 months ago, distribution contracts were awarded to the private sector in seven townships in Mandalay district. The contractor in each township has taken over the existing ESE staff and manages the distribution business. It passes on the "normative" monthly collection from electricity sale to ESE. The contractor's profit depends on the loss reduction that can be achieved through better operations.

(iii) **Distribution privatization:** Building on the experience with YESB, a proposal for establishing a joint venture with a private sector company (to be identified) for distribution business in Mandalay is being reviewed by the Government. A private sector partner would be given 49% share and the existing assets of ESE will be valued at 51%. When approved and implemented, it will be the first major privatization of distribution business.

39. As an internal arrangement, ESE "buys" electricity from MEPE at MK37/kWh ($0.0381/kWh) and based on the national retail tariff, collects from the consumers (at an average) about MK40/kWh ($0.0412/kWh). The actual collection is higher than the tariff indicated in Table 1 on account of maintenance fee from every consumer at the rate of MK1000/month ($1.031/month) and capacity charges based on connected load (per kVA basis) from industrial and commercial consumers. Although the business has positive operating revenue, it does not leave enough surpluses to upgrade the distribution system, which is essential when demand grows inherently – the same consumers buy new appliances and use more electricity. As a result, distribution lines and transformers are overloaded during high demand periods and the technical losses increase, the reliability also reduces. Because of the

sparse population in most of Myanmar (including the cities), distributions costs (per kWH and per customer basis) will tend to be higher than normal.

40. ESE gets annual budget allocations from MOEP for all capital and revenue expenses. All procurement is carried out centrally. Project accounts are opened at the start, which close when the equipment is put in service. There are "circle" level offices in districts. These offices have qualified accountants for reviewing and authorizing expenditure and revenue. In general, bills receivables are low as customers pay within 2 weeks.

b. Yangon City Electricity Supply Board

41. The population of Greater Yangon is about 6 million. YESB is responsible for electricity supply. It was created in 2006 and for the first 5 years (till 2011) it functioned as a separate organization with its own books of account. It had to meet its expenses from the revenue earned from the sale of electricity without budgetary support from the Government. After opening of the Myanmar economy, YESB was brought under the MOEP and now functions like the other electricity enterprises.

42. The summer peak demand for the YESB grid was about 850 MW in 2013. For the present Yangon is the main center of Myanmar economy and so the peak demand is growing at a rate of about 15% annually. There is a shortage of available power generation in the country, and Yangon's needs to disconnect 250 MW – 300 MW during the summer months.

43. YESB is also implementing a program to install digital energy meters that will improve the accuracy of billing and so lower reported losses. The distribution loss is estimated as 19%, which is high by international standards; in Indonesia, in 2010, energy losses were 9.70%, consisting of 2.25% transmission losses and 7.64% distribution losses.[10]

44. Like ESE, YESB has also given a concession to a private company for the distribution in one township – South Dagon. It started in April 2013 so evaluation of results is not possible as yet. There is also a suggestion to seek an international strategic investor for the whole of YESB, however a decision is yet to be made.[11] This could help address the institutional weaknesses of the distribution company, but will still require an adequate tariff level that would make the business viable. Further, the value of YESB (from the viewpoint of an interested strategic investor) will depend on the type of business it has – if it is a monopoly for the whole Yangon region or portions have been carved out for awarding long-term concessions to local private sector companies.

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[10] Indonesia. *Perusahaan Umum Listrik Negara (PLN) Statistical 2010*. Downloaded from the PLN Internet website on 8 July 2013; http://www.pln.co.id/dataweb/STAT/STAT2010ENG.pdf

[11] According to YESB, International Finance Corporation (IFC), World Bank Group, is developing a proposal for consideration of MOEP.

45. According to YESB, the budget allocations are inadequate for regular maintenance and timely upgrade of the distribution network; underground cables installed in 1926 are still being used although the technology is very old. The overloading of distribution networks and sub-stations results in lower reliability and higher losses.

46. YESB took two initiatives in July 2013, it invited bids for (i) electricity generation and distribution in 15 special economic zones, and (ii) import of liquefied natural gas (LNG) using to floating regasification unit to boost power generation. The procurement process is ongoing.

2. Transmission and Gas-Based Power Generation

47. MEPE operates and maintains all gas-based power generation. There are nine operating gas-based power plants, four of which are in Yangon (Ywama, Thaketa, Ahlone and Hlawga). The total installed capacity is 678 MW but the firm capacity is only 427 MW (63%).[12] Of the nine power plants, six are open cycle (OC) gas turbines (278 MW) and other three are combined cycle (CCGT) (400 MW). The unit sizes are small, which indicates a medium level of technology. Interestingly, the Ywama plant supplies heat to a neighboring tire manufacturing plant from the heat recovery steam generators with the first two gas turbines so 18 MW of steam turbine capacity remains unutilized.

48. The two CCGT power plants have been de-rated because the steam turbines are unable to achieve the designed condenser vacuum.[13] They use ground water for condenser cooling (a closed circulating water system) but because of fouling and high conductivity, there is a high rate of condensers tube leakages. To prevent mixing of circulating and boiler water about 16% of the condenser tubes have been plugged at Thaketa, which reduces the amount of heat removed from the condenser and so there is insufficient vacuum. MEPE needs to address the problem of condenser tube leakage. It is impractical to change or re-size the condenser. The more practical solution may be improving the quality of circulating water by chemical dosing and filtration, which will remove the cause of condenser tube leakages. This will require a proper investigation of the chemical regime of the power pants and possibly investment in a new filtration plant.

49. To help urgently address the power shortages in Yangon, four new power plants have been implemented with an aggregate capacity of 215 MW, and addition 64 MW will be added in another year (total of 279 MW). The new projects have been implemented by the private sector under a build-operate-transfer (BOT) arrangement.[14] These projects are open cycle, gas engine-based projects using banks of gas engine-generators of different sizes (1 MW to 4 MW) at three locations, and a gas turbine combined cycle (2 x 41.5 MW + 38 MW) at Ahlone. MEPE

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12 Mann, gas-based plant with 37 MW installed capacity, stopped operation in 2005 so it is excluded.

13 The steam gives away less of its energy to the turbine shaft when the condenser vacuum is insufficient, which leads to lower output and efficiency.

14 The power purchase agreements for the four power plants are being finalized. This unusual situation has arisen because the project developers have taken a risk by responding to the Government's plea for accelerated project implementation for addressing the power shortage.

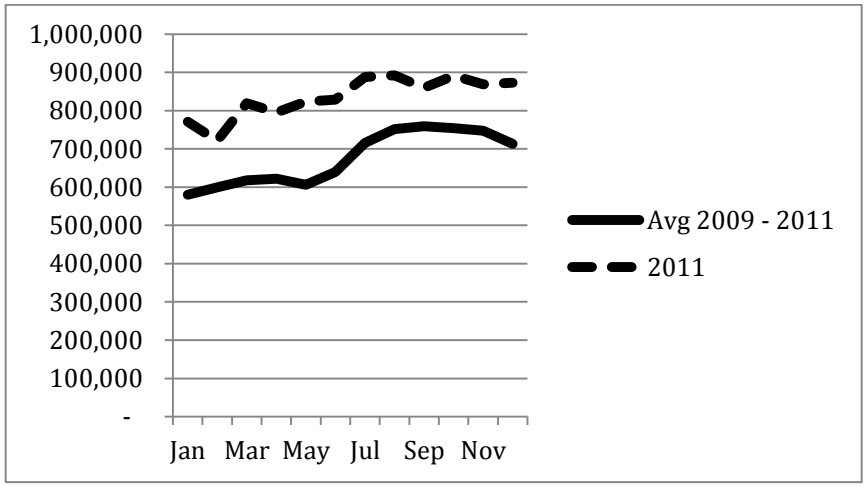
provides the gas free of cost for operation of the projects and has committed to buy 350 GWh annually from each of the three gas engine-based power projects, and 85% output from the CCGT. The annual energy available from these four private sector BOT projects is 1,900 GWh, an increase of the grid generation by 19%.

50. MEPE has also obtained (as gift from Thailand) a used gas turbine power plant (2 x 120 MW) for installation at Ywama; some of the major parts have already arrived at site and foundation civil works is under progress. This capacity is expected to be available in 2014.

51. MOEP has identified developers for implementing several new CCGT power plant - two stages of 500 MW each at Thaketa (by different developers), 486 MW at Hlawga, 500 MW at Kanbauk (Mandalay), 230 MW at Mawlamyine (Bago); another 100 MW will be implemented at Kyak Phyu (Rakhine) by MOEP or by soliciting bids. The total installed capacity of all new gas-based projects (including the 279 MW from the four BOTs) is 2,880 MW (and the estimated annual gas requirement is 633 million cubic feet (MMcft). The fuel will be provided from Myanmar's share from existing (100 MMcft), imported LNG and new production sharing contracts. When complete, these new gas-based power pants will provide additional 16,520 GWh, or add another 152% to the grid generation.

52. MEPE also carries out the generation scheduling and load dispatch function. Figure 1 presents the monthly power generation (MWh) for 2011 and the average of 2009 – 2011 (correction also done for 30-day months). The increase is on account of new capacity additions, mainly the Yeywa Hydropower Project (790 MW), the largest in Myanmar, in 2010. There is load shedding because of shortage in generation capacity during summer. On the other hand, according to MEPE, water has to be spilled from dams (for safety reasons) without electricity generation for about 2 months in a year.

Figure 1: Monthly Power Generation (MWh)



Source: Power Generation data from *Assessment of Myanmar Power Sector*

53. As an illustration of supply shortage, on 18 May 2012, the available generation capacity was 1,321 MW (27 MW from coal, 200 MW from the hydropower joint venture, 341 MW from gas-based, and 753 MW from MOEP's own hydropower) whereas the demand was estimated as 1,850 MW – the load shedding was 529 MW, which is 40% of the demand that was met. With further increase in generation capacity, the load shedding was about 200 MW in 2013.

54. Further, MEPE implements, operates and maintains all transmission lines (132 kV and higher voltage) and substations. There have been some recent initiatives that would be improving the performance of the enterprise:

(i) The first 500 kV transmission line (250 km) is being implemented with bilateral assistance from Serbia. Japan and ADB are developing the second stage (about 125 km near Yangon) of the 500 kV transmission system.

(ii) All transmission grid energy meters were replaced with state-of-the-art static energy meters in end 2012; the better accuracy has improved energy accounting and transmission loss is now measured as about 4% as compared to 7.5% earlier.

(iii) Procurement is in progress for phase 1 of a new SCADA system; AF-Consult, Switzerland has prepared the design and international competitive bidding has been used.

55. The grid substations have used the basic single-bus configuration and single phase transformer bank, on-load tap changers are not used, and transmission lines are single circuit (n-1 design criteria has not been used)[15], all these lead to poor voltage regulation, low reliability and availability. Any maintenance work on switchgear requires complete shut down. Mostly SF_6 (sulfur hexafluoride) circuit breakers have been used.

56. MEPE is also the "single buyer" for all power produced by HPGE and the private sector power projects. The tariff for purchase and sale of bulk power has been set so that the hydropower and coal-based generation and electricity distribution enterprises have a net operating revenue (higher revenue from sale of electricity than operating expenses). This leaves MEPE to report all the financial loss in the electricity sector. It has to pay at the rate of $5 per million British thermal units (MMBtu) ($176.68 per thousand cubic meter),[16] so the average cost of generation from the nine gas-based power plants is MK116/kWh ($0.12/kWh). Overall, MEPE reported a shortfall of MK35 billion in FY2013,[17] which is about 10.6% of the total sales valued at MK40/kWh, the average retail tariff. The Government paid this as subsidy, which is in addition to the subsidy on gas supply.

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15 Outage of one transmission component (transmission line or transformer) does not reduce the capacity under the n-1 design criteria.

16 The gas price was $11.6/MMBtu in 2011.

17 The figure for loss was provided by the accounts department of MEPE. It will need to be further verified as a media report quotes a far higher amount.

3. Hydropower and Coal-Based Generation

a. Installed Capacity, Hydropower and Coal Based

57. HPGE is responsible for hydropower and coal-based electricity generation. There are 20 hydropower plants under operation (Table A3.1, Appendix 3). Most of the installations are relatively new – though the oldest started operation in 1960, next two were added in the 1980s, three in 1990s, eight in 2000s, and six in 2010s. The total hydropower installed capacity is 2,780 MW, the largest unit size is 197.5 MW. Only four hydropower plants have units larger than 50 MW, which suggests a medium level of technology. There is only one mine-mouth coal-based power plant (120 MW).

58. The "firm capacity" available from all the hydropower plants is 986 MW (35% of installed capacity). This is because of the hydrology, the water flow during summer months is low so all units cannot be operated.

59. The Baluchaung hydropower project (168 MW) has completed over 50 years of operation. A major repair and renovation plan is being prepared for overseas development assistance from the Government of Japan; the works will start in 2014. In general, all hydropower equipment is operating well. During monsoon when the reservoir water levels are adequate, all the units are available for power generation. Since the turbine speeds are generally low, there are no serious issues of vibration or cavitation of the turbine runners.

60. The Tigyit coal-based power plant operates well below the design capacity (about 40%), the main reason is that the fuel quality is far below what was used for the design. The lignite mine has about 23 million tons of proven reserve and the project has already used about 5 million tons up till now. There is insufficient fuel to plan any capacity addition. Further, if the output is doubled (according to design capacity), the fuel could run out in another 8 – 10 years, unless further surveys reveal additional lignite reserve. The project is located far from the coastline (east of Nay Pyi Taw) so importing coal for blending is not a feasible option.

b. Capacity Addition

61. MOEP is adding hydropower and coal-based power generation capacity that are at various stages of implementation; (i) there are 11 hydropower projects (total 2,012 MW and 7,867 GWh) under construction, of which 7 are using government budget allocations (Table A3.2, Appendix 3).[18] MOEP is also investigating another 3 hydropower projects with aggregate capacity of 420 MW. Since budget allocations are done annually and not always according to the proposed implementation schedule, cost and time overruns are common. Implementation of a 140 MW hydropower projects takes 5 to 6 years; (ii) the private sector has prepared

[18] International experience suggests that a turnkey engineering-procurement-construction (EPC) contract is effective in controlling time and cost overruns. However, EPC contract cannot be awarded when fund flow is dependent on annual budget allocations and the total project cost is not firmly tied up at the beginning.

feasibility studies for 17 projects with a total capacity of 13,459 MW (Table A3.3, Appendix 3); and (iii) another 48 hydropower projects with total capacity of 18,958 MW are under investigation (Table A3.4, Appendix 3). The projects under (ii) and (iii) use the BOT model and are being developed by foreign companies in partnership with MOEP. In all, 17 companies are engaged (9 from People's Republic of China [PRC] and 2 each from India, Korea, Thailand, and China-Thailand partnership). The private sector has also signed MOU for developing 5 coal-based projects (2,560 MW) and the feasibility reports are under preparation. In all, the total capacity that is under investigation and feasibility study is 35,000 MW. The Government suspended or terminated implementation of 7 hydropower projects (9,270 MW), including Myitsone (6,000 MW).

