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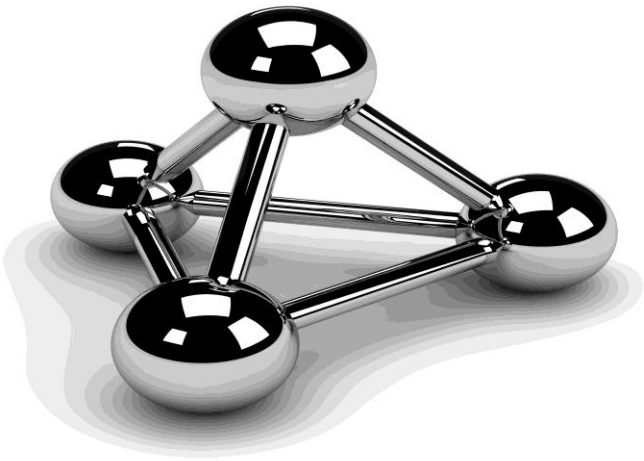
Myanmar Power Sector Financial Analysis and Viability Action Plan

– Inception Report



MEPE-CS-2: Myanmar Power Sector Financial Analysis and Viability Action Plan
August 2015

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LIST OF ACRONYMS

CCGT	Combined Cycle Generation Turbine
DEP	Department of Electric Power
DHPI	Department of Hydro Power Implementation
DHPI	Department of Hydro Power Planning
EPGE	Electric Power Generation Enterprise
ESE	Electricity Supply Enterprise
GoM	Government of the Republic of Myanmar
HPGE	Hydro Power Generation Enterprise
MEPE	Myanmar Electric Power Enterprise
MNPED	Ministry of National Planning and Economic Development
MOE	Ministry of Energy
MoEP	Ministry of Electric Power
PPP	Public Private Partnership
YESB	Yangon Electric Supply Board
YESC	Yangon Electric Supply Corporation

A1: INTRODUCTION

1.1 Deloitte Touche Tohmatsu India Private Limited ("Deloitte") has been appointed as a Consultant by Myanmar Electric Power Enterprise (MEPE) to support MEPE with the following objectives:

(a) Inform stakeholders on the financial status and outlook of the power sector, including revenue requirements and any subsidy requirements for generation, transmission and distribution subsectors

(b) Assist the Myanmar authorities in preparing a power sector financial viability action plan, inclusive of revenue and cost management

(c) Increase institutional capacity of Myanmar power sector enterprises to carry out forward-looking financial analysis of the power sector

(d) Develop an integrated financial model for forward-looking financial analysis of the power sector--covering generation, transmission and distribution subsectors—and related energy sector such as the natural gas and solar sector.

1.2 The contract was signed on 15th July 2015 between MEPE and Deloitte followed by a kick-off meeting, attended by representatives of MEPE and World Bank to finalize the overall project scope and objectives. A counterpart team and a nodal person from MEPE was identified to facilitate all communications with the Consultants.

1.3 The project initiation phase started immediately after the issuance of the Notice to Proceed. A critical step in this phase was to develop a common understanding on the detailed data requirements for the assignment. This is essential to develop a data-driven baseline from which further analysis can be undertaken and the integrated financial model can be developed. Accordingly, a detailed list of data requirements was shared with MEPE to be collated from various sector entities.

1.4 This Inception Report captures the progress achieved so far based on the data received and early analysis of the state owned power enterprises and outlines our approach towards developing the integrated financial model. .

1.5 Initiating appropriate communications and obtaining a shared understanding with the stakeholder groups on the assumptions in particular, is also a critical step. Hence, Deloitte team is proposing an Inception Presentation in the month of September, 2015 to the wider stakeholder group with participation from MEPE, World Bank and MOEP's other enterprises. The date of the presentation shall be decided based on mutual availability and convenience.

A2: REVIEW OF THE POWER SECTOR AND PROGRESS MADE IN RECENT YEARS

2.1 Myanmar's current power situation remains severely constrained. With low levels of electrification of around 26% and widespread curtailment of power to industrial and commercial consumers the demand for power is not adequately met.

2.2 Rapid enhancement in power generation as well as transmission and distribution infrastructure is thus critical to reducing poverty and enhancing the medium- and long-term development prospects of Myanmar. Despite being richly endowed in primary energy sources, viz, hydro resources, gas and coal, Myanmar's power generation has been inadequate under the years of isolation it faced before the commencement of the democratic reforms process in 2011.

INSTITUTIONAL STRUCTURE:

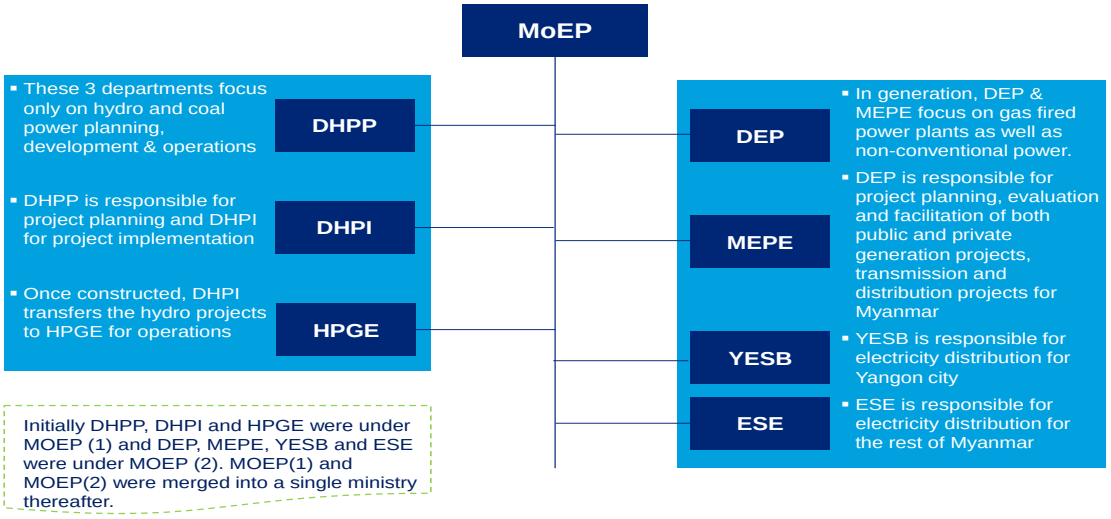
2.3 The Ministry of Electric Power (MOEP) is largely responsible for the electricity supply business in Myanmar. MOEP was restructured in 2012 with the merger of the former MOEP (i) and MOEP (ii).