62. Foreign joint venture (JV) BOT project development goes through five phases (four for BOT by domestic company) prior to start of construction. Essentially, it starts with the signing of an MOU, which allows the IPP 12 months to prepare the pre-feasibility report and another 18 months for the feasibility report (with engineering, like a detailed project report). MOEP signs the MOU after obtaining endorsement of Office of the Attorney General (OAG), MNPED and MOF. The second phase is the signing of the MOA after a complete review of the feasibility study report and the financial analysis. Before signing, the draft MOA has to be reviewed by OAG, MNPED and MOF, and submitted for the approval of the Union Cabinet. The third phase requires the approval of the Myanmar Investment Commission (MIC) under the Myanmar Investment law. By this phase, the developer is also required to prepare the environmental impact assessment (EIA) and the social impact assessment (SIA) and obtain the approval of MOECAF. The fourth phase is the signing of the Joint Venture Agreement (JVA).[19] Like the MOA, the draft JVA also requires the review by OAG, MNPED and MOF, and approval of the Union Cabinet. Finally (fifth phase), the signed JVA is submitted to MNPED, for legal opinion to the OAG, and for Concession Agreement (right to construct, operate, transmit, distribute and sell electricity) to the MOEP. Based on these documents, the developer can start the construction of the project.

c. Hydropower Project Implementation

63. The Department of Hydropower Implementation (DHPI) is responsible for implementation of the projects once the investigations are complete. It has about 3,900 employees, including 308 officers (professionals). Its in-house capacity is sufficient for implementing projects of about 25 MW capacity and carry out site preparation works (including the construction of diversion channel) for larger projects. AF-Consult Switzerland Ltd (earlier Colenco) and New Japan Engineering Corporation, a subsidiary of Kansai Electric, Japan, provide engineering and construction supervision support. While hydropower projects have not been implemented on the three of the major rivers (Ayareywaddy, Chindwin and Thanliwin), several JV-BOTs are presently being prepared along the Sittaung River (total capacity of about 18,000

[19] A JVA is not needed in a BOT developed by a domestic company.

MW). MOEP has established the Cascade Control Center, with Deputy Minister as the chair, to coordinate the water flow, generation and environmental aspects for the cascade.[20]

D. Climate Change

64. Myanmar electricity sector presently uses hydropower and natural gas for electricity generation so its carbon footprint is small compared to most countries in the region. However, the rainfall pattern will be changing because of the impact of climate change and changes in hydrology may affect hydropower generation. Intuitively, the average annual rainfall is expected to rise because the monsoons will carry more moisture from the warmer oceans. However, there may be more intense weather conditions (typhoons or cyclones) in the future that have heavy downpours in shorter duration. The storage capacity of dams may not have been designed to hold water from heavy rainfall so there may be no increase in hydropower generation; the dams, particularly the run-of-river ones, would have to spill the water for safety reasons.

65. The intense weather conditions will also increase the risk for large structures close to the coastline – stacks and transmission line towers. However, the available information regarding frequency and intensity of the future typhoons is inadequate for suggesting design changes.

E. Human Resources

66. MOEP recruits employees at three levels – technicians and workmen, supervisors and officers. Technicians generally have a high school degree with vocational training; supervisors require a diploma and officers require a bachelor degree in engineering sciences or equivalent. After joining, the employees undergo formal training at the training centers (Hydropower Development Center, Paunglaung, near Nay Pyi Taw and Hlaingtharyar Training Center, Yangon) and on-the-job training in one of the field units.

67. Myanmar has three technical, post-secondary education programs. After 11 years of schooling (high school), a student can attend 2-years vocational course to learn the trades (black smith, carpentry, fitter etc.). Alternately, 3-year program in the government technical institute gives a diploma in engineering, after which the student can join a 1-year course to get a Bachelor of Technology degree. The top 10 students from the vocational course can also join the government technical institute for a year and get a diploma in engineering. A Bachelor of Engineering degree is awarded after a 6-year course following high school.[21]

68. To augment the technical knowledge base, MOEP has also sent staff for graduate engineering programs in Japan (two staff), Thailand (three staff) and South Korea (one staff),

[20] In March 2013, Salween Watch, and international NGO released a status report of the cascade projects. The report highlights the ecological issues and political instability in the area.

[21] The tertiary education system has been changed several times in the past, the description is of the present system that started in 2012.

and for short-term course to Japan (5 engineers every year for 6 weeks) and Norway and other countries (2 – 4 weeks). The funding of such foreign studies and training is included in the scope of the engineering consultants and provided by International Center for Hydropower, Norway. Further, the equipment suppliers (from PRC) are required to train and share know how with counterpart staff in MOEP so they have the capacity to operate and maintain the equipment.

69. The gender balance in MOEP is skewed; the number of women officers may be less than 10%. However, there are no apparent gender barriers. There are women in senior positions, including a head of finance in an enterprise and a head of a gas-based power plant in Yangon.[22] An engineering degree or diploma is the basic qualification for most positions and the number of girl student taking up these courses is also limited, this possibly impacts the gender balance.

III. POWER SECTOR REFORM AND BUILDING INSTITUTIONAL CAPACITY

A. Policy Initiatives

1. New Electricity Law

70. Myanmar's electricity sector faces considerable challenges, some key issues are, (i) distribution networks are significantly de-rated because of inadequate maintenance and upgrades, the peak load shortage (load shedding) during summer season is about 200 MW; (ii) there are nearly 6.3 million households (71% of the total) that do not have electricity supply, and the cost of alternatives is prohibitive for poor rural households; (iii) technologies that are "normal" in Asia region are yet to be introduced (e.g. 500 kV transmission), there will be steep learning curve but also the opportunity to "leap frog" to new and efficient systems; (iv) adequate reserves of primary energy sources are available but present production (particularly gas) is exported under long-term contract. Together with new gas production, renewable energy supply (hydropower, wind, solar) has to be increased; some large capacity hydropower sites are in regions with ethnic conflict so political stability has to be established first; and (v) the sector is not financially viable and requires Government budget funds for capital expenditure and gas purchase.

71. There is clearly an urgent need of new investments. However, in order to successfully meet its challenges, the Government will need to expedite the enactment of the new Electricity Law that will be better suited to meet the challenges, and MOEP will need to formulate and implement policy reforms and carry out institutional strengthening as more funds become available following the economic transformation being implemented by the Government.

72. The Electricity Law (1984) needs to be revised because of the complexities of a large electricity system and the large number of players that will be required to work in a coordinated manner for achieving the electricity sector goals of the Government. A revised

[22] The Power Sector Advisor has met the two senior staff during the course of the assignment; there would be other senior women staff as well.

draft Myanmar Electricity Law has been prepared by MOEP and a legal consultant engaged through ADB has provided inputs. Different ministries are presently reviewing the new draft law. The IAR does not again review or comment on the new draft Electricity Law. Instead, it lists some key provisions that will be necessary for ensuring the development and proper governance of the electricity sector.

(i) **Nodal ministry:** MOEP has to be recognized as the nodal ministry for all matters related to the electricity sector.

(ii) **Unbundling:** Distinct functions have to be separated and responsibilities assigned to specific departments and legal entities. This allows enterprises to build expertise according to their mandate.

(iii) **Policy and long-term planning:** Under the new legal framework, policy and long-term planning should remain with MOEP, preferable under a policy and planning department. Close coordination with other ministries will be necessary to understand what is going to be rate of GDP growth, what will be the environmental standards, which sectors will get priority (e.g, encouraging manufacturing creates employment for surplus labor when the agriculture sector is modernized), timeframe when more natural gas will be available to meet the domestic energy demand, and how will the growth of the electricity sector be financed (e.g., surplus revenue from electricity sale, private sector, foreign investors, borrowings, tax revenue) etc. The long-term (strategic) plans help identify the electricity demand and supply gap so companies can plan their investments. These long-term plans are indicative and require regular updates because of macroeconomic factors (e.g., economic growth and exchange rate not being the same as projected) and other barriers that are beyond the control of the energy sector.

(iv) **Safety:** Safety during project implementation and operation is of utmost importance for the prevention of loss of property and life. A separate inspectorate, under the MOEP, will be necessary.

(v) **Economic regulation:** Price setting and entry of new players (licensing) is another distinct function. For the electricity sector to be financially viable, the electricity tariff should meet several criteria – recover full cost of development, GTD, trade and sale of electricity; industrial and commercial sectors in Myanmar should not be put at a disadvantage in comparison to neighboring economies because of a high electricity cost; it should include a reasonable return on equity investment to attract the private sector; it should be sufficiently high so less electricity is wasted and renewable energy investment does not get discouraged. Historically, the MOEP departments and enterprises carried out GTD and MOF provided the resources for its development and operations; cost recovery mattered but oversight of MOF provided the discipline. The new Electricity Law will promote private sector investment as part of the reform policy of the Government. To provide transparency and a level playing field between state-

owned enterprises and the private sector, a start has to be made to create a separate electricity regulator within the MOEP. Electricity sector also has an "information bias", wherein the entities engaged in GTD know more about the business (trends and issues) than government or regulator. Therefore, it will be necessary to quickly build the capacity of the regulator in terms of economics, financial and utility practices. As in-house regulatory capacity is built, and the electricity sector expands to include more private sector players, the regulatory body will have to be a separate and independent legal entity. International financial institutions and bilateral donors (generally referred to as development partners) provide extensive support for building regulatory capacity and Myanmar can readily avail this.[23]

(vi) **Standards and codes:** These are already being developed with the support of ADB. A separate department under MOEP can be made responsible for announcing these and ensuring that these are updated from time to time when new technology becomes available.

(vii) **Corporatization:** The state-owned enterprises, departments that are involved in GTD, and the YESB need to become separate legal entities registered under the Myanmar Companies Act. Creation of these separate commercial entities is critical for the growth of electricity sector. Then debt and contract obligations will not automatically pass on to the Government.[24] Such corporations function on a "going concern" basis and are required to maintain proper accounts (income statement, balance sheet and cash flow) that have to be audited annually by an independent external auditor. They have to balance their revenue and expenses and maintain a positive net worth of the company.[25] For new projects, they can borrow from commercial banks (or international financial institutions like the ADB) but the shareholder's (Government's) equity contribution and retained earnings from business have to be about 30% of the project cost. This introduces financial disciple and the flexibility for day-to-day operations to the governing board and management of the state-owned enterprises. The MOEP can appoint the board members and specify performance standards to ensure that the enterprises adhere to the sector policies. The

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[23] Government of Norway has provided $800,000 for technical assistance to be approved and managed by ADB, it includes assistance for enactment of the new Electricity Law and strengthening regulatory capacity.

[24] Theoretically, a foreign company can petition a court in its country to allow it to take over the assets of a country's embassy in that country when a commercial contract with a state entity is breached and arbitration award is in its favor. Further, the International Monetary Fund normally counts the obligations under a power purchase agreement as a long-term government liability and accordingly lowers the borrowing capacity of the Government, which hampers developmental assistance. Therefore, liabilities of power companies should be kept away from the government.

[25] The electricity tariff of loss making corporations will have to be adjusted to a full cost recovery level to enable them to balance the revenue and cost, provided the performance level is not below industry standards.

conversion to corporate structure will require time, mostly to segregate the assets and establish required organizational systems. Corporatization is not the same as privatization; the state-owned enterprises can co-exist with private sector companies for electricity generation and distribution. It would allow comparison of performance and indication regarding reasonable project and O&M costs. More information about corporatization is in Box 1.

Box 1: Corporatization of Power Sector Enterprises

In order to convert HPGE, DHPI, ESE, MEPE and YESB to real "enterprises" that have a distinct identity from the Government, the following transformation will be necessary.

- Establish governing board for each enterprise that includes independent (economic and technical experts) and non-executive directors (nominees from the government). All decisions of the governing board will be collective, although the basis can be a majority vote.
- Clarify which ministry will exercise the duties of the Government shareholding (MOF or MOEP or any other – planning, state-owned enterprises).
- Require enterprises to pay taxes and dividends.
- Establish a reporting relationship to the shareholder.
    - The focus of the reports should not be on day-to-day operating decisions, but on management strategies and organizational performance.
- Adopt generally accepted accounting standards for all financial reports; these have to be audited and submitted to the Government – the ministry that is responsible for government shareholdings. An internal audit department is also required. The annual reports have to be made public as these are state-owned enterprises.
- Require enterprises to prepare strategic plans and five-year plan (FYP) investment plans that coincide with the government's FYPs. Once the government (MNPED) endorses the FYPs, the enterprises would have the authority to raise debt. However, initially the MOF may arrange debt from development partners (these generally have lower interest rate).
- MOEP and enterprise management sign performance contracts with key results; while the management will be responsible for achieving annual performance targets, the government will be responsible for providing agreed inputs. This will be particularly important while tariffs remain below full cost recovery level, and the government needs to provide subsidies and funds for project implementation in a timely manner.
- Require enterprises to prepare their human resource policies and systems with due emphasis on (i) recruitment of skilled personal and regular training, (ii) adequate compensation and benefits, (iii) recognition and rewards for exemplary work, (iv) high level of motivation, move towards gender balance.
- Introduce performance-based compensation schemes for management
- Clearly state the delegation of authority to various levels within an enterprise – governing board, general manager/chief engineer, superintendent engineer, executive engineer, and assistant engineer for matters related to procurement of goods and services. Economic procurement will require transparent competitive bidding system with clear evaluation criteria.

2. Electricity Policy

73. In general, the present draft electricity policy, together with the objectives and action plan, covers the key aspects of the Myanmar electricity sector. However, MOEP can consider inclusion of some more key elements under "objectives". Considering the ongoing transformation process, greater clarity in MOEP's electricity policy will enable other players to plan their investments. Some key elements are:

(i) **Electricity tariff, economic procurement and subsidy:** the basis for determining electricity tariff needs to be clarified; should it be market based and reflect the demand supply gap, or be determined on a cost plus basis for power generation and distribution; will there be a uniform nationwide retail tariff? Apart from overall cost recovery, electricity tariffs can fulfill other objectives such as extending support to the poor in a transparent manner, setting tariff for different categories based on voltage level and bulk consumption, introduction of regional tariffs to reflect level of service, encouragement for energy conservation, and promotion of renewable energy. Consumers have to be assured that the cost of electricity supply will be kept as low as possible, since they have little choice to select providers. This will require a sentence at the policy level that MOEP will always follow economic procurement. Further, even with subsidized gas supply, the present level of tariff will need to increase to cover full cost of supply and to leave adequate surplus for further growth. Then, how will electricity be made affordable for poor households? Use of lifeline tariff (about 20 kWh/month/household)[26] allows cross-subsidy so other domestic consumers would bear the cost of subsidy. However, the number of poor households will be large in Myanmar (as a percentage of total domestic consumers) so to reduce the burden, the Government could decide to provide electricity subsidy (cash transfer) directly to some of the poor households. There will soon be the question of a uniform national tariff; with democratization and decentralization, the expectation of consumers in resource rich and more economically advanced provinces will become different. Then it will become difficult to have the same national tariff across the different consumer categories in all of Myanmar.

(ii) **Energy access and gas supply network:** the outcomes include extension of electricity supply to villages that are not yet connected to the grid. The rural

[26] The 20 kWh/month/household level is about the minimum level of household electricity consumption considering use of 4 light bulbs, one small television and cell phone charger. To remain within this low level, low-income households will require support for purchasing compact fluorescent lamps or light emitting diodes. For MOEP, the energy saved by ensuring the use of efficient lamps will lower investment in new generation and grid network. Several countries (e.g., Philippines, Pakistan) have distributed compact fluorescent lamps free of cost using loans from international financial institutions and sought benefit from the Clean Development Mechanism under the Kyoto Protocol.

household use energy for lighting, charging cell phones and entertainment. However, the use of firewood for cooking cannot be substituted by electricity. The viable alternatives are to provide liquefied petroleum gas (if the refineries have adequate capacity) or build a network of gas pipeline. There is a strong energy efficiency argument for building the gas supply network instead of using it for power generation – even CCGT power plants have about 50% efficiency so half the energy in gas is lost.[27] When the same gas is supplied directly to homes, over 80% of the energy will be used for cooking. If the energy policy were to accept this more efficient approach, the development of electricity distribution network will have to be coordinated with gas network planning.

(iii) **Private sector participation:** At present, private sector companies create JVs with MOEP for developing and implementing hydropower projects. However, it is generally easier to raise debt from commercial banks for projects with long pay-back periods (15 – 20 years) when projects are developed by private sector enterprises with distinct legal entities that can be made to discharge the liabilities. The electricity policy will need to make this explicit, which can be done when the enterprises become corporations. Further, it will help to also clarify that selection of the private sector provider (in generation and distribution) will be on a competitive basis and the performance will be monitored in a transparent manner.

(iv) **Energy efficiency and conservation:** Use of international assistance would accelerate the growth of the electricity sector, but the development partners will want MOEP to support energy efficiency (both on supply side and electricity consumption side) and gradually lower energy intensity (thereby manage carbon dioxide emissions). Promoting energy efficiency and conservation is also economical, then less capacity is needed to meet the future demand of electricity services. The policy needs to express this explicitly and the action plan needs to mention the institutional arrangement to track energy efficiency and carbon dioxide emissions. Further, there are two suggestions that can demonstrate Myanmar's commitment to this global cause; (a) with significant gas production, Myanmar is in a good position to consider early adoption of carbon capture and storage – the captured carbon dioxide can be stored in depleting gas and oil wells for extended recovery;[28] and (b) converting all open cycle gas based generation to combined cycle. These possibilities may be included in the outcome section. Further, MOEP needs to commission a climate change impact assessment study to understand how changes in rainfall pattern would affect the hydropower generation. Development partners that have

[27] The rejected heat from a thermal power plant can be utilized in a combined heat and power plant or a centralized district cooling systems. However, Myanmar does not require heat supply and is unlikely to implement district cooling in the vicinity of power plants.

[28] The carbon capture and storage technology is yet to be fully developed so Myanmar need not commit funds for this. Assistance can be sought from development partners to carry out investigations at this stage.

expertise in the field and run climate change models can be requested to provide assistance for such a study. MOEP may need to install more weather monitoring stations so the model can use data from the main rain sheds.

(v) **Small renewable projects:** Small hydropower (less than 20 MW), wind and solar power projects (less than 1 MW) can be implemented quickly, have a small environmental footprint and are economically attractive because they do not use fuel or produce carbon dioxide. Myanmar has numerous opportunities for implementation of small renewable energy projects – e.g., a foreign company has prepared a proposal to install small turbines (aggregate capacity of 8 MW) on existing irrigation canals; the water flow is fairly regular and about 50% utilization factor is possible. The development of such projects can be expedited by establishing separate fast-track procedures for power purchase. By connecting these small renewable projects to the grid, MEPE will avoid use of gas, which will reduce the average cost of generation and make more gas available for export. At the same time, the project will become "bankable" because of the assured dispatch.

(vi) **Consultation.** An important part of electricity policy formulation should be consultation with stakeholders, i.e., with representatives of various consumer categories, potential investors and project developers, civil society (e.g., media and NGOs), international electricity experts, and development partners. These stakeholders would examine the draft policy from their own point-of-view and enable MOEP to take a balanced position that does not favor a particular interest group. The discussions are generally enriching, and with good information sharing, it also becomes easier to implement a policy that has buy in of such a large audience.

3. Rural Energy Delivery

74. With an electrification ratio of only 16% in rural areas and a 75% share of biomass in primary energy mix, the Government faces an immense challenge. Lack of commercial energy is increasing the use of firewood, which is related to deforestation. Further, biomass is a weak energy source that is inadequate for most human needs, except cooking where it also causes indoor air pollution and associated health hazards. The Government has already recognized the need to rapidly expand rural energy supply. To spearhead this task, the inter-ministerial REDC has been created. A successful rural energy delivery program will improve the delivery of critical social infrastructure services like education, health, security, and drinking water; provide entertainment and communication; and thereby promote inclusive growth and reduce poverty. Further, it helps restore gender balance as mostly women collect firewood and cook. With ready availability of commercial energy supplies, women will have more time for studies, caring for the family, and productive economic activities.

75. Together with the extension of electricity grid by MOEP, several other ministries are implementing projects for rural electrification and energy supply. MOI coordinates the activities

of the REDC, MOST has implemented pilot off-grid projects using wind and solar energy, rural electrification department under the Ministry of Border Affairs has implement about 17,600 solar home systems in FY2013 and plans to implement another 13,600 solar home systems and 80 mini-hydropower projects in FY 2014.

76. A public awareness and information dissemination program is necessary for the rural population to discourage the use of fuel wood. Indiscriminate use of fuel wood (and charcoal) is contributing significantly to de-forestation, soil erosion, and possibly changes in rainfall patterns. More serious, indoor pollution caused by the wood and charcoal stoves expose the family members to greater risks of respiratory diseases and shorter life span. Improved cook-stoves can at least help reduce the amount of fuel needed for cooking and the indoor pollution till alternate energy supply becomes available.

77. Rural energy delivery has to include both electricity (for lighting, entertainment, communications, home appliances, and light machinery that improve agriculture productivity) and cooking fuel. It can be expedited in several ways and considering the large number of households (about 12 million) spread over the full expanse of the country, more than one approach will be necessary. Some options are mentioned below, these have been implemented successfully in one Asian country or another and with good coordination, these offer an opportunity for leap frogging and avoiding the pitfalls. The relevant technologies are now commercially available and costs are reasonable.

(i) **Non-Governmental organizations**: There is a significant presence of non-governmental organizations in Myanmar that can use direct contributions and assistance from development partners and implement the rural energy delivery program. As necessary, these organizations can partner with MOEP for expediting the rural electrification program.

(ii) **Private sector management and investment:** The private sector is already involved in delivery of electricity services using micro-grids. MOEP leases the equipment (diesel generator sets and distribution system) and the operator manages the service, billing and collection. In such cases the tariff is usually much higher than the MOEP because the costs are high. Such arrangements should be formally included in the MOEP's action plan to provide electricity in regions that can afford the higher tariffs.

(iii) **Vicinity of power plants and grid substations:** MOEP can also assign targets for rural grid-based electrification to HPGE and ESE. Power projects, particularly hydropower, are usually located in remote areas. There can be a general guideline that villages within a 20 km radius (more for larger power plants) of a new, existing power generation project, or grid substation should be electrified and supplied directly from the facility. ESE or a private contractor may be assigned the responsibility for managing the small distribution business. Including the capital cost of such electrification in the cost of the project would have very little impact on the generation or transmission tariff.

(iv) **Renewable energy:** Micro-grids can also be established using renewable energy (small and mini hydropower, wind and solar). International assistance would be available to adopt such a "green" approach; the private sector can also be encouraged to use renewable energy.[29]

(v) **Biomass for cooking and electricity:** Available local biomass (from planned forestry or agriculture residue) can be processed to provide clean rural energy. The biomass can be first gasified and piped to village homes for cooking and when it is not required for cooking, used in gas engines to generate electricity. MOST already has about 175 bio-digesters in service that provide fuel and electricity, these have to be evaluated and expanded with improvements, where necessary.

(vi) **Gas supply:** Expanding the gas supply – liquefied petroleum gas or piped natural gas network – will also be an efficient and clean approach for rural energy delivery program.

(vii) **Rural energy development fund:** The Government can establish a rural energy delivery fund (a non-banking financial institution) that uses budget allocations as equity and raises more capital to implement a larger rural energy delivery program.

(viii) **Rural electricity cooperatives:** Philippines and Bangladesh established a large number of rural electricity cooperatives in the 1990s to quickly expand rural electrification (126 cooperatives in Philippines and 70 in Bangladesh). There has been an issue of lack of proper management and technical capacity of these cooperatives (usually "taken-over" by the influential people in the villages) so care will be needed if this approach is to be used in Myanmar.

78. The outcome of the rural energy delivery program will hinge on two critical "soft" issues – how the program is coordinated and how much resource can be allocated to cover nearly the whole population within a reasonable time, say 5 – 7 years.[30] The Union Government has already established the REDC that is chaired by MOI. This committee needs to assign targets (number of household connections and regions or districts) to various central enterprises and organizations under the provincial governments that have the knowledge and expertize to implement the rural energy delivery program. Accordingly, it should allocate financial resources to carry out implementation of the program. The decision regarding approach and private sector or NGO involvement may be left to the enterprises and organization. The performance (number of households provided reliable energy supply) should be monitored and targets

[29] ADB is presently considering a TA to develop this approach.

[30] Before the 1997 Asian financial crisis, Indonesia had about 20 million household consumers and was extending electricity supply to 1 million households annually. Myanmar has a large capacity addition program so electricity will be available. A far higher target is feasible in Myanmar because even accessible regions have no connection, the target can be divided into a larger number of enterprises, and several approaches can be concurrently implemented.

modified from time to time so that enterprises those perform better get more resources and are able to align more closely to the Government's goal.

79. On their part, the enterprises will need to create a separate department with adequate and properly skilled work force for rural energy delivery. This is necessary because rural energy supply is commercially insignificant but socially very important; enterprises will have to give special attention to it over the next 5 – 7 years, apart from their normal responsibilities, for helping the Government achieve the goal.

80. It has to be clear at the onset that rural energy delivery program is economically attractive but not commercially viable (revenue can not equal expenses) – it is a social necessity. For one, the cost of delivery of energy services in sparsely populated rural areas will be higher as compared to urban areas. Subsidy – for capital and revenue – will be needed. The rural households presently use firewood, which adds nearly nothing to the household expense.[31] They have a very low willingness to pay for an alternative to firewood (gas or improved cook stoves) or for lighting; many poor households will have inadequate income to buy a television for entertainment so electricity supply will not be a priority. This will change gradually. Ready availability and use of commercial energy (gas and electricity) will free up time and enable the households to upgrade their skills and increase income through economic activities (employment or micro enterprises). As incomes grow, their need for commercial energy will grow and so will the willingness to pay. In about 5 – 7 years, they are likely to start demanding a reliable energy service and also be ready to pay a reasonable cost.[32] Since the social objectives are high, the program will be fully justified for budgetary support, which needs to be done in a transparent manner and after ensuring proper accountability.

81. Another related issue is going to be tariff setting. Presently Myanmar has uniform national tariffs for various consumer categories.[33] However, the cost of delivery of energy services and the willingness to pay are going to be different in rural areas in different parts of the country; the tariff levels, particularly for electricity, will also need to be different.

4. Sustainability of Rural Energy Delivery System

82. Empirical evidence from other countries suggests that sustainability is a serious issue in rural energy delivery programs; the local community generally lacks the technical capability to properly maintain or repair machines like micro-hydropower turbines, diesel engines, generators; and in the absence of a commercial approach, there is little fund available for buying consumables (lubricants) and spares, engaging technicians for repair, or even paying wages to staff. A review after 5 years of initial installation has often shown that the equipment

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[31] Since kerosene is not subsidized, its use is very limited in Myanmar. They use candles for lighting; in all probability they are doing without or minimal lighting and are unable to carry out activities in evening hours.

[32] However, care needs to be taken in planning for the future growth in energy demand in rural areas; with improvement is skills, the rural population also migrates to urban or semi-urban areas and the thus increases the growth of energy demand in another area.

[33] There are a few exceptions for off-grid supply being carried out informally by private companies; these charge a higher rate.

is not performing as designed and requires additional funds for rehabilitation. Therefore, when implementing the rural energy delivery program, it will be necessary to include following two features.

(i) The organization that overseas the implementation should also be responsible for establishing a system for proper maintenance of the equipment. If in-house capacity is not available, suitable local entrepreneurs should be identified and long-term maintenance contracts signed. The local community should have a voice in the management of such maintenance contracts for ensuring quality of service. These could be entrepreneurs that sell farm implements, repair vehicles, or service of other small machinery. If the region is so remote that local entrepreneurs cannot be identified, training could be given to some local educated people, but such training should form part of a more general livelihood development program.

(ii) A cost recovery system should also be developed whenever electricity is provided (by grid- or off-grid systems) to a household for the first time. In rural areas, a large share of the population may have a low household income so would not be able to afford to pay at the normal tariff rate even if the consumption level is very low (less than 20 kWh per month). Still, they need to understand that provision of energy entails costs and they need to share it. A possible approach could be to apply a concessional rate of about 25% of the regular residential tariff for the first 2 years, and increasing it by the same amount every 2 years to reach full tariff level in 6 years. By then, the electricity supply is expected to have a positive impact on the income and affordability. Of course, rural consumers whose income is above the poverty level should be required to pay at the regular tariff from the beginning. Generally, people are willing to pay for electricity provided the service is of an acceptable standard. A proper arrangement for billing and collection of money will be needed. Again, the local community may lack structured arrangements and it may be too costly to employ staff to do billing and collection for small communities. Innovative approaches may become necessary, e.g., responsibility for electricity billing and collection can be given to a local school, primary health clinic, or a local shop. Such stakeholders have a strong interest in getting proper electricity supply, so they will want to persuade households to make timely payments.