2.4 MOEP is currently organised along the following two broad groups, as also depicted in the figure below.

(a) **Hydro and Coal based Generation:** organised under DHPP, DHPI and HPGE.

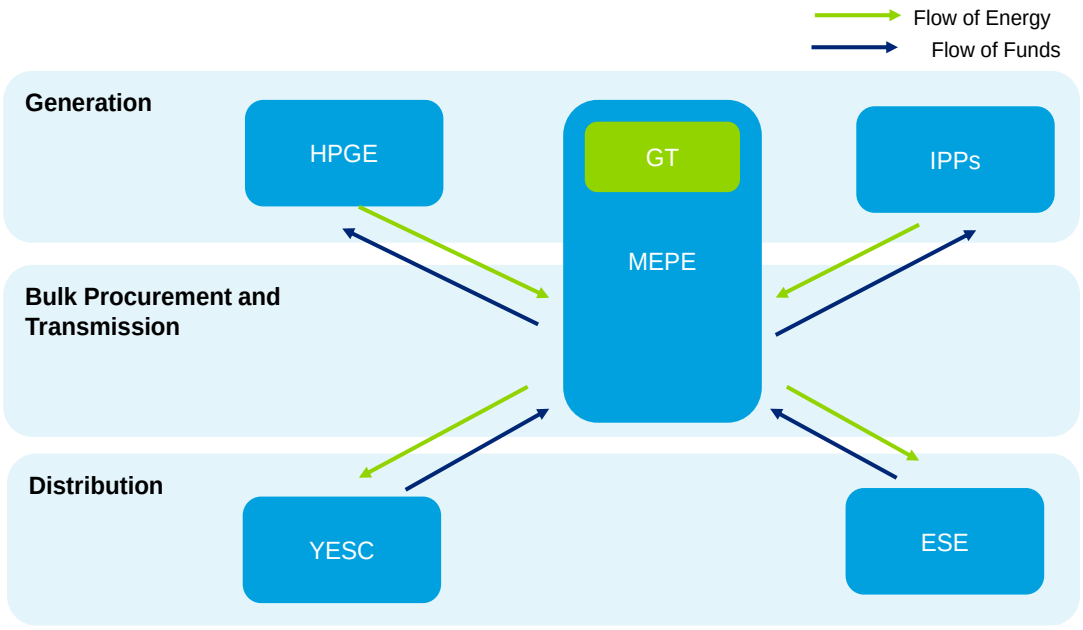
(b) **Gas & Non-conventional energy based Generation as well Transmission and Distribution of power:** organised under DEP, MEPE, YESB and ESE.

Figure 1: MOEP Institutional Structure



2.5 The roles of the various state owned enterprises in terms of charting out the primary responsibilities across the power sector value chain have been presented below:

Figure 2: Roles of various State owned Enterprises

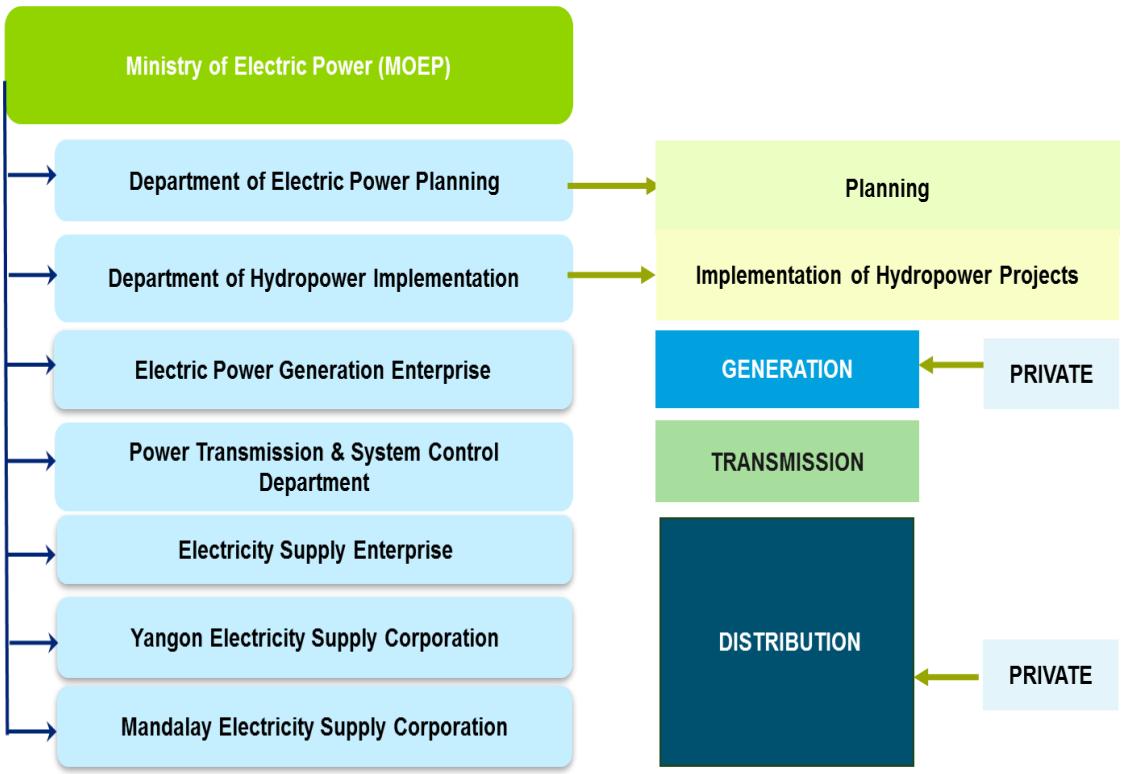


2.6 The Yangon Electricity Supply Board (YESB) has recently been corporatized and the new entity formed is named as Yangon Electricity Supply Corporation (YESC).