B. Technology and Infrastructure

1. Capacity Addition

83. Under normal circumstances, with 35 GW of hydropower and coal-based power and 2.6 GW of gas-based power capacity under development, there would be little need to identify new project proposals for meeting Myanmar's existing demand and the expected growth over the next 10 years. However, there are considerable uncertainties regarding the implementation timeframe of the new projects. MOEP's own projects need annual budget allocations, which is

uncertain. Some sites are in conflict areas and site work can only start after the local community fully accepts the project. The weighted progress of six hydropower projects (total capacity 491 MW) is over 50% so these will be completed by 2016. The other projects under construction (total capacity 1,521) would get completed but the timeframe is uncertain.[34] The situation is very different for JV-BOT project proposals that only have feasibility reports (13,459 MW) or are under investigation (18,958 MW). There is a high degree of uncertainty regarding their completion or the implementation schedule. Similarly, developers of the 500 MW combined cycle gas turbine projects have not tied up the debt and lack proper project implementation schedules.

84. In order to better manage the project development process, several changes are necessary:

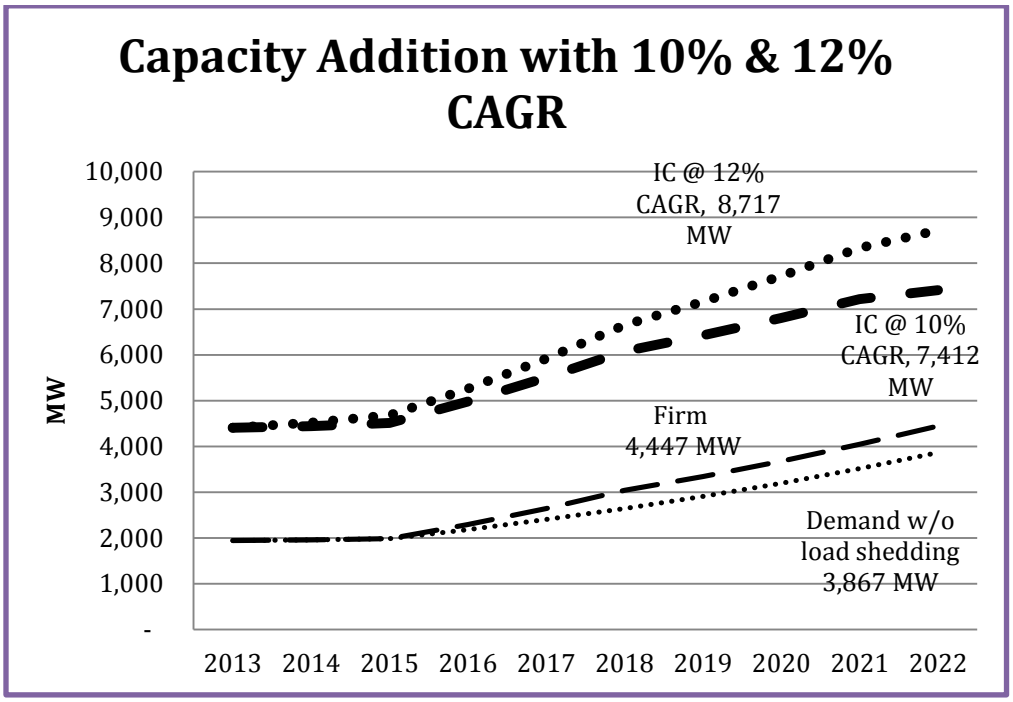
(i) **Planning capacity addition:** The need for additional generation capacity is not well established. The JV partners (and their lenders) do knot know if the project get dispatched and sell power or remain idle because other projects will get completed before it, i.e., there is a high dispatch risk? All projects have been justified considering the low per capita consumption and the large population. However, for utilizing the power plants, a similar investment has to be made by MOEP in transmission and distribution networks. The JV partners will be observing how MOEP is expanding the networks and how per capita income (the economy) is increasing so people have the capacity to buy more electricity. Till they are satisfied that the new power plants will be utilized, it is unlikely that the JVs will invest in procuring equipment and start the construction. To address this dispatch risk, all JV partners who are yet to tied up funds or start project construction have to be informed that the MOU and MOA are being cancelled. MOEP should then update the demand projections and capacity addition plan by only considering the "serious" projects. A reserve capacity[35] of 15% is adequate for ensuring a reliable and un-interrupted power supply in a system with a good mix of generation. However, the Myanmar system has a high share of hydropower projects so the reserve capacity may be higher to account for the dry summer months (it will also depend on the completion schedule of the new large storage hydropower projects). New projects should only be identified when reserve margin drops below the desired value. The planning department will need to acquire and train staff in the use of computer software program for long-term generation planning. Planners and consulting firms commonly use several such programs, like Long-range Energy Alternatives Planning System (LEAP), MARKet Allocation (MARKEL), and Wien Automatic System Planning (WASP). Presently, there are enough new projects under development and construction to match the possible increase in electricity demand. MOEP can take a couple of years to resolve this issue and prepare a proper capacity

[34] For example, the progress of MOEP-funded Shweli 3 (1,050 MW) is only 6%.

[35] Reserve margin is the peak demand divided by firm available capacity.

addition plan, mainly by deferring the projects that are now in the pipeline. With very simple calculations, Figure 2 below indicates the generation capacity needed after 10 years, i.e., in 2022, with compounded annual growth rate (CAGR) of peak demand as 12% and 10%. It will take about 3 years to overcome the capacity shortage and assuming 15% reserve margin that would be possible after another 2 years, the needed capacity would be between 7.4 GW and 8.7 GW. About 7 GW capacity would be in place when all the projects under development and implementation get completed (by 2016). To put this CAGR in perspective, with the massive growth of the manufacturing sector in PRC, the CAGR of installed capacity was only 12.1% during the past 10 years (2002 – 2012); Myanmar is unlikely to have similar growth rate for 10 consecutive years even though the base capacity requirement is small.

Table 2: Possible Growth of Electricity Demand and Installed Capacity



CAGR – compounded annual growth rate; IC – Installed Capacity; MW = Megawatt

Source: Power Adviser's calculation

(ii) **Tie up of project funds:** In order to economically implement large projects, there is no alternative to tying up the total project cost (including about 10% contingency) before starting construction. This will not be possible when MOF makes annual allocations in the union budget. A solution will be possible once the enterprises under MOEP are changed into corporation. Then the budget allocation will still be needed for equity, which will be about 30% of the project cost. The major part of the funds needed for project implementation can be raised as debt from domestic banks or international financial institution, which we be available in a timely manner. The, projects can generally be implemented

according to schedule even if there are minor deviations in the flow of budget funds (equity). When several projects are implemented at the same time, there would be some flexibility by management of bills payables (money owed to equipment suppliers). Similarly, for BOT and JV-BOT projects, the developers should also be required to submit the loan agreements, or other letters, confirming that total project cost (including contingency) has been tied up – this should be a major milestone event and failure to achieve it timely should result in cancelation of the MOA.

(iii) **Expeditious project development and approval:** There is a need to streamline the approval procedure for hydropower projects and reduce the number of times a BOT or JV-BOT proposal has to be submitted for review and approval by Office of Attorney General, MNPED, MOECAF, MIC and Union Cabinet. Ideally, there should be an in-principal concurrence by the external ministries at the project identification stage – when a pre-feasibility report is available that provides economic justification and flags the key considerations during project development. In case of JV-BOT, the partner has to be also identified. If a competitive bidding procedure were to be used to select an IPP, an outline bidding documents would be needed. Once the in-principal agreement is there to move ahead, MOEP should prepare the proposal and should build capacity accordingly. It needs to create a dedicated team for the development and approval of JV-BOT and other types of IPP projects. This team should be adequately staffed with professionals having the right skill mix – economist, engineers, procurement specialists, financial analysts, environmental specialists, social specialists, and legal counsel. Legal inputs are also commonly sourced from outside as it is easier for international law firms to track the developments in power purchase agreement (PPA) structuring and terms. Development partners can be requested to provide support for engaging international experts during the initial learning period. The team should thoroughly review all aspects of the project proposal and submit the draft MOU, MOA, JVA, Concession Rights, EIA and SIA to all the ministries for their approval. Preferably, the Union Cabinet approval should only be needed at the final stage, and later changed to a plan-stage approval when sufficient experience is available for successful development of projects.

(iv) **Project design:** It is a common practice for power companies to engage engineering institutes and consultants for preparing the detailed engineering of large projects. Enough in-house capacity is then needed to prepare specifications and review the work of the engineering consultants. MOEP will need to decide if they will adopt a similar approach. Presently the design of all hydropower, coal-based, and transmission line projects is prepared in-house, which may be justified as good engineering consultants may not be available in Myanmar. However, this could change as private sector implements more power projects and this facilitates building domestic engineering capacity. Meanwhile, the in-house design capacity may have to be maintained.

(v) **Project implementation:** Presently, the enterprises purchase the equipment for a project and carry out the erection themselves. MOEP should consider turn-key EPC contracts for implementation of large projects (e.g., above 200 MW) so that time and cost overruns can be controlled. The same should apply to all JV-BOT projects (since MOEP is a JV partner it can make this a pre-condition). Project cost may increase a little because the contractor will require higher returns to compensate the project implementation risk, but economic and financial benefits are always higher when capital remains unproductive for a shorter implementation period. In large projects the returns only come after incurring nearly 80% of the project cost over 3 – 5 years, so it is important to complete projects on schedule.

(vi) **Meteorological monitoring stations:** For all its dams, HPGE needs to plan the annual power generation and maximize the generation during summer months when water flow in the rivers is low. It needs computer models that use satellite data for forecasting the rainfall in the catchment areas and determine the water flow and reservoir capacity. This can help shift some of the generation to dry summer months without spilling water during the rainy season. Presently, only one meteorological monitoring station is available for taking ground measurements. A complete network of such monitoring stations in all river valleys will increase the accuracy of the forecasting. Assistance for obtaining equipment, computer software and know how for the forecasting can be sought from development partners. Further, Myanmar will need to leapfrog to Geography Information System–based records for all networks (e.g., road, rail, pipelines, transmission lines, and distribution systems), land records, maps, meteorological stations etc. This will enable enterprises in different sectors to share reliable data. Systematically implementing GIS at the national level will avoid duplication and save costs.

2. Restoration of Installed Capacity

85. Inability to use the full design capacity of power generation equipment leads to economic and financial losses. The under utilization of the coal-based Tigyit project (120 MW, completed in 2005) is reportedly because of lower heat content in the fuel compared to what the boiler has been designed for. There are several case studies of fuel conversion when boilers had to be modified to burn a different fuel, i.e., lignite-based boiler converted to oil and oil-based boiler converted to coal. Engineering firms with specialty in boiler design can be engaged to examine the problem in depth and suggest cost effective modifications so the power plant output can be restored to its designed value. Similarly, the under utilization of gas-based generation capacity is linked to high failure of condenser tubes. Engineering firms having specialty in water chemistry can be engaged to suggest treatment technologies for improving the ground water quality, which will the prevent condenser tube failures and the steam turbines can operate at the design capacity.

3. Renewable Energy

86. With a high share of hydropower (now 75%, which may increase over the long term with development of hydropower project sites already identified), Myanmar is well positioned to install wind and solar power projects without affecting the reliability. The interruptability of the wind and solar power can be addressed by varying the generation from storage-type hydropower projects for regulating supply frequency (50 hertz). The gas-based generation will be reduced when wind and solar are available, which will free up gas for export.

87. The "late mover" advantage will allow Myanmar to benefit from the significant reduction in cost of equipment in recent years, the improvements in technology, and larger number of experienced wind and solar project developers. MOEP can invest in resource measurements (wind masts and solar radiation monitoring stations) for about a year and then it can invite competitive bids from international developers. With grid development to take place in large parts of Myanmar, connectivity is unlikely to be an issue – these renewable projects can be connected to the main grid but supply power to surrounding areas. Planned use of renewable energy will be an instance of leap-frogging.

4. Transmission Lines

88. MEPE has to continue building more transmission lines. The single circuit 230 kV transmission lines have to be converted to double circuit lines where n-1 design criteria is not satisfied. New 230 kV lines will also be required to extend transmission to regions that presently do not have grid supply and to augment existing transmission capacity over medium distance. For transmitting power over about 150 km or 150 MW, the 230 kV voltage level has high losses and requires more reactive power. The Myanmar geography is favorable; two large capacity 500 kV transmission line corridors from south to north (as backbone) will reduce losses and provide stability to the grid system. This will also help accelerate rural electrification as large capacity grid substation can be created within about 150 km of the 500 kV backbone lines.

C. Market Structures

89. MOEP has already moved away from the usual industry structure, i.e., a vertically integrated, national power utility that is responsible for the whole of the electricity sector. MOEP now does planning, development, project implementation, and electricity GTD, but the actual operations have been delegated to enterprises. MOEP also buys power at an agreed rate from a JV-BOT hydropower company and there are several JV-BOT and BOT projects under implementation. In some sense, the electricity generation segment is already competitive. There is a system of transfer pricing between the generation and transmission enterprises and between transmission and distribution enterprises. ESE and YESB have awarded management contracts for distribution on a trial basis so the electricity distribution segment will gradually have more than one company, though the geographical monopoly is likely to continue. If the Government continues with the transformation, the enterprises will become corporations and be independent legal entities. Thus, a market structure is already evolving.

90. For the electricity sector to work efficiently (i.e., provide reliable supply of "quality" electricity at reasonable cost), Myanmar needs to consider either of the two general market structures – the single-buyer model or wholesale competitive electricity market. Both these structures allow competitive pricing and have clear indications for adding new generation and transmission capacities, which ensures timely sector expansion as the economy and household incomes grow.

91. In both models, the transmission segment remains a regulated monopoly. It is economical to have a single transmission company – MEPE – that provides open access over the transmission infrastructure to all generation and distribution companies. There are several alternatives for determining transmission pricing, most common being the "postage stamp" rate where the investment and O&M costs are uniformly shared by all power flow (MK/kWh), irrespective of the distance of transmission. If there is a limitation of space for building new transmission lines, congestion charges can be applied, this happens when hydropower has to flow over very long distance through densely populated areas to reach a load center, or under sea cables are used to cross to islands. More complex pricing techniques are used when multiple users are involved. Presently, it will be advisable to use the simple "postage stamp" transmission tariff, and ensure open access to all transmission infrastructure.

5. Single-Buyer Model

92. The single-buyer model has been used in most countries to enable private sector investments in power generation, which is the most capital intensive segment. In Myanmar, MEPE needs to be designated as the single-buyer. For a single-market model to work efficiently, it will need to analyze the demand-supply situation, make long- and medium-term projections and determine when new generation (and transmission) capacity will be needed. The needed capacity could be base load or peaking. MEPE will then seek interest and invite bids for addition of such capacity. By doing so, it will ensure competition at entry stage and the most economic generation is selected for implementation. In most cases, the invitation to bid may be sent after identifying a suitable site, preparing the pre-feasibility report, carrying out the EIA and SIA. These preparations will lower the dispatch and project development risks, which would result in more bids (including international) and competitive pricing. Another common practice is to offer two-part tariff, a fixed annual charge that reflects the investment and fixed O&M costs (MK billion per MW per year, paid on a monthly basis), and another variable charge that reflects the fuel (in case of fossil fuel-based power plant) and variable O&M costs (MK per MWh basis). Along with other terms for providing generation services, MEPE will need to sign a PPA with the winning bidder that will ensure a revenue stream over the useful life of the project equipment with a reasonable rate of return on capital (8% - 12%, depending on the risk profile). There could also be a "tolling" basis for determining generation tariff, in which case the fuel cost element is taken out from the PPA and MEPE will need to arrange and pay for the fuel, the project sponsor will merely convert the energy in the fuel to electricity and charge a "toll",

which can also be based on a two-part tariff.[36] In the case of hydropower projects, since there is no fuel cost, the treatment will be similar to the "tolling" arrangement.

93. In India, there is a further regulatory requirement for the electricity regulatory commission to approve the generation tariff. This is a very transparent process, all guidelines and past orders are available on the Internet, and the project sponsors have to submit a petition with the tariff calculations. Following a detailed review by the regulator and representation by power purchasers, the tariff is approved, usually for a 3 – 5 year period.

6. Wholesale Electricity Market

94. The Philippines, Singapore and Australia in this Asia-Pacific region have functioning wholesale spot electricity markets. The wholesale electricity price is set for intervals of 15 minutes (or 30 minutes) based on supply – demand gap. The generation companies submit in advance the per MWh rate at which they will be willing to sell from a power station or a unit (theoretically, the bid price is based on the marginal cost – the cost for producing the last kWh). The System Operator (usually a part of the transmission company) will then dispatch the stations according to the "merit order" – the lowest cost generation being dispatched first. All generators that get dispatched during the interval will actually be paid according to the clearing price, i.e., the most expensive generation that was needed to meet the electricity demand during the interval and not according to the bid they submitted. For example, a large base load power plant may submit a "zero bid" so it will be assured of being dispatched, but will get the rate at which the market clears. The difference between the clearing price and the variable cost allows them to recover the capital cost of the power project. When demand – supply gap is narrow, the power plant with the highest variable cost will get dispatched, which may be an open cycle gas, an old inefficient coal, or pumped hydropower project. Movements in clearance price then indicate when new generation capacity would be needed – when more expensive plants get dispatched for longer durations. Sponsors can plan to implement highly efficient plants with low variable cost. Although all power flow gets priced, it is not necessary for all transactions to be according to the clearing price. The actual payment between the seller and buyer can be according to long-term contracts (generally not more than 5 years), but any difference between the contract amount and actual supply gets priced at the market clearing price. A Market Operator is established to manage the transactions.

95. Although a brief description of the wholesale electricity market has been included in the IAR, it will not be possible to introduce it now because the Myanmar electricity market is small and has only a few generation companies. A long learning period is also needed to understand and manage the economics of a market.

7. Retail Competition

96. To complete the discussion on the market structure, it is necessary to mention retail competition. In advanced markets, consumers with a high demand are allowed to switch their

[36] MOEP presently uses the "tolling" arrangement but a single-part tariff (energy charge) is used.

supplier. In this case, the distribution function is further unbundled into the network component and sale component. For example, traders can buy electricity from generation companies, pay the transmission charges to MEPE, distribution charges to ESE (or YESB) and sell to customers. This is possible only when the wholesale market is functioning.

97. MOEP has already started awarding distribution management contracts and is also considering creation of a JV for electricity distribution in Mandalay. This will lead to another issue for the regulator to deal with. At some stage the private sector distribution company will want to install its own generation capacity to increase its profit margin. In order to ensure competition, there has to be a limit to the "backward" integration. Further, consumers may seek introduction of retail competition if the distribution company in a neighboring region performs far better and offers more competitive prices.

D. Human Resources

98. The key to success for the MOEP enterprises will greatly depend on how staff, executives (engineers, accountants, geologists etc.) and senior officials perform. There are two elements for this (i) the organizational design (OD) determines how various units in an enterprise interact to achieve the organizational goals, it includes a management information system to keep track of technical, financial and human resource indicators; and (ii) human resource development (HRD) determines the motivation of employees because of the compensation and benefits package, and it includes training that enables employees to maintain and upgrade their skills, and perform at a level that meets the job requirement.

99. There is no immediate need for adding staff or creating new organization or departments; the existing ones have to be better aligned to MOEP's work plan and consolidated. The sale to employee ratio (GWh sale per employee) is considerably low when compared to PLN in Indonesia, which is also a vertically integrated utility like the various MOEP departments and enterprises taken together; according to the 2010 PLN Statistics, its sale to employee ratio was 3.5 GWh/employee, whereas, MOEP has a ratio of 0.4 GWh/employee. It is clear that the OD exercise will involve examination of all work processes, significant computerization, simplification of tasks where possible, and removal of unnecessary steps. Since high growth in sales is expected in the coming years, staff retraining and reassigning would help avoid large-scale retrenchment.

100. As part of the transformation process, i.e., changing from a government organization (as public servants) to a commercial enterprise, it will be advisable to utilize the services of a management consulting firm to provide advice for OD and HRD, and help implement the change.[37] While the techniques are well established and it should be possible to adopt a model that has successfully been used in another regional power company, changing employee's

[37] There are four large international management consulting firms that have implemented such change in electricity sectors in other Asian countries – PricewaterhouseCoopers, KPMG, Ernst & Young, and Deloitte Consulting.

behavior requires leadership of the head of the enterprise, it takes time and very focused efforts; external experts will help smoothen the transformation.

101. The IAR has a large number of recommendations to enable MOEP borrow from ADB and other development partners. To avail these opportunities, MOEP will require knowledge and capacity for following procedures for fund disbursement, project accounts, internal and external audit, insurance of project assets, computerization, tariff studies. These capacity building measures have to be taken on a high priority for unlocking the external assistance that will enable to electricity sector to expand following international standards.

102. Another ongoing ADB technical assistance is helping build capacity for preparation and approval of EIA and SIA, MOECAF is the executing agency. MOEP staff should be encouraged to attend the seminar and other capacity building exercises under this TA. It will enable them to know how projects should address environment concerns and how to make them “inclusive” with community participation. Discussions are also going on between the Government and ADB for a large program for building capacity of the civil service officials; senior MOEP officials would be able to also benefit from it to learn about development and public finance. ADB and others development partners will be extending more lending and non-lending assistance, which will include international consultants providing specialized inputs for project preparation and implementation. Every such project offers an opportunity for counterpart MOEP staff to acquire the specialized skills. It will be advisable to assign the counterpart staff for such projects on a full-time basis to enable them to learn by actual practice under the supervision of international experts.

103. Transformation will also require a change in work culture. Due importance has to be given to electricity customers and other stakeholders that provide services necessary for MOEP and the enterprises to deliver the electricity services. For this the management will need to establish systems for delegating responsibility to and ensuring accountability of different layers of managers. Specifically, the delegation of authority and responsibilities for procurement, financial approvals and staff related administrative matters should be well documented and clear to all. Empowerment of staff in this way helps create a responsive organization, they will be able to interact with customers and stakeholders and suitably address their needs. Further, the work culture should promote teamwork and close cooperation between different departments of the enterprises; synergies are possible when boundaries are lowered.

104. During discussions, the mid-level managers showed a positive outlook to the opening of the electricity sector and the economic reform process in general. They consider the changes to be necessary for the expansion of the electricity sector and posing no threat to their career. They expressed a need for training and upgrading of skills.

105. MOEP lacks staff with certain specialists, e.g., energy economics, economic and financial analysis, business law, banking and financial services, insurance, environmental engineering, planning resettlement, water chemistry, internal audit, and company secretariat. Some retraining is possible but new recruitment will also be necessary in these areas.

106. The break up of existing employees in various departments and enterprises is given in Table 2. The rapid expansion of the electricity sector could lead to an explosion in the number of employees in the enterprises. Even now, the approved employee strength is about 16,000 more. The filling of vacancies will need to be managed properly. The actual increase should be determined carefully; effort should be made to achieve international productivity benchmarks (employees-per MW of installed capacity, -per 1000 customer, -per million MK revenue, etc). Enterprises should also have internal targets for continuously improving the productivity ratios.

Table 2: Number of Employees in Various Departments and Enterprises

	Department Enterprise	Officers	Others	Total
1	Minister's Office	22	24	46
2	Department of Electric Power	38	65	103
3	Department of Hydropower Planning	24	44	68
4	Department of Hydropower Implementation	308	3,590	3,898
5	Myanma Electric Power Enterprise	551	3,868	4,419
6	Electricity Supply Enterprise	462	7,274	7,736
7	Hydropower Generation Enterprise	227	1,403	1,630
8	Yangon City Electricity Supply Board	310	3,130	3,440
	Total	**1,942**	**19,398**	**21,340**

Source: Department of Electric Power

1. Training

107. The electricity sector is in a peculiar situation because of the long period of international sanction. It was able to procure and install modern equipment (e.g., switchgear, transformers, generators) but the procurement was done from regional vendors as the international manufacturers were not permitted to sell equipment to Myanmar. This had a negative impact on knowledge transfer. The learning that is necessary and that happens through the technicians of the original equipment manufacturers never took place. Now that the sector is being opened out, the technical training needs have to be properly assessed and the "back log" cleared. For example, MEPE requires its technicians to get skilled in maintenance of high voltage SF_6 switchgear, use of special equipment to repair lines while it is in use (hot line), detection of loose joints (hot spots) using infra-red photography, and periodic analysis of gas released by transformer oil to understand the internal condition. It also needs a fully equipped laboratory for high voltage testing. A thorough training needs assessment can be carried out during the preparation of a project loan and funding for the training and training equipment (laboratory and training literature) can be included in the project loans from development partners.

108. The electricity sector will also be upgrading the technology, like larger-sized hydropower machines, combined cycle gas turbines, large coal-base projects, 500 kV transmission, etc. These modern systems also have high-technology instrumentation and control systems that automate the operations and prevent human error. Further, commercialization will also require

managers to place a high priority to cost while allocating resources, which is going to be a new approach. The method for keeping accounts will also change.

109. In anticipation of these changes, MOEP will need adopt a structured approach to training and augment the capacity of the two departmental training centers in Paunglaung, Nay Pyi Taw and Hlaingtharyar, Yangon. It requires a large program to retrain and upgrade the skills of all the employees.[38] Special courses will have to be designed so formal training can be imparted to all. International experts that come to Myanmar to implement non-lending projects can be required to conduct seminars and short training courses at the training institutes.

110. Some special equipment will be needed for the departmental training centers as well. Simulators for hydropower and thermal power plants (coal- and gas-based) can sharpen the skills of control desk operators and reduce the human error. They learn to handle various emergencies under simulated conditions instead of actual operations. The hydraulic laboratory needs a large number of testing equipment and computer software to be able to test all material and carry out flow modeling. Learning the use of infra-red camera helps locate hot spots in transmission and distribution networks before these result in insulation failure.

111. The curriculum of the university education program should also be modified to include courses relevant to the electricity sector. Support can be sought from development partners that give high priority to infrastructure and education. The Yangon Institute of Technology is already developing a masters program for water resource engineering. The development partners may consider providing assistance for including courses in energy economics, expansion planning, design, climate change, greenhouse gas mitigation and adaptation, and electricity technology.

IV. POWER SECTOR INSTITUTIONS - INTERNATIONAL EXPERIENCE (ASIA)

112. Brief information about electricity sector institutions in five Asian countries is provided in this section – PRC, India, Indonesia, Philippines and Bangladesh (Table 3). While Indonesia is continuing with the same structure, the other countries have implemented significant reforms to be better positioned for serving the needs of the economy and people. Myanmar economy has opened up recently and the electricity sector needs to change also. Lessons about institutional capacity can be taken from these countries. These are ADB member countries and borrow or have borrowed for implementing power projects. This gives MOEP the opportunity to use ADB staff support for getting detailed information regarding policy formulation, regulatory regime, organization structures, and human resource development from the countries and enterprises that are similar to Myanmar.

[38] A separate paper titled *MOEP, Myanmar, Training Needs Assessment and Training Proposal* has been submitted to MOEP. It includes more justification for training and how training needs assessment and suitable training courses can be designed.

Table 3: Installed Capacity and Generation of Electricity in Some Other Asian Countries

		PRC 2012	India 2012	Indonesia 2010	Philippines 2010	Bangladesh 2012
Installed Capacity	GW	1,140	211	29.95	16.23	8.53
Generation	TWh	4,940	911	170	65	31.4

Source: Websites of China Daily, Ministry of Power, national utilities, board and Energy Information Administration, US.

A. People's Republic of China

113. In 2002, the installed capacity in PRC was about 360 GW, all electricity transmission and distribution assets and 46% of the power generation plants were directly under the State Power Corporation, which functioned like a government ministry. Provincial and local governments owned the remaining generation assets, mostly in partnership with industry and local governments. The State Council (the union cabinet) announced major reforms in December 2002 and the assets of State Power Corporation were unbundled and separated mainly into seven corporations. Two grid companies were created (for transmission and distribution) – State Grid Corporation of China, covering 26 provinces and China Southern Power Grid Company, covering five southern provinces. Five generation companies were created – China Huaneng Group, China Datang Corporation, China Huadian Corporation, China Guodian Corporation, and China Power Investment Corporation; each was given about 20 MW or about 20% of the power market at the time. Another five companies were created for engineering and construction services. Since then, PRC has not had a ministry of electricity (nor ministry of energy). More recently (2008), the National Energy Administration was established under the National Development and Reform Commission (NDRC) to coordinate the activities of the energy sector corporations and announce energy policy. The energy policy was announced in October 2012 and the Electricity Law was enacted in 1996.