MOEP PROPOSED RE-STRUCTURING:

2.7 A further restructuring of MOEP is on the cards to streamline operations and bring in efficiency by consolidating similar functions under one entity. All power generation by HPGE and MEPE (GT) have now been combined and a new generation entity named EPGE is formed. The power transmission and system planning is consolidated under the Power Transmission and System Control Department. Another power distribution entity named Mandalay Electric Supply Corporation has been added to supply power in the Mandalay region. A single Planning Department is also carved out to plan for an integrated power sector development and not separately for hydro or gas as was the case earlier. The proposed restructuring of MOEP has been depicted pictorially below:

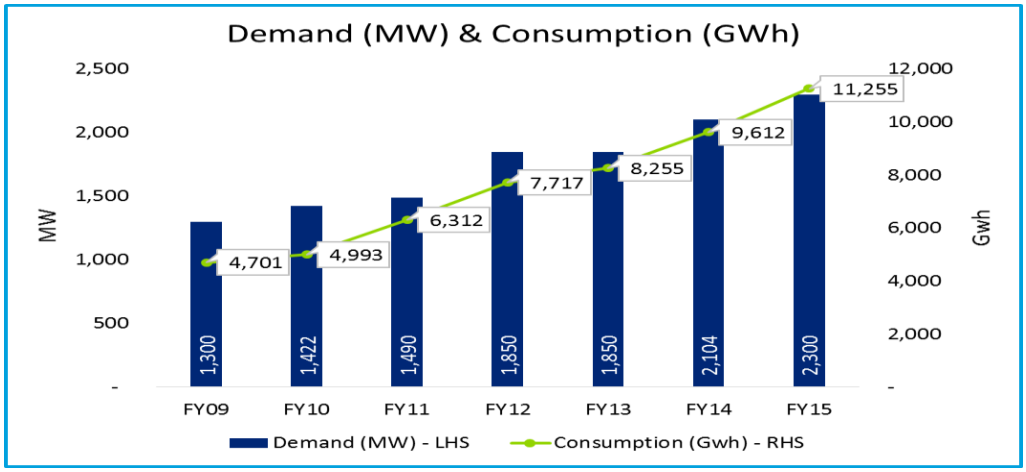
Figure 3: MOEP Proposed Re-Structuring



DEMAND SCENARIO IN MYANMAR:

2.8 The current demand supply situation registers a gap of around 575 - 600 MW with demand increasing at an annual rate of 10-15 % on an average over the past few years. Demand in FY15 touched 2300 MW while the firm capacity that has been recorded is close to 1700 MW.

Figure 4: Demand & Consumption



2.9 Demand forecasts in this environment are not easy, as it has to factor in the lost load experienced currently in addition to the new load forecasts based on increase in economic activity and electricity access. The JICA master plan records two alternative demand scenarios – a low case and a high case, with demand reaching 9,100 MW in the low case to 14,542 MW in the high case in 2030. This is against an on-grid peak demand of 2300 MW in 2014.

Table 1: Demand Forecast as per JICA Master Plan

Year	High Case (MW)			Low Case (MW)		
	Total	Non-Industry	Industry	Total	Non-Industry	Industry
2020	4,531	3,060	1,472	3,862	2,390	1,472
2030	14,542	9,819	4,723	9,100	5,631	3,468

2.10 The break-up of this demand forecast indicates most of the growth to be centred in and around Yangon and Mandalay. While this makes it relatively easier for planning and development in these two regions, as it concentrates infrastructure development and makes prioritisation of projects relatively easy, it also underlines the need for more distributed generation capacity addition for other regions until a robust integrated grid network is economically justifiable for all parts of the country.

POWER GENERATION (SUPPLY SCENARIO):

2.11 Before 1960, the generation system consisted mainly of isolated grids supplied by diesel generators and mini-hydropower. The first medium-scale hydropower plant, Baluchaung-2 in central-east Myanmar, about 420 km north of Yangon, was commissioned in 1960 with an installed capacity of 84 MW. The first gas-fired power plant, Kyunchaung in central-western Myanmar, was commissioned in 1974 with an installed capacity of 54.3 MW. The 120 MW Tigyit power plant in central Myanmar was completed in 2002 in central Myanmar and was the only coal-fired power plant in operation. It is currently non-operational due to technical problems with the boiler units.

2.12 At the end of March 2015, the total operational gas-based capacity in the country was approximately 1062 MW, as against an installed capacity of 1411 MW. Similarly, the installed capacity of hydro based power plants in the country is 3,151 MW of which 2,630 MW is the allocated capacity of Myanmar, and only about 1593 MW of this allocated capacity was operational in FY15.

2.13 The table below summarises the fuel-wise generation position of Myanmar:

Table 2: Installed Capacity in Myanmar (MW)

	FY14			FY15		
Plant	Own	IPPs+Rentals	Total	Own	IPPs+Rentals	Total
Hydro	1860.00	1111.00	2971.00	2040.00	1111.00	3151.00
Gas	714.90	221.30	936.20	954.90	456.18	1411.08
Coal	120.00	0.00	120.00	120.00	0.00	120.00
Total	2694.90	1332.30	4027.20	3114.90	1567.18	4682.08

Plant-wise details provided in Annexure

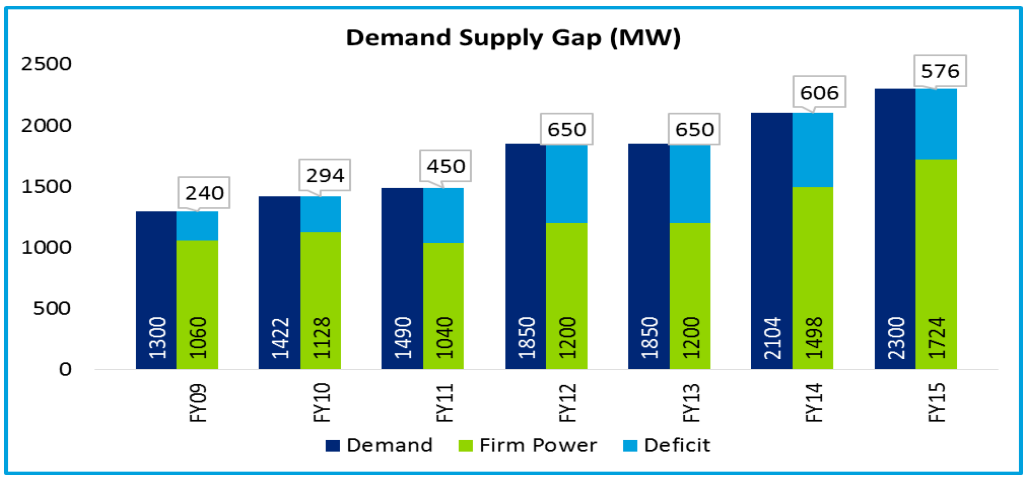
2.14 Out of the installed capacity of 3,151 MW of Hydro Power, two of the plants – Shweli-I and Dapein-I export majority of the produced power to China.