114. Corporatization had an impressive result on the PRC electricity sector. The new companies had a very high degree of autonomy; the managements could take investment decisions and borrow directly from domestic banks (foreign exchange regulation prevented foreign borrowing). Each of the five generation companies wanted to capture a larger share of the "market" and embarked on massive growth program. By 2006, PRC was adding about 100 GW capacity annually, lead by the five generation companies and other newly formed provincial companies. Such a scale of adding new capacity had not been done in any country and initially few industry experts even believed that this was possible.[39] The phenomenal capacity addition rate allowed the power sector to meet the rapidly increasing demand of the

[39] The private sector has grown tremendously in PRC and by 2012 its contribution was about 60% of the GDP according to a CCTV report. In the power sector, the private sector participated in provincial and local government level power generation. However, these companies are not modelled like those in the western and other developing countries in Asia. They have very close relations with government agencies and cannot be really called IPPs. There performance has not been properly documented and no evaluation reports are publically available.

economy with a double-digit GDP growth. PRC already had nearly complete electrification. The economies of scale allow the average tariff to be in the range of $0.08/kWh to $0.12/kWh. Provinces have different tariffs; low-income households pay less than $0.05/kWh and commercial and industrial consumers pay at a higher rate than households. A very large power equipment manufacturing industry has also developed in the country because of the immense domestic demand.

115. New technologies have been introduced by way of larger size units (minimum is 330 MW and largest is 1,000 MW for coal-based power plants), 750 kV alternating AC and 500 kV DC transmission lines. PRC had already established its position as world leader in hydropower with the implementation of Three Gorges project (22.7 GW capacity and 85 TWh annual energy output), the new companies went on to exploit remaining hydropower potential. PRC has the largest capacity in the world for small hydropower and small wind power, mostly for off-grid supply. In Tianjin, PRC also implemented, as the first in a developing economy, the integrated gasification combines cycle project (IGCC, 250 MW) that stated generation in 2012 and is now piloting carbon capture and storage for the same project.

116. For renewable energy, PRC turned to the private sector and non-power sector enterprises. In less than 10 years, PRC has added 75 GW of wind (highest in the world)[40] and 8.3 MW of solar power.[41] In the beginning, it adopted an innovative approach for pricing wind and solar power – first a competitive national tender was held to establish the "benchmark" tariff in a particular location, then the project developers were allowed to freely add more capacity in the vicinity as long as the tariff remained the same. More recently, it introduced the feed-in tariff system. The PRC manufacturing industry also responded to the international growth of renewable energy, it is the largest manufacturer of solar photovoltaic equipment and around 2008 it had over 70 manufacturers of wind turbines and components. Many global leaders have established manufacturing and engineering facilities in PRC. In case of wind projects, the initial requirement was to source 70% of the components domestically.

117. The State Electricity Regulatory Commission oversees the electricity sector and collects all data. However, pricing (retail and generation-level tariff) and entry (approval for adding capacity) is controlled by the NDRC in the union government and pricing bureaus in the provincial governments.

118. The generation and the grid companies have acquired tremendous technical knowledge and managerial skills. They have ventured out to implement projects in other countries, including Myanmar. The State Grid of China took over the management of the electricity transmission company in the Philippines in 2009, the assets are still owned by the government. In May 2013, according to media reports, it also bought 20% of the shares of the transmission grid in Australia from Singapore Power. The equipment manufacturers are regularly winning foreign orders for the supply of power generation equipment.

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[40] Global Wind Energy Council report.

[41] European Photovoltaic Industry Association report.

119. The existing electricity sector structure undoubtedly succeeded in expansion of the electricity sector and ensured the financial viability. However, there are still some challenges, e.g., the dispatch system does not reflect resource conservation (efficiency level is not considered), grid companies give a lower priority to dispatching higher-cost wind power (relative to coal-based power), large-scale use of coal (3.62 billion tons in 2012) has lead to environmental problems, the distribution companies remain under pressure because the tariff is closely regulated even though the cost of fuel is deregulated.

B. India

120. In India, the Ministry of Power overseas the power sector. According to the Indian Constitution, electricity is a concurrent subject so the union and the provincial governments share the responsibility for development of the sector and delivery of electricity services to consumers and economy. Since both countries were British colonies, there is considerable similarity in the initial laws and organization of the Indian and Myanmar electricity sectors. Like the YESB, India also has province-level boards that are responsible for the electricity sector.

121. The major change in India happened in 1975 when two corporations were created; these were wholly owned by the union government and had the mandate to develop thermal power (National Thermal Power Corporation, NTPC) and hydropower (National Hydropower Corporation, NHPC).[42] The generation (capacity and energy) from these centrally owned power projects was allocated to the provinces in the region in accordance to the formula for sharing resources between the union and the state governments.

122. NTPC received strong support from international financial institution (in the first 15 years it borrowed over $3 billion from the World Bank for implementation of coal and gas based projects). Over the years it has developed immense institutional capacity and is now a *Maharatna* state-owned enterprise that has been recognized for many achievements. It enjoys considerable autonomy and can take decisions to create JVs with Indian and foreign partners. Appendix 4 provides a short description of NTPC.[43]

123. The Power Grid Corporation of India was created in 1994 by separating the power transmission lines from the union government-owned generation companies and the 400 kV transmission lines that had been implemented by the provincial electricity boards. This corporation now manages the five regional transmission grids, nearly all 400 kV transmission lines, the regional interconnections (several are high voltage direct current that allow controlled power flow), and the generation scheduling and load dispatch centres. There is also a dedicated transmission line from east to north India that is owned by the private sector.

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[42] NHPC is one of the foreign companies that has signed a MOU with MOEP for a JV-BOT to develop hydropower projects in Myanmar.

[43] NTPC is considered a good example for Myanmar to consider measures for institutional capacity building. Over the years, many NTPC managers have left to lead private sector companies in India, which has allowed the transfer of good institutional practices.

124. There are a few other corporations fully owned by the union government, i.e., the Neyveli Lignite Corporation to manage the vertically integrated functions of lignite mining (30.6 million ton per year) and power generation 2,740 MW); the Damodar Valley Corporation for coal mining (0.38 million ton per year), thermal (5,210 MW) and hydropower (147 MW), flood control and irrigation (4 multi-purpose dams, a barrage and 2,494 km of canals) along the Damodar river valley; and there are two corporations for implementation and operation of specific large hydropower projects.

125. The Ministry of New and Renewable Energy in India is responsible for development of all types of renewable energy. By end 2012, the share of power generation capacity by renewable energy in the overall energy mix was 12% (25,900 MW). Mining of coal is under the Ministry of Coal, and exploration and production of petroleum products is under the Ministry of Petroleum and Natural Gas – these ministries have several state-owned companies for carrying out the commercial activities, and the ministry formulates policies.

126. India started its economic reforms in early 1990s. Knowing the critical need for adequate electricity supply for faster economic growth, the Government opened the electricity sector and in 1993 invited the private sector to implement power generation projects. Over the years many improvements have been made in the system.

127. The Union Government enacted the Electricity Law in 2003 and the Central Electricity Regulatory Commission was established under its provisions. After the provincial legislatures endorsed the Electricity Law 2003, they also created state-level electricity regulatory commissions. India also has the Central Electricity Authority based on the pre-independence electricity law, it carries out long-term planning and provides technical leadership in the electricity sector, including the functions of the inspection that is beyond the capacity of the factory inspector. The Ministry of Power announced the National Electricity Policy in 2005 and the National Tariff Policy in 2006, the Central Electricity Authority prepared the National Electricity Plan in 2007.

128. India has a state-owned Power Finance Corporation that raises capital for mid-sized projects and rehabilitation works. In FY 2012, it approved loans totalling about Rs 700 billion ($13 billion) and disbursed Rs 410 billion ($7.6 billion). To finance and promote rural electrification, the Ministry of Power has the Rural Electricity Corporation.[44] Starting 1995, the Ministry of Power launched the *Rajiv Gandhi Grameen Vidyutikaran Yojna (Rajiv Gandhi rural electrification scheme),* under phase 1 to extend electricity to 110,000 un-electrified villages (using capital subsidy of 90%) and providing electricity connections (100% subsidy for installation, i.e., Rs 2,200 [$41] per connection) to 23 million poor rural households. The target was achieved in December 2011.

[44] Internet website of Power Finance Corporation, downloaded in May 2013.

129. Investment approvals for all government-supported projects require support of the Planning Commission and approval of the Public Investment Board under the Ministry of Finance. The corporations are allowed to borrow from local and with certain provisions, also from foreign banks. All enterprises are legally separated from the government and are required to maintain proper accounts on the "ongoing concern" basis; the audited accounts of centrally owned corporations are tabled in the parliament and disclosed publically.

130. By end 2012, the total installed capacity of India was 211,700 MW, and the share of private sector was 30%, Table 4.

Table 4: Electricity Generation Capacity (2012)

	Installed Capacity (MW)	Share (%)
Provincial Government-Owned	86,300	40%
Union Government-Owned	63,000	30%
Private Sector-Owned	62,400	30%
Total	**211,700**	**100%**

Figures have been rounded off.
Source: Ministry of Power Internet website

131. India allows 100% foreign direct investment is all GTD (except nuclear power) and trading of power. Investments are encouraged by a 10 years tax holiday over first 15 years of operation and waiver of import duties on capital goods for large power plants (over 1,000 MW). The initial efforts to attract private sector investment was mostly unsuccessful, nearly 250 MOUs were signed between 1991 to 1998 but only 17 thermal power plants (5,533 MW) could be completed.[45] The investment climate improved but the sector is yet to attract the required level of investments for addressing the chronic power shortages in most regions. The main reason has been the poor financial health of the provincial government-owned distribution companies and issues related to fuel supply – both coal and gas.

132. The private sector has always been present in the distribution segment; two private sector companies own the electricity distribution in Mumbai, one company owns the Kolkata distribution company and another in the neighbouring industrial area, Ahmedabad and Surat have private distribution companies. More recently, the distribution in Delhi was also privatised on a competitive basis and handed over to two private companies, which also own the Mumbai distribution companies. However, the privatization is limited to large urban centres. In 1999, the distribution segment of a province (Odhisa) was split into four geographical parts and privatized. The financial health of the sector has improved and no subsidy is given to the distribution companies. Recent media report suggests that more provinces are planning to privatise distribution.

[45] AFD Working Paper No. 99. Private Sector Participation in the Indian Power Sector and Climate Change. August 2010. The authors are from India's National Council for Applied Economic Research.

C. Indonesia

133. In Indonesia the Ministry of Energy and Mineral Resources, specifically the Directorate General for Electricity and Energy Utilization (DGEEU), is responsible for the electricity sector. The state-owned Perusahaan Umum Listrik Negara (PLN) is a vertically integrated utility that has GTD. It has created two wholly-owned subsidiary company for operation of the power stations. PLN also buys electricity from IPPs using PPAs with two part tariffs.

134. The Presidential Decree 2006 provides the National Energy Policy, and the new Energy Law was enacted in 2007. The Energy Law has created the National Energy Council that is chaired by the President. The new Electricity Law was enacted in 2009.[46] The government (Ministry of Energy and Mineral Resources and the Directorate General) has issued several regulations for supply of electricity, cross-border trade, power purchase from geothermal projects, small and medium-scale renewable energy projects, and excess power.[47]

135. Indonesia had also devolved power to the local governments in 1999, which included matters related to energy policy. This was changed by amendments in 2004, which brought back the responsibility for energy policy matters to the union government.

136. The National Development Planning Agency (BAPPENAS) is responsible for planning of the economic sectors, including electricity. It also approves tariffs for electricity and all new capacity addition, if effect, it assumes the role of the regulator.

137. The total installed capacity in Indonesia was 36,200 MW (2011); 75% was owned and operated by PLN, 21% by IPPs, and 4% by small producers. The energy mix for power generation was coal, 51%; gas, 24%; oil, 14%, hydropower 6%, and geothermal 5%. Java-Bali, with 29,300 MW was the largest power grid, the next biggest was Sumatra with 5,900 MW; there are in all about 1,100 grids mostly supplied by oil-based diesel generator sets. The electrification ratio is 73% with 35 million consumers.

138. Indonesia also has a very large capacity base of captive power plants, i.e., power generation equipment (usually diesel generation sets) that are owned by large commercial consumers (hotels, malls) and industry. Though there are no formal records, the capacity is estimated to be over 29,000 MW.[48] A recent regulation allows PLN to buy power from such captive power plants during grid emergency conditions.

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[46] Another Electricity Law was enacted in 2002 but annulled by the Constitutional Court in 2004. The 2002 law provided for private ownership and competition in electricity sector, but it was found to be against the provision of the 1945 Constitution that required the government to take all responsibility for energy.

[47] Presentation by Ministry of Mines and Energy Resources.

[48] Differ Group, Indonesia. *The Indonesian electricity system - a brief overview*. 2012

D. Philippines

139. The Philippines has the Department of Energy that is responsible for all aspects of energy, including electricity. The Electric Power Industry Reform Act (EPIRA) was enacted in 2001. It led to complete privatization of all electricity sector assets. The power generation plants and the transmission assets of the state-owned company, National Power Corporation, have been sold through a bidding process. The wholesale electricity spot market was created and retail competition is also allowed – consumers with more than 1 MW demand can buy power directly from the spot market. Electricity Regulatory Authority is independent from the government and decides all retail tariffs (the wholesale price is determined by bilateral contracts and the clearing price of the spot electricity market). Philippines also has unbundled tariff, i.e., each component is listed in the consumer bills.

140. Even before EPIRA, a large share of power generation was with IPPs, 28 projects with a total capacity of 5,700 MW were owned by the private sector, and another 2,300 was under construction. The push for private sector investments came in early 1990s when Philippines faced economic losses because of power shortages. However, a far larger capacity was built than required and by 2005, the total capacity reached 15,600 MW where as the demand peak was only 8,600 MW. Capacity payments had to be made to the IPPs even though their utilization was well below the contracted capacity.

141. Manila Electric Company is a private-owned listed company that supplies electricity to Manila and the region around the capital city. It accounts for 55% of the country's electricity sale.[49] There are another 16 investor-owned power companies in regional cities and towns, and about 125 rural electricity cooperatives. The National Electricity Authority, in Department of Energy, provides oversight over the cooperatives. In general, the administration of the cooperatives is weak and they are mostly incurring losses.

E. Bangladesh

142. Bangladesh has the Ministry of Power, Energy and Mineral Resources. The Bangladesh Power Development Board (BPDB) is the largest institution (it is not a company) in the electricity sector. Its two subsidiaries – Northwest Power Generation Company and Electricity Generation Company of Bangladesh – own and operated 53% of the country's installed capacity. BPBD is the single buyer of all bulk electricity, and it sells to the distribution companies. The Power Grid Company of Bangladesh owns and operates the transmission lines (132 kV and 220 kV). The distribution companies buy power from BPDB at the grid substations; the shares of the four distributions companies are Dhaka Power Distribution Company, 21%; Dhaka Electricity Supply Company, 11%; Western Zone Power Distribution Company 6%, and Rural Electrification Board (REB) 36%. The remaining 25% of power is distributed by BPDB.

[49] Manila Electric Company website.

143. There are six IPPs with total capacity of 1,231 MW that supply power to the BPDB and Rural Electricity Board under long-term PPAs; 10 small-scale IPPs (less than 35 MW) with total capacity of 220 MW; and 1,679 MW of generation capacity procured on a short- to medium-term basis under rental arrangements.

144. The main source of power generation is gas (73%). However, these are mostly the conventional type (steam cycle) that have a low efficiency of 28% to 35%, or open cycle turbine that have even lower efficiency. There is an electricity supply shortage; in June 2011, the installed capacity was 6,600 MW and the peak demand was 4,900 MW, it is estimated that about 30% of the load was shed in the summer. The estimated economic loss because of the power shortage is estimated to be 0.5% of the GDP.[50]

145. The National Energy Policy 2008 provides the key information regarding targets, investments and management. It has an aggressive plan for adding capacity (about 9,000 MW between 2011 and 2015) through the government-owned companies and IPPs. More rental power plants are also being implemented.

146. Bangladesh does not have significant hydropower reserves. It is encouraging wind and solar power. To promote rural energy, Industrial Development Company installed 800,000 solar home systems and 10,000 biogas plants, the Grameen Shakti (in association with Grameen Bank) installed another 180,000 solar home systems.

147. The Bangladesh Energy Regulatory Commission does the regulation under the Energy Regulatory Commission Act 2003. This act allows the government to issue policy directives to the regulator and the tariffs to be set in consultation with the government. The strong government control over tariff is viewed negatively and has been a discouragement for private sector investment.

148. The government has announced several policies; for small private sector power plants in 1998, for remote area power supply systems in 2007, for enhanced private sector participation in 2008, and for renewable energy in 2009.

F. Institutional Model for Myanmar Electricity Sector

149. It will not be possible, or even advisable, for Myanmar to copy the institutional model from another regional country. The stage of development of the electricity sector is different, so are the resources and issues, so the institutions have to also be different. However, key aspects of successful institutions should be adopted, and some suggestions are presented.

(i) While all countries started with a wholly government-owned and –controlled electricity sector, presently nearly all encourage private sector participation in power generation and some are also opening the distribution business.

[50] ADB. Sector Assessment (Summary): Power. Manila. 2012

Myanmar is already on the same path. However, entry of the private sector also adds the cost of regulation – a balance has to be achieved between the attractiveness of the sector (profits) and the tariff to be paid by the consumers (since competition is limited and market-based pricing cannot be easily achieved). Myanmar will need to invest more (in terms of human resources) in regulation as has been done by the other countries.

(ii) PRC was able to add very large capacities in just 10 years, from 364 GW in 2002 to 1,140 GW in 2012 (12% CAGR, or 3.1 times).[51] It has multiple enterprises that have all types of ownership. The owners and managers have full autonomy and "compete" to expand rapidly, enhance their capabilities to do more business, adopt new technologies, innovate, forge alliances, and obtain finance from domestic banks to support the expansion. Though on a far smaller scale, Myanmar also needs to perform similarly. It is already getting private sector to participate in power generation and distribution. Corporatization of the four MOEP enterprises and DHPI, and increasing the authority of the management teams would lead to a more rapid expansion of the electricity sector.

(iii) There has been a shift towards unbundling of the electricity sector over the past 20 years, i.e., separation of GTD. In large power systems, it is always advisable to establish several enterprises to manage the risk – if one management team does not perform well, the likelihood of failure of the whole system is low. When the policy is changed to enable private sector investments, it leads to the creation of several companies responsible for individual power plants or distribution network in a particular township. The unbundling in developed countries is mostly to encourage competition so it was carried out along the four main functions of the electricity sector – GTD and sale. MOEP would need to realign the responsibilities of the enterprises to follow a similar pattern.

(iv) Myanmar needs to extend energy supplies to large parts of the rural regions. Bangladesh has the Infrastructure Development Corporation and India has Rural Electrification Corporation, both are state-owned, non-banking financial institutions that focus on rural electrification and energy supply. This approach of establishing a specialized financial institution can be further improved based on lessons learnt and applied to Myanmar. Like rural electrification, the development of renewable energy also requires considerable support from the government before it can become commercially viable; the same or another financial institution can help promote renewable energy.

(v) Funds from development partners have been used by all countries in the region to expand the power sector, particularly for the addition of power generation and transmission capacity, extension of rural energy supply and initially supporting the entry of the private sector. To efficiently utilize the external funds, help comply with the conditionalities that accompany such lending and

[51] US Energy Information Center Internet website and media report.

non-lending assistance, and submit timely reports, the project implementation enterprises establish a special cell of three to five staff that liaison with the external agencies. MOEP will also benefit by creating an "international division" under the Department of Power for the coordination between the project implementation enterprises and the lenders, e.g., for the forthcoming Power Transmission and Distribution Improvement Project the international division can coordinate between MEPE, ESE and YESB on one side and the ADB project tam on the other side.[52]

(vi) NTPC, India has been functioning successfully for 38 years; the performance of its power plants has consistently been of very high standard – utilization is over 85% even for 30 years old coal-based power plants. Its core strength is the institutional systems established during the initial years, i.e., delegation of financial and administrative powers, financial management, procurement through competitive bidding, quality assurance (during construction and procurement), staff training, attention to environment and resettlement. MOEP can study these systems and adopt them according to its requirement.

V. CONCLUSIONS

150. MOEP has a challenging task of transforming the electricity sector so it is responsive, grows rapidly and becomes financially sustainable. The country has adequate energy resources that is mostly clean (hydropower and gas); the private sector is already investing in electricity generation and distribution; development partners are keen to extend assistance for reducing poverty, which includes extension of energy supply to about 71% of the population; and the Government is strongly committed to the reform process (market-based economy, deregulation, parliamentary processes, press freedom, and gradual resolution of ethnic conflicts). With continued macroeconomic stability, Myanmar has a comparative advantage for foreign direct investments (in the manufacturing, tourism, mining, oil and gas, agro-processing sectors) that can help the economy grow at a rapid pace and large poverty reduction is possible with proper governance. Its geographical location (between several large economies) and large domestic market are also attractive for new investments. By timey transforming the electricity sector, MOEP will ensure that electricity supply does not become a binding constraint for economic growth, something faced by several developing countries.

[52] The amount of official development assistance will be limited by the debt bearing capacity of Myanmar, which is determined in consultation with the International Monetary Fund. Therefore, one such the international division will be enough to coordinate all the activities for the electricity sector during the next few years.

NATIONAL ENERGY MANAGEMENT COMMITTEE

National Energy Management Committee formed by President Thein Sein

10 January 2013 - New Light of Myanmar

Republic of the Union of Myanmar
President Office
Notification No (12/ 2013)
12th Waning of Nadaw 1374 ME
(9 January, 2013)
Formation of National Energy Management
Committee and of Energy Management Committee

For ensuring the development of energy and electrical sectors, National Energy Management Committee and Energy Management Committee are formed as follow:-

(1) National Energy Management Committee

a. Vice-President (2): Patron
b. Union Minister for Energy: Chairman
c. Union Minister for Electric Power: Vice-Chairman
d. Union Minister for Agriculture and Irrigation: Member
e. Union Minister for Environmental Conservation and Forestry: Member
f. Union Minister for Industry: Member
g. Union Minister for Mines: Member
h. Union Minister for National Planning and Economic Development: Member
i. Union Minister for Science and Technology: Member
j. Dr Myint Soe, Senior Geologist of Geological Survey and Minerals Exploration Department under the Ministry of Mines: Member
k. U Win Khaing, Chairman of Myanmar Engineering Society: Member
l. U Aung Myint, General Secretary of Renewable Energy Association Myanmar: Member
m. Deputy Minister for Energy: Secretary
n. Deputy Minister Ministry of Electric Power: Joint-Secretary

(2) Duties and functions of National Energy Management Committee are as follow:-

a. To formulate National Energy Policy based on energy demand and production and fulfillment of energy requirement on energy matters of the State,
b. To formulate Energy Regulation for ensuring implementation of energy development of the State in accord with National Energy Policy,
c. To supervise the facts and figures on energy for ensuring qualified and accurate statistics,

d. To coordinate with Privatization Commission and Myanmar Investment Commission for changing the ratio between state-owned and private-owned sectors through privatization,

e. For development of electrical sector, to fulfill the current requirements by laying down short-term plans,

f. To lay down long-term plans based on sustainable development of industrial sector of the State and GDP to be able to meet the increased demand for electricity,

g. To generate electricity with the use of coal as in many other countries as there has been greater demand for electricity and to use Clean Coal Technology (CCT) aimed at placing emphasis on environmental conservation,

h. To strive for generating electricity depending on regions and topographical situation with the use of solar power, hydro power, wind power, geothermal, bio mass and bio fuel to be able to meet the public demand for electricity,

i. To formulate necessary measures for adequate supply of energy for development of industrial sector,

j. To take systematic measures in laying down development plans to be able to cover three sectors as energy, industrial and electrical sectors are mutually dependent,

k. To prioritize and supervise oil and natural gas and natural resources to be able to meet domestic demands,

l. To carry out oil and natural gas production through local and foreign investments in accord with international regulations,

m. To sell value-added petrochemical products rather than unrefined ones,

n. To coordinate natural gas and electricity generation in order to meet Urea fertilizer demand of the agriculture sector,

o. To adopt convenient pricing policy for both consumers and investors depending on international prices,

p. To explore environmental impact and social impact assessment ahead of the implementation and to release information the people should be informed of,

q. To enforce energy sufficiency ambition in industry, transport and household sectors and cut energy wastages,

r. To invite foreign and domestic investments in energy development and increase FDI in accord with international norms,

s. To conduct necessary assessment to participate in civil nuclear energy activities in ASEAN,

t. To adopt National Energy Security Strategy that envisages the future generations, apart from the current energy issues,

u. To make arrangement for drafting necessary law, rules and regulations to be able to implement in accordance with the National Energy Policy and National Energy Security Strategy

v. To invite the President Office (3), President Office (5), Union ministers, representatives of Pyithu Hluttaw (Member of the Natural Resources and Environmental Conservation Committee) and (Member of the Mineral and Natural Resources Affairs Committee).

(3) Energy Management Committee

a. Union Minister Ministry of Energy: Chairman
b. Deputy Minister Ministry of Agriculture and Irrigation: Member
c. Deputy Minister Ministry of Environmental Conservation and Forestry: Member
d. Deputy Minister Ministry of Electric Power: Member
e. Deputy Minister Ministry of Energy: Member
f. Deputy Minister Ministry of Industry: Member
g. Director-General Ministry of Mines: Member
h. Director-General Ministry of Science and Technology: Member
i. U Pe Kyi Managing Director (Retd) Myanma Oil and Gas Enterprise Ministry of Energy: Member
j. Dr Thein Tun Director-General (Retd) Ministry of Electric Power: Member
k. Daw Kyaw Kyaw Win Director (Retd) Myanmar Oil and Gas Enterprise Ministry of Energy: Member
l. U Thaung Win Chairman Energy and Renewable Energy Committee Myanmar: Engineering Society: Member
m. U Win Kyaing Member of the Central Executive Committee Myanmar Renewable Energy Association: Member
n. The personnel nominated by the chairman: Secretary

(4) Tasks of the Energy Management Committee are as follow:

a. to participate in laying down the energy development policy and plans of the National Energy Management Committee
b. to coordinate with authorities concerned for changing the ratio between state-owned and private-owned sector sectors through privatization.
c. to systematically link the Energy Plan and Industrial Development Plan as the energy sector and industrial development, which are necessary for becoming an industrialized country, are depending each other.
d. to adopt the reform plans to be able to upgrade the situation of selling raw materials of natural resources to producing and selling value-added products.
e. to carry out check, recheck, counter check in the field trips as statistics, facts and figures are important for making policy making and decision making regarding the projects related to the energy sector; and to carry out feasibility study to be able to get the correct facts and figures and information
f. to seek advices and cooperation from the responsible personnel involved in the energy sector so as to get yearly approximate energy demand in terms of short-terms and long-terms.
g. To lay down objectives and adopt rules and regulations for short-term and long-term implementation in accordance with the energy development policy laid down by the National Energy Management Committee.

h. To carry out yearly review over the weak and strong points when implementing objectives in accordance with short-term and long-term rules and regulations, and to rewrite the rules and regulations if necessary.

i. To lay down objectives and strategies after making assessment to opportunities and limitations regarding the tasks for energy development,

j. To devise plan to improve and modernize the investment of the Union government, foreign and domestic investment, region/state investment,

k. To formulate environmental conservation laws and rules to regulate energy projects to minimize environmental and social impacts,

l. To urgently recover losses caused by unprecedented natural disasters and adopt energy reserve policy,

m. To adopt pricing policy and form pricing committee for purchase and sale of energy product,

n. To set work procedures to allow local entrepreneurs to hold stakes in foreign investments in coordination with scrutinized companies and organizations,

o. To lay down plans to attract foreign and domestic investments in renewable energy projects such as solar energy, wind power, geothermal energy, biomass and biofuel projects,

p. To regulate energy development projects by foreign and domestic investors in accord with energy development rules and regulations,

q. To seek technology and management assistances from experienced international organizations in cooperation with local experts, hire consultancies, and review and adopt management and technology standards and norms.

r. To educate the staff and those from private sector through media or workshop with the support of foreign and domestic experts and send them to local and foreign technological trainings,

s. To invest in energy development under the leadership of National Energy Management Committee, tapping utmost financial and technological assistances from international monetary institutions,

t. To gather information for effective use of energy, set plans and projects for effective utilization of energy, and adopt yearly, short-term and long term objectives and rules and regulations for drafting the project,

u. To gather information for effective use of energy, adopt plans and projects for effective utilization of energy, and coordinate implementation of the project, and

v. To seek ways and means to implement generating electricity through civil nuclear energy sector in cooperation with regional and international organizations.

Thein Sein (signed)
President
Republic of the Union of Myanmar

DRAFT ELECTRIC POWER POLICY – MINISTERY OF ELECTRIC POWER

A. Policies

1. To employ the available energy resources in power generation for the sufficient supply of electricity.
2. To promote the effective and efficient use of electricity for future energy sufficiency, reserves and sustainability in our nation.
3. To conduct the reliable power quality to be supplied safely.
4. To enhance the electricity distribution system to be developed in accordance with the advance technologies.
5. To adopt the environment-friendly ways in electricity generation, transmission and distribution.
6. To encourage the expansion of power transmission and distribution throughout the country and the Public-Private-Participation in each sector.
7. To get millennium achievements, besides of construction of thermal power plants, have to construct more hydro power plants yearly by the least of EIA and SIA, whereas hydropower is the clean and renewable energy.