2.15 For the Shewli-1 hydropower plant (600 MW), the agreement with the PRC investor is that, three of its six generating units will provide power to the Myanmar grid. Of the total generated electricity, 50% will be provided at no cost to Myanmar and an additional 15%, if required, will be provided at cost. For the Dapein-1 hydropower plant (240 MW), 10% of the generated electricity will be made available to the Myanmar central grid. Therefore, the total hydro-power generation capacity, which serves the demand of Myanmar, is limited to 2630 MW.

DEMAND SUPPLY GAP:

2.16 The continued over-dependence on hydro creates seasonal deficits, particularly during the dry season from January to May every year. The chart below depicts the increase in peak deficit across the years, which have occurred in the dry seasons.

Figure 5: Demand Supply Gap



2.17 With supply not being able to keep up with the increasing demand from existing consumers in the system, distribution utilities routinely resort to large scale rationing of power, particularly to industrial zones, which get on an average 5 hours of supply a day in the dry season. This has a deleterious effect on industrial production on the one hand and industries resorting to establishing their captive power generation capacities on the other hand. This will further create a pressure on the subsidizing segment of consumers to move out of the system, thus exerting substantial tariff pressures on the domestic and other subsidized segments on account of cost recovery.

2.18 To ease demand pressures in the short term, a few gas-based rental power plants (gas-engines) are in operations. The details of these capacities are provided in the table below.

Table 3: Details of Rental Plants

Plant	Status	Supplier	Installed Capacity (MW)	Award Type	Charge (Cents/kWh)
Kyauk Phyu	Contract Period over	Agg	4.4	Negotiation	3.4
Kyauk Se	Operational	APR Energy	110.625	Negotiation	3.4
Kyaukphyu	Operational	V-Power	49.92	Bid	2.5 – Rainy Season; 2.8 Summer season

Plant	Status	Supplier	Installed Capacity (MW)	Award Type	Charge (Cents/kWh)
Myingyan	Operational	Aggreko	103.04	Negotiation	3.4

2.19 While the capacity charges contracted by these Rental Plants are comparable and at times lesser than those for CCGT IPPs, the corresponding energy charges are higher because of the lower efficiencies of gas-engines compared with CCGTs. Rental projects are nevertheless useful short-term options for the country as they can be strategically used to fill the gap between gas availability at sites and the time taken for competitively bid out projects to be commissioned. Besides helping reduce the short-term demand-supply gap, it also provides greater flexibility for MOEP to go in for competitive bidding and prevent the lock-in effect of long-term negotiated deals, which may be commissioned faster but are likely to be substantially inferior to competitively bid out projects both in terms of capacity charges and efficiency of plants.

2.20 There has been a surge in private sector proposals in Generation in the recent years. The current sum of unsolicited proposals from gas based plants add up to about 4,000 MW[1] of capacity and from small and medium hydro plants to about 25,000 MW of capacity. In, addition, there are development plans for several export-oriented, large hydro projects (above 1000 MW), totalling to about 20,000 MW of capacity, parts of which will be reserved for Myanmar's usage.

2.21 Recently, MOEP bid out successfully the 230 MW, Myingyan CCGT project, with Sembcorp, Singapore emerging as the successful bidder with a capacity charge quote of US $ cent 3.05/kWh and average net heat rate of 7,393 BTU/kWh-HHV. These are substantially improved outcomes compared with what have been offered under the unsolicited proposals received by MOEP.

ENERGY BALANCE IN MYANMAR:

2.22 The current structure of the Power Sector in Myanmar follows a Single Buyer Model where MEPE procures power from all sources and is responsible for bulk supply of this power to the two distribution utilities, viz, YESC and ESE.

2.23 A summary of the energy balance situation in the entire country for the past few years is provided in the table below.

[1] All of which are proposed to be developed by 2020-21

Table 4: Energy Balance

Million kWh	FY10	FY11	FY12	FY13	FY14	FY15
MEPE						
HPGE-Net Generation (a)	4,267	5,302	6,890	6,587	6,822	6,539
MEPE-Net Generation (b)	1,380	1,958	2,491	2,789	2,621	2,831
MEPE-PP-Gas (c)	-	-	-	-	450	2,238
MEPE-PP-Hydro (d)	1,060	1,062	722	1,208	1,972	2,195
Availability (e) = a+b+c+d	6,707	8,322	10,103	10,584	11,865	13,802
Sale (f)	6,193	7,674	9,326	9,932	11,309	13,350
Transmission Loss (g)=f-e	514	648	776	651	555	453
Transmission Loss	7.67%	7.78%	7.69%	6.15%	4.68%	3.28%
YESB						
Power Purchase (h)	2,843	3,611	4,365	4,613	5,197	5,982
Net Generation (i)	0	0	0	0	0	1
Sale (j)	2,214	2,893	3,525	3,752	4,245	4,922
Distribution Loss (k)=h+i-j	630	718	840	860	952	1,061
Distribution Loss	22.14%	19.89%	19.25%	18.65%	18.31%	17.74%
ESE						
Power Purchase (l)	3,403	4,063	4,979	5,326	6,112	7,367
Net Generation (m)	64	69	76	84	97	95
Sale (n)	2,779	3,419	4,192	4,503	5,366	6,333
Distribution Loss (o)=l+m-n	688	713	863	907	843	1,129
Distribution Loss	19.84%	17.25%	17.07%	16.77%	13.58%	15.13%
Country						
Power Purchase (p)=c+d	1,060	1,062	722	1,208	2,422	4,433
Net Generation (q)=a+b+i+m	5,712	7,329	9,457	9,460	9,539	9,466
Sale (r)	4,993	6,312	7,717	8,255	9,612	11,255
Distribution Loss (s)=p+q-r	1,778	2,079	2,462	2,413	2,350	2,644
Distribution Loss	26.26%	24.78%	24.19%	22.62%	19.65%	19.02%

A3: PERFORMANCE ANALYSIS OF STATE OWNED ENTERPRISE

HYDRO POWER GENERATION ENTERPRISE (HPGE):

3.1 Hydro Power Generation Enterprise operates the Hydro and Coal Plants owned by MOEP.

3.2 HPGE added plants like Nancho (40 MW), Phyu Chaung (40 MW) & Upper Paunglaung (140 MW) with a total capacity of 220 MW in last 2 years. The total installed capacity and the Net generation of HPGE plants is summarised in the table below:

Table 5: Average PLF of HPGE's own plants

Particulars	Units	FY13	FY14	FY15
Installed Capacity (Hydro + Coal)	MW	1940	1980	2160
Net Generation	MUs	6,587.18	6,822.12	6,538.72
Average PLF	%	39%	39%	35%

3.3 Out of the 240 MW installed capacity of Dapien 1 only 9 MW is currently operational due to non-availability of the transmission line. The power generated from this plant could not be evacuated and connected with the main grid as the associated transmission infrastructure has not been planned in coordination with the power plant. The power generated from this hydro power station is presently sold and distributed to the surrounding local villages.