B. Objectives

1. In order to transmit the generated power, increased in the period of fifth five-year plan, through Myanmar Power System to Regions and States, the Transmission Lines and Primary Substations are to be implemented and also the Distribution Plans for electricity supply to the Industries and Public are to be worked out.
2. To provide the technical know-how and policy support to the local people with their cooperation and participation in using alternative energy such as bio-mass in rural areas, far from the National Grid.
3. To meet the electricity demand for the areas, where electricity through the National Grid is not accessible, are to be supplied by Mini Hydro and Diesel Generators.
4. In order to be reliable the quality of Myanmar Power System which is conducted for generation, transmission, distribution and consumption of electric power and to supply the electricity with the least of power interruption and loss at the Standard Voltage Level, our skills staffs shall carry out by getting technical know-how from abroad.
5. To fulfill the power demand of Myanmar, not only Hydro Power Generation and also Gas Turbine Power Plants are to be in operation, and Wind Power and Solar Power Plants are economically and widely constructed to reinforce the power supply.
6. To carry out distribution of electricity to Regions and States in the whole nation by connection of National Grid.
7. To get more number of electrified villages with great effort.

8. To generate more electricity from the renewable energies resources.
9. To carry out the under constructed projects will be finished in time.
10. To generate and distribute electricity from the existing power stations with full capacity.

C. Action Plan

1. The existing highest voltage level of Myanmar Power system is 230 kV. The power generation and demand will increase in the near future, 500 kV transmission line have to be constructed to mitigate the transmission loss while transmitting power to the further area.
2. Modernized information and communication technology control system, SCADA has to implement to control and balance the real time generation, transmission, distribution and utilization.
3. Distribution lines and substations have to construct in States and Regions to enhance power distribution.
4. To implement the modernized meter reading system, a good way to reduce power loss in distribution system.
5. To reduce transmission and distribution losses, less power loss transformers, quality conductors and insulators have to be used.
6. To transmit the power from power plants, according to the specified criteria, voltage regulating equipments (shunt reactors and capacitor banks) have to install in the power stations and substations.
7. To generate full efficient power of gas turbines up to natural gas fulfillment, while the hydropower generation reduce in the dry season.
8. Feasibility study report on wind power projects have to survey systematically and if possible construct the project in Mon State, Kayin State, Thanintharyi Region and also in other state and region.
9. Combined cycle power plants have to implement near Yangon to distribute the power to the Thilawa special economic zone located in the Yangon Region.
10. To implement the Independent Power Producer (IPP) practiced in neighboring countries.
11. To manage consequently sectional organizations for fulfilling energy and power of nation.
12. To be generated and managed power of various resources such as hydro, wind, solar, coal, gas and geothermal for harmony supply and demand.
13. To draw policies for firmly using of the nation’s resources.
14. To draw Energy Development Plan, Energy Security Policies balanced Energy demand and energy distribution/ delivery.
15. To be implemented energy efficiency ways for using effectively energy resources and electric power.

16. In using of energy resources and generation of electricity, to manage by way which implementing of Environment friendly.
17. To prescribe the Energy Pricing Structure Policy such as the price of petroleum, natural gas, metal and electricity.
18. In order to be systemic in generation, transmission, distribution to prescribe Generation Code, Transmission Code, Distribution Code which are international grade by the aid of technologies from foreign.
19. In performing the investment of internal and external private tasks of electrical sector, to perform the approval, Power Purchase agreement, work permit in accordance with competitive and standard practices of IPP.
20. Each nation suggests many ways for energy security of their countries, also in our country, to organize a Committee like that Energy Policy Committee, EPC which analyze the various types of energy and present the energy policy.
21. Moreover, to establish an organization which regulates to be consistent with rules and regulation when ministries, organizations, private sectors implement the tasks in accordance with the instructions of National Energy Management Committee.

Table A3.1: Existing Hydropower and Coal-Based Generation Capacity

Power Plant	Location	Start	Type	Source of Equipment	Units	Installed MW	Firm MW
Hydropower							
1. Baluchaung (1)	Kayah	1992	dam, 1 y storage	Japan	2 x 14	28	26.0
2. Baluchaung (2)	Kayah	1960	dam, 1 y storage	Japan	6 x 28	168	155.0
3. Kinda	Mandalay	1985	MPD - irrigation	Germany	2 x 28	56	21.0
4. Sedawgyi	Mandalay	1989	dam	Japan	2 x 12.5	25	20.0
5. Zawgyi (1)	Shan	1995	RoR	PRC	3 x 6	18	4.0
6. Zawgyi (2)	Shan	1998	MPD - irrigation	PRC	2 x 6	12	3.4
7. Zaungtu	Bago	2000	MPD - irrigation	PRC	2 x 10	20	8.7
8. Thaphanseik	Sagaing	2002	MPD - irrigation	PRC	3 x 10	30	13.4
9. Mone	Magwe	2004	dam	PRC	3 x 25	75	37.7
10. Paunglaung	Mandalay	2005	dam	PRC	4 x 70	280	104
11. Ye`nwe	Bago	2007	dam	PRC	2 x 12.5	25	14
12. Khabaung	Bago	2008	dam	PRC	2 x 15	30	13.7
13. KengTawn	Shan	2008	RoR	PRC	3 x 18	54	43.1
14. Shweli (1)	Shan	2008	RoR, JV w/PRC [a]	PRC	6 x 100	600	174.8
15. Yeywa	Mandalay	2010	dam	PRC	4 x 197.5	790	175
16. Tapein (1) [a]	Kachin	2011	dam, export to PRC [a]	PRC	4 x 60	240	30.1
17. Shwegyin	Bago	2011	dam	PRC	4 x 18.8	75	50.6
18. Kun	Bago	2011	dam	PRC	3 x 20	60	17.5
19. Kyee On Kyee Wa	Magwe	2012	dam	PRC	2 x 37	74	42.0
20. Thaukyegat	Bago	2013	dam	PRC	3 x 40	120	32.3
Total						**2,780**	**986.2**
Coal-Based							
22. Tigyit	Shan	2005	Lignite, mine mouth	PRC	2 x 60	120	27
Capacity in Operation						**2,900**	**1,013.2**

JV = joint venture; PRC = People's Republic of China; MPD = multi-purpose dam; RoR = run-of-river; y = year

[a] Shweli 1 output is for PRC (50%) and Myanmar (50%); Tapein 1 project supplies power only to nearby areas and PRC because of transmission constraint.

Source: *Assessment of Myanmar Power Sector*, and inputs during meeting with from Hydropower Generation Enterprise

Table A3.2: Hydropower Projects Under Construction

	Name of Project	Location	Installed Capacity MW	Energy GWh	Weighted Progress (June 2013)	Expected COD Year	Implementing Agency
1	Chipwi Nge	Kachin	99	599	100%	2012/13	JV/BOT
2	Thaukyegat - 2	Bago	120	605	100%	2012/13	BOT
3	Nancho	Mandalay	40	152	95%	2013/14	MOEP
4	Upper Paunglaung	Bago	140	454	77%	2014/15	MOEP
5	Phyu Chaung	Bago	40	120	68%	2013/14	MOEP
6	Thahtay	Rakhine	111	386	26%	2018/19	MOEP
7	Upper Yeywa	Shan (N)	280	1,330	17%	2019/20	MOEP
8	Upper Kengtawng	Shan (S)	51	267	15%	2018/19	MOEP
9	Shweli - 3	Shan (N)	1,050	3,500	6%	2020/21	MOEP
10	Baluhaung - 3	Kayar	52	334	80%	2013/14	BOT
11	Upper Baluchaung	Bago	29	120	37%	2014/15	BOT
	Total		**2,012**	**7,867**			

BOT = build-operate-transfer; COD = commercial operation date; GWh = Gigawatt-hour; JV = Joint Venture; MOEP = Ministry of Electric Power; MW = Megawatt; Re = Region; St = State
Source: Hydropower Generation Enterprise

Table A3.3: Hydropower Projects With Feasibility Study Reports

	Name of Project	Location	Installed Capacity MW
1	Manipur	Sagaing	380
2	Hutgyi	Kayin	1,360
3	Chipwi	Kachin	3,400
4	Tongxinqiao	Kachin	320
5	Upper Thanliwn (Kunlong)	Shan (N)	1,400
6	Shweli - 2	Shan (N)	520
7	Sinedin	Rakhaine	76
8	Ywathit (Thanlwin)	Kayan	4,000
9	Naopha	Shan (N)	1,000
10	Mantong	Shan (N)	200
11	Keng Tong	Shan (S)	96
12	Wan Ta Pin	Shan (S)	25
13	Solue	Shan (S)	165
14	Keng Yang	Shan (S)	28
15	He Kou	Shan (S)	88
16	Nam Kha	Shan (S)	200
17	Nam Tamhpak	Kachin	200
	Total		**13,459**

MW = Megawatt; N = North; S = South
Source: Hydropower Generation Enterprise

Table A3.4: Hydropower Projects Under Investigation

	Name of Project	Location	Installed Capacity MW
1	Htu Kyan	Shan(S)	105
2	Hseng Na	Shan(S)	45
3	Tha Hkwa	Shan(S)	150
4	Palaung	Shan(S)	105
5	Bawlake	Shan(S)	180
6	Laza	Kachin	1,900
7	Dapein - 2	Kachin	168
8	Gawlan	Kachin	100
9	Wu Zhongze	Kachin	60
10	Lawngdin	Kachin	435
11	Hkan Kawn	Kachin	140
12	Wutsok	Kachin	1,800
13	Kaunglanhpu	Kachin	2,700
14	Renam	Kachin	1,200
15	Hpizaw (Pisa)	Kachin	2,000
16	Lemro	Rakhine	600
17	Lemro - 2	Rankhine	90
18	Nam Tamhpak	Kayah	180
19	Upper Thanliwn	Shan (E)	7,000
	Total		**18,958**

E = East; MW = Megawatt; N = North; S = South
Source: Hydropower Generation Enterprise

NATIONAL THERMAL POWER CORPORATION LIMITED, INDIA

A. Introduction

1. National Thermal Power Corporation, Limited, India (NTPC) is a state-owned enterprise, established in 1975. It is becoming an international "integrated power major" with interests in coal- and gas-based power, hydropower, coal mining, power equipment manufacturing, oil and gas exploration, power trading and distribution. The growth demonstrates exceptional institutional capabilities, which is well recognized by the financial market. In February 2013, it sold 9.5% equity for $2.1 billion, which places its market capitalization at about $22 billion (NTPC Internet website).

B. Institutional Performance

2. NTPA started as a 100% central government owned company with a mandate to build and operate coal-based power plants to meet the countries growing power demand. Now it operates 41,180 MW capacity and has 17,910 MW under construction (Table A4.1).

Table A4.1: Overview of National Thermal Power Corporation

	Operating		Construction	
	No. of Projects	**Capacity (MW)**	**No. of Projects**	**Capacity (MW)**
NTPC Owned				
Coal	16	31,855	12	12,690
Gas/Liquid Fuel	7	3,955		
Renewable energy projects	-	10	3	1,340
Sub Total	**23**	**35,820**	**15**	**14,030**
Owned By JVs				
Coal	7	5,360	4	3,710
Renewable energy projects			1	170
Total	**30**	**41,180**	**20**	**17,910**

JV = joint venture; MW = Megawatt; NTPC = National Thermal Power Corporation;
Source: NTPC Internet website (19 May 2013)

3. The tariff for NTPC power stations is approved by the Central Electricity Regulatory Commission (CERC) every 3 years. In accordance to the regulations, the tariff is based on annual fixed charge and energy charge rate. NTPC is required to petition the CERC with detailed calculations of every component of these charges, and approval is accorded after hearing the response from the "buyers" and a very detailed scrutiny. For illustrative purpose, Table A4.2 presents the approved tariff for two coal-based power projects – newly commissioned Simhadri (1,000 MW) and about 25 years old Korba (3 x 200 MW and 3 x 500 MW).

Table A3.2: Illustrative Tariff of NTPC Projects

		Simhadri	**Korba**
Capital Cost	Rs million	50,852	18,353
	$ million	930	336
Annual Fixed Charge	Rs million	11,882	7,839

		Simhadri	Korba
	$ million	217.2	143.3
Energy Charge Rate	Rs/kWh	1.596	0.501
	$/kWh	0.0292	0.0092
Total (85% utilization)	Rs/kWh	3.751	1.045
	$/kWh	0.0686	0.0191

The exchange rate used for the calculation is Rs 54.7 = $1 (May 2013)
Source: Central Electricity Regulatory Commission Internet website, www.cercind.gov.in

4. Starting 2009, based on net worth, revenue, profitability and global presence, the Government of India categorized seven central state-owned enterprises, including NTPC, as "Maharatna" companies. Consequently, the company board of directors enjoy greater autonomy for (i) capital expenditure up to about $900 million, (ii) investment in joint ventures and subsidiaries in India and abroad, (iii) mergers and acquisitions, and (iv) human resources management.

5. The management team has consistently shown a high level of performance over the years. NTPC has a compounded annual growth rate of 19% in terms of installed capacity; the power plants have an availability factor of 90% and utilization factor of 85%. The productivity is high, it employs 0.74 person per MW installed capacity and generates 9.25 GWh per employee. The company maintains sound financial health – the debt to equity ratio is 0.7; total assets is $28.3 billion (December 2012), annual revenue of $11.6 billion and net income of $1.67 billion (FY2012).

6. NTPC has diversified into the complete value chain of the power sector through its subsidiaries and joint ventures. In upstream it does coal mining, oil exploration, and jointly owns a liquid natural gas terminal; it partners with power plant equipment and transformer manufacturers; it owns coal- and gas-based, hydropower, solar power plants and has also created a joint venture to implement a nuclear power plant; it has joint ventures for generation projects in Bangladesh and Sri Lanka; it does power distribution business and offers consulting services to other Indian distribution companies and boards; and it carries out power trading, including buying power from Bhutan and selling to Bangladesh.

7. NTPC's success can be attributed to its high institutional capacity that includes transparent and effective decision making (e.g., for project procurement and human resource management). It has created a highly motivated work force and a healthy work culture. It has numerous initiatives that enhance the creativity, innovation, functional aptitude and teamwork of its employees.

C. Personal Experience in NTPC

8. The Power Sector Advisor (Anil Terway) worked in NTPC from February 1977 to March 1995. Those were the formative years of the company and provided the learning ground not only for the technical skills related to fossil fuel-based power generation but also institution building. The management practices and systems established in the early period have remained valid as NTPC has grown to be a 41 GW and $28 billion company.