Financial Review:

3.4 The power generated by HPGE is sold to MEPE at a tariff decided by MOEP. This tariff was fixed at Ky 20/kWh from FY10 to FY14. MOEP decreased the tariff to Ky 18/kWh in FY15 to compensate the procuring entity, MEPE, which was making losses mainly due to procurement of costly power from other sources. The key indicators for HPGE's financial performance over the last 5 years are presented in the table below:

Table 6: Key Financial Indicators of HPGE

Particulars	Units	FY10	FY11	FY12	FY13	FY14	FY15
Net Units Generated/Sales*	MUs	4267	5302	6890	6587	6822	6539
Revenue*	Mn Kyat	85346	106045	137798	131744	136442	117697
Generation Cost	Mn Kyat	21883	33916	32287	26328	57646	50084

Particulars	Units	FY10	FY11	FY12	FY13	FY14	FY15
PBT	Mn Kyat	63462	72129	105511	105416	78796	67613
Rev/Sales	Kyat/kWh	20.00	20.00	20.00	20.00	20.00	18.00
Gen Cost/Sales	Kyat/kWh	5.13	6.40	4.69	4.00	8.45	7.66
PBT/Sales	Kyat/kWh	14.87	13.60	15.31	16.00	11.55	10.34

*Free Power from IPPs is added

3.5 HPGE has been making profits. The Revenue/Sales has remained steady over the years at Ky 20/kWh owing to the mandate by MOEP and decreased in FY15 as part of a decision to support MEPE to sustain its financial performance owing to growing power purchase costs from other sources. While, in the same period, the Generation costs/kWh has increased at a CAGR of 8.4%. This has resulted in erosion of the PBT/Sales margin to Ky 10.34/kWh in FY15 from Ky 14.87/kWh in FY10.

3.6 Most of the HPGE's assets have been fully depreciated and not many new assets have been added in the recent years. This has helped HPGE to maintain the profitability despite no tariff increase in the past. An increase in y-o-y costs @ 8.5% with same tariff will lead to further erosion of PBT to Ky 6.5/kWh by FY20.

MYANMAR ELECTRIC POWER ENTERPRISE (MEPE):

3.7 MEPE plays the role of a single buyer in the country and procures power from all sources. It owns the transmission assets and is responsible for bulk supply of the power to the two distribution utilities, viz, YESC and ESE.

3.8 The energy balance for MEPE has been summarised in the table below:

Table 7: Energy Balance for MEPE

Particulars	Units	FY10	FY11	FY12	FY13	FY14	FY15
Units Generated	MUs	1428	2012	2556	2882	2725	2912
Power Purchased - HPGE	MUs	4267	5302	6890	6587	6822	6539
Power Purchased - External	MUs	1060	1062	722	1208	2422	4433
Units consumed by station	MUs	48	54	65	94	104	81
Units sold	%	6193	7674	9326	9932	11309	13350
Loss % (Actual)	%	7.67%	7.78%	7.69%	6.15%	4.68%	3.28%

3.9 The system planning, design of the transmission assets and augmenting transmission capacity to meet the load requirements is what MEPE has been doing along with playing the role of a Single Buyer and bulk supply of electricity to distribution utilities. MEPE has been consistently able to reduce transmission losses from 7.67% in FY 10 to 3.28% in FY15 through systematic investments towards strengthening existing lines and by introducing efficient and modern system interventions like Scada, etc.

3.10 MEPE has added 240 MW of gas based plant in Ywama in FY15 thereby increasing its installed capacity from 715 MW in FY14 to 955 MW in FY15. The own generation plants are running at an average PLF of 34% - 40% which necessitates MEPE to depend on power from IPPs and rentals to meet the growing demand of Myanmar.

Table 8: Average PLF of MEPE's Own Plant

Particulars	Units	FY12	FY13	FY14	FY15
Installed Capacity	MW	714.9	714.9	714.9	954.9
Net units Generated	MUs	2491	2789	2621	2831
PLF	%	40%	45%	42%	34%

3.11 Also, the station heat rate of these plants are substantially high leading to high requirement of gas a precious resource which should be conserved with efficient plants. The data below shows an average net heat rate of 15000 BTU/kWh recorded by these plants in the last two years against a world average almost half to this value. A back of envelope calculation indicates savings of almost 100 million USD annually is possible if these plants could be replaced by more efficient combined cycle gas turbines.

Table 9: Net Heat Rate of MEPE's own plant

Particulars	Units	FY14	FY15
Net units Generated	MUs	2621	2831
Gas Consumption	MCF	53905	56881
Conversion	BTU/CF	741	765
Gas Consumption	MMBTU	39928769	43486084
Net Heat Rate	BTU/kWh	15237	15362

3.12 Currently MEPE procures gas from MOE at subsidized rates for its own plants, rental plants and IPPs. MOE used to charge a fixed price of $5/MMBTU to MEPE till FY15. However this has been increased to $7.5/MMBTU for FY16. The gas price charged by MOE to MEPE for various plants is summarised in the table below:

Table 10: Gas Price for various plants in Myanmar

Particulars	Units	FY15 (P)	FY16 (P)
MEPE – Own Plants*	$/MMBTU	5	7.5
Rental Plants	$/MMBTU	10 to 12	10 to 12
IPPs	$/MMBTU	5	7.5

*Except Kyunchaung Plant which is charged at 200,000 Kyat/MCF

3.13 The increase in gas price would increase the cost of power generation and procurement costs for MEPE and pose a risk for cost recovery for MEPE through tariffs charged to Distribution Utilities unless retail tariffs are increased commensurately.

Financial Review:

3.14 MEPE has been making losses from FY13 onwards. The losses are mainly on account of procurement of costly power from Gas IPPs (including rentals) and not recovering the cost from the Distribution Utilities. The brief snapshot of financial performance of MEPE has been provided in the table below:

Table 11: Key Financial Indicators for MEPE

Particulars	Units	FY10	FY11	FY12	FY13	FY14	FY15
Per unit cost of PP – Own Gen	Kyat/kWh	5.62	4.64	3.89	76.97	69.81	113.38
Per unit cost of PP – HPGE	Kyat/kWh	20.00	20.00	20.00	20.00	20.00	18.00
Per unit cost of PP – External	Kyat/kWh	0.15	0.16	0.16	25.33	48.42	63.40
Per unit cost of PP – Total	Kyat/kWh	13.90	13.86	14.61	35.62	36.80	52.14
Revenue	Mn Kyat	123861	153481	186877	370924	434041	724010
PP+Own Generation Cost	Mn Kyat	93259	115301	147593	376989	436648	719689
Transmission Expenses	Mn Kyat	10627	11994	16975	29097	36816	75470
PBT	Mn Kyat	19974	26185	22309	-35162	-39423	-71149
Rev/Sales	Kyat/kWh	20.00	20.00	20.04	37.35	38.38	54.23
(PP+Own Gen)/Sales	Kyat/kWh	15.06	15.02	15.83	37.96	38.61	53.91
Transmission/Sales	Kyat/kWh	1.72	1.56	1.82	2.93	3.26	5.65
PBT/Sales	Kyat/kWh	3.23	3.41	2.39	-3.54	-3.49	-5.33

3.15 MEPE has revised the generation tariff for YESC and ESE consistently over the last 3 years. The tariff (on weighted average basis) has gone up at a CAGR of 39% from Ky 20/kWh in FY12 to Ky 54.23/kWh in FY15. However, the generation and power purchase cost per unit sales has increased at a CAGR of 50% over the same period leading to losses for MEPE. Further the operational cost of MEPE like Salaries, Maintenance repairs and others are growing at a CAGR of 46% over the same period which is substantially high.

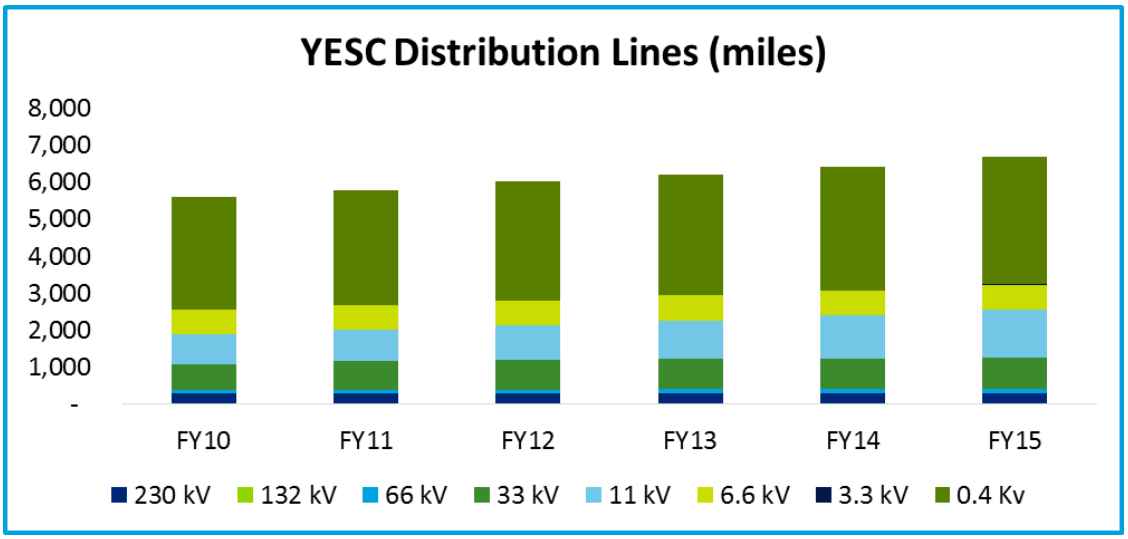
3.16 The above, highlights the need for all possible means to optimize cost of power generation on one hand and urgent need for a policy on subsidy administration to MEPE till cost reflective tariffs are charged to YESC and ESE.

YANGON ELECTRICITY SUPPLY CORPORATION (YESC):

3.17 YESC supplies power to consumers in the Yangon region of Myanmar.

3.18 The total distribution line length of YESC has increased at a CAGR of 3.6% from 5601 miles in FY10 to 6691 miles in FY15. The year-wise break up of distribution lines is provided in the chart below:

Figure 6: Distribution Line Length of YESC



3.19 The energy balance for YESC has been provided in the table below:

Table 12: Energy Balance for YESC

Particulars	Units	FY10	FY11	FY12	FY13	FY14	FY15
Units Generated	MUs	0	0	0	0	0	1
Power Purchased	MUs	2843	3611	4365	4613	5197	5982
Units consumed by station	MUs	0	0	0	0	0	0

Particulars	Units	FY10	FY11	FY12	FY13	FY14	FY15
Units sold	MUs	2214	2893	3525	3752	4245	4922
Loss % (Actual)	%	22.1%	19.9%	19.3%	18.7%	18.3%	17.7%

3.20 YESC has been successful in reducing the aggregate technical and commercial losses from 22.1% in FY10 to 17.7% in FY15. And with systematic investments, the losses are expected to reduce further in the future.

Financial Review:

3.21 The tariff charged to the consumers by both YESB and ESE is fixed by the Ministry of the Electric Power. In the last 3 years, there has been a consistent increase in tariffs by the MOEP and realization by YESB has gone up from Ky 42.06/kWh in FY12 to Ky 79.40/kWh in FY15. However, the PBT margin of YESB has reduced substantially over these 3 years from a level of 33% in FY 12 to 8% in FY15. A brief snapshot of YESB's financials is provided in the table below:

Table 13: Key Financial Indicators for YESC

Particulars	Units	FY10	FY11	FY12	FY13	FY14	FY15
Per unit cost of PP+Own Gen	Kyat/kWh	20.05	20.04	20.03	38.46	40.06	57.11
Revenue	Mn Kyat	77387	109397	148256	213404	240544	390770
(PP +Own Gen) Cost	Mn Kyat	57015	72385	87434	177430	208190	341699
Others	Mn Kyat	5338	8006	11690	12742	15622	18722
PBT	Mn Kyat	15034	29006	49131	23231	16732	30348
Rev/Sales	Kyat/kWh	34.95	37.82	42.06	56.87	56.66	79.40
(PP+OwnGen)/Sales	Kyat/kWh	25.75	25.02	24.81	47.28	49.04	69.43
Others/Sales	Kyat/kWh	2.41	2.77	3.32	3.40	3.68	3.80
PBT/Sales	Kyat/kWh	6.79	10.03	13.94	6.19	3.94	6.17

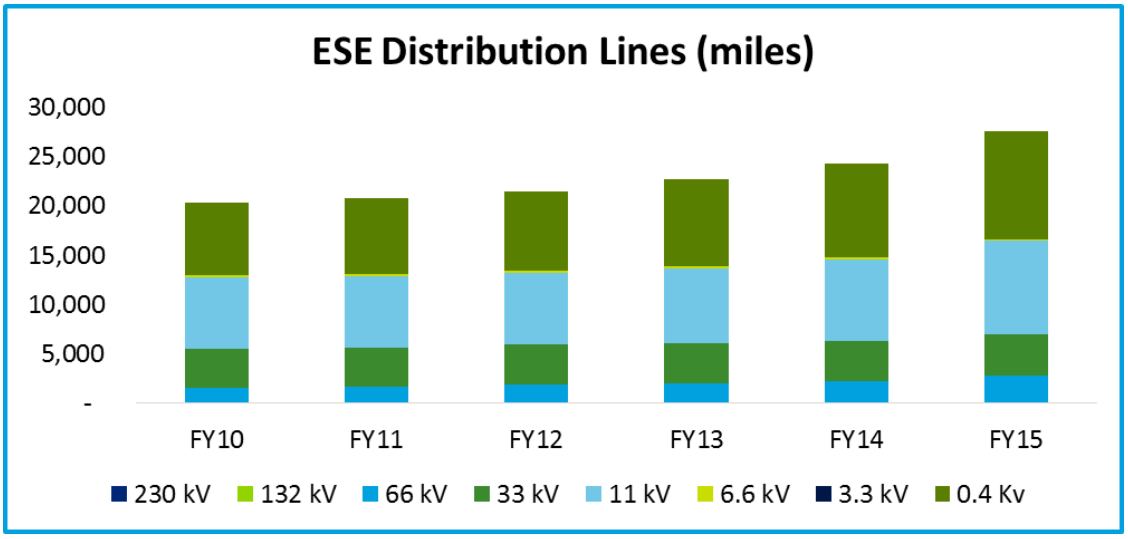
3.22 The power purchase cost per unit sales has increased at a CAGR of 41% from Ky 24.81/kWh in FY12 to Ky 69.43/kWh in FY15. On the other hand, the average billing rate has increased only at a CAGR of 24% from Ky 42.06/kWh in FY12 to Ky 79.40/kWh in FY15. Sustaining such high tariff growth in future would therefore be challenging for MOEP.

ELECTRICITY SUPPLY ENTERPRISE (ESE):

3.23 ESE supplies power to all consumers in Myanmar other than Yangon region.

3.24 The total distribution line length of ESE has increased at a CAGR of 6.2% from 20351 miles in FY10 to 27548 miles in FY15. The year-wise break up of distribution line addition is provided in the chart below:

Figure 7: Distribution line length of ESE



3.25 The energy balance for ESE has been provided in the table below

Table 14: Energy Balance for ESE

Particulars	Units	FY10	FY11	FY12	FY13	FY14	FY15
Units Generated	MUs	69	77	87	95	106	104
Power Purchased	MUs	3403	4063	4979	5326	6112	7367
Units consumed by station	MUs	5	8	11	11	9	9
Units sold	MUs	2779	3419	4192	4503	5366	6333
Loss % (Actual)	%	19.8%	17.3%	17.1%	16.8%	13.6%	15.1%

3.26 The loss levels in the ESE is much better than YESC despite having a much larger area to serve and diverse load distribution. ESE has done a remarkable job in this aspect in the past, though it is to be seen whether such low levels of loss prevail while they add new consumers (primarily low voltage consumers) and expand into newer distribution areas.

Financial Review:

3.27 The PBT margin for ESE has also dropped significantly from 25% in FY 12 to around 3-5% in last 3 years. A brief snapshot of ESE's financials is provided in the table below:

Table 15: Key Financial Indicators for ESE

		FY10	FY11	FY12	FY13	FY14	FY15
Per unit cost of PP – Own Gen	Kyat/kWh	88.10	84.95	73.02	80.46	81.14	86.36
Per unit cost of PP – MEPE	Kyat/kWh	19.99	20.00	20.00	36.38	36.89	52.00
Per unit cost of PP – Total	Kyat/kWh	21.25	21.09	20.80	37.06	37.58	52.44
Revenue	Mn Kyat	92686	127715	167933	234903	267315	443874
(PP+Own Gen) Cost	Mn Kyat	73676	87129	105126	200505	233346	391295
Others	Mn Kyat	14149	15724	21506	23201	26934	34316
PBT	Mn Kyat	4861	24862	41301	11196	7034	18262
Rev/Sales	Kyat/kWh	33.35	37.35	40.06	52.17	49.82	70.09
(PP+Own Gen)/Sales	Kyat/kWh	26.51	25.48	25.08	44.53	43.49	61.78
Others/Sales	Kyat/kWh	5.09	4.60	5.13	5.15	5.02	5.42
PBT/Sales	Kyat/kWh	1.75	7.27	9.85	2.49	1.31	2.88

3.28 This is mainly because the average billing rate for ESE has increased from Ky 40.06/kWh in FY12 to Ky 70.09/kWh to FY15 (at a CAGR of 20%), while the power purchase cost per unit sales has increased from Ky 25.08/kWh in FY12 to Ky 61.78/kWh in FY15 (at a CAGR of 35%).

3.29 It needs to be analysed how these Distribution Utilities perform in future as any further hike in retail tariffs may not be possible after such rampant increases in the last 3 years. Moreover, there is limited headroom to increase tariffs for the Industrial category of consumers as these consumers are already charged at peak level and tariffs have touched regional benchmarks.

Table 16: Industrial Tariff in South-East Asian Countries

Country	Industrial Tariff (USD/kWh)
Vietnam	0.064
Bangladesh	0.095
Malaysia	0.081
Thailand	0.075

Country	Industrial Tariff (USD/kWh)
Singapore	0.138
Myanmar	0.087

3.30 The financial model, that will be developed, will test these scenarios and suggest possible measures around any issues identified during the analysis.

A4: ELECTRICITY PRICING & SUBSIDY IMPLICATIONS

4.1 The current structure of the Power Sector in Myanmar follows a Single Buyer Model where MEPE procures power from all sources and is responsible for bulk supply of this power to the two distribution utilities, viz, YESB and ESE.

4.2 MEPE has limited own sources of generation and procures bulk of the power from other sources including the HPGE and external IPPs. So far, the portfolio of projects is weighted heavily towards lower cost hydro power resources combined with its own power generation from low cost gas allocations. This has helped in the past to keep the tariffs under limits.

4.3 Faced with a changing power procurement mix, due to increased emphasis on gas-based generation to meet base load requirements, there has been recently a significant pressure on tariffs across the value chain.

4.4 MEPE's bulk supply tariff to YESC and ESE has gone up from the levels of Ky 20/kWh in 2012 to Ky 54.23/kWh in 2015. The consumer tariffs have also been hiked from Ky 40-42 /kWh to Ky 70-79/kWh to compensate for increase in power purchase costs.

4.5 The movement of tariff and cost across the years at the bulk supply and retail level are indicated in the table below.

Table 17: Tariff and cost movement for various State owned Enterprises

Kyat/kWh		FY10	FY11	FY12	FY13	FY14	FY15
HPGE							
Rev/Sales	(1)	20.00	20.00	20.00	20.00	20.00	18.00
Own Gen/Sales	(2)	5.13	6.40	4.69	4.00	8.45	7.66
Other Exp/Sales	(3)	-	-	-	-	-	-
PBT/Sales	(4) = (1) – (2) - (3)	14.87	13.60	15.31	16.00	11.55	10.34
MEPE							
Rev/Sales	(1)	20.00	20.00	20.04	37.35	38.38	54.23
(PP+Own Gen)/Sales	(2)	15.06	15.02	15.83	37.96	38.61	53.91
Other Exp/Sales	(3)	1.72	1.56	1.82	2.93	3.26	5.65
PBT/Sales	(4) = (1) – (2) - (3)	3.23	3.41	2.39	(3.54)	(3.49)	(5.33)
YESB							
Rev/Sales	(1)	34.95	37.82	42.06	56.87	56.66	79.40
(PP+Own Gen)/Sales	(2)	25.75	25.02	24.81	47.28	49.04	69.43
Other Exp/Sales	(3)	2.41	2.77	3.32	3.40	3.68	3.80
PBT/Sales	(4) = (1) – (2) - (3)	6.79	10.03	13.94	6.19	3.94	6.17

Kyat/kWh		FY10	FY11	FY12	FY13	FY14	FY15
ESE							
Rev/Sales	(1)	33.35	37.35	40.06	52.17	49.82	70.09
(PP+Own Gen)/Sales	(2)	26.51	25.48	25.08	44.53	43.49	61.78
Other Exp/Sales	(3)	5.09	4.60	5.13	5.15	5.02	5.42
PBT/Sales	(4) = (1) – (2) - (3)	1.75	7.27	9.85	2.49	1.31	2.88

4.6 So far, most of the entities in the power sector have managed to stay profitable, though their PBT margins have consistently declined over the years with MEPE turning into a loss making entity in the recent past. Hydro power additions in the past were likely financed by government grants, leading to substantially lower tariffs, the impact of which is seen in the lower cost of procurement for MEPE over the past. Tariffs for gas-based power from IPPs are however close to Ky 105/kWh[2] while the revenue realized by MEPE from sale of each unit of power to the distribution utilities is only Ky 54.23/kWh. This is the situation despite an upward revision in retail tariffs over the past three consecutive years. So, each unit of power procurement from gas based power station, in the future, will rapidly erode the profitability of MEPE and the sector as a whole.

4.7 The practice of subsidized pricing of gas allocations to the power plants changed from FY2013 onwards, resulting in gas-based power generation costs to rise substantially. A considered policy for pricing of energy for domestic usage may need to be considered for the country as it may not be appropriate to price it simply at the opportunity cost of exports, which has been the method envisaged for new cases of allocations in recent times.

4.8 Although the sector has managed positive gross margins so far, after accounting for other costs, MEPE has been making loss for the last 3 years starting FY13. This situation was redressed to an extent by the tariff increases across the value chain in FY14.

SUBSIDY IMPLICATIONS:

4.9 Though MEPE has been in losses in the last few years, the sector has so far not required any external subsidy support from the Government of Myanmar. This is calculated and shown in the table below. Profit was registered for all sector enterprises taken together, if we exclude the operating costs of the departments like DEP, DHPP and DHPI.

[2] A levelised tariff equivalent to Myingyan IPP bid tariff considered at gas price of USD 7.5 / MMBTU

Table 18: Myanmar Power Sector Performance

HPGE+MEPE+YESB+ESE		FY14 Per unit Cost (Kyat/kWh)	FY14 (Mn Kyat)	FY15 - Prov. Per unit Cost (Kyat/kWh)	FY15 - Prov (Mn Kyat)
Rev/Sales	(1)	52.84	507859	74.16	834644
(PP+Own Gen)/Sales	(2)	37.23	357852	57.94	652076
Others/Sales	(3)	9.04	86868	12.22	137493
PBT/Sales	(4) = (1) – (2) - (3)	6.57	63139	4.00	45075

4.10 However, the situation is likely to change significantly with the commissioning of the Myingyan IPP in 2018. This shall be a critical factor to be analysed as part of the overall viability plan. It is prima facie obvious that the sector will be dependent on external subsidy support from the Government of Myanmar over the medium term, while also requiring sustainable tariff revisions at regular intervals.

A5: WAY FORWARD AND APPROACH TO THE INTEGRATED FINANCIAL MODEL

5.1 The next critical task is to focus on the development of an integrated financial model. The model will be structured such as both entity wise and integrated analysis is possible.

5.2 The financial projections will be made separately for the HPGE, MEPE's Generation business, MEPE's Transmission business, YESC and ESE. The financial projections of HPGE and MEPE-Generation shall then be merged to have the consolidated financials for the Power Generation business / or that of the re-structured EPGE of the future.

5.3 Deloitte team shared a detailed list of data requirements in the first week of engagement with the counterpart team from MEPE. Based on the data received from various entities, the list of assumptions considered for financial analysis and projections of the Myanmar Power Sector for the next 10 years are detailed out and presented in the Annexure of this report. Since as per the discussions held in the last week of August 2015 with the counterpart team, no comments have been received on the assumption list, we propose to walk through the main assumptions in a workshop to be held at an appropriate time in September 2015 to build a shared understanding on the assumptions being used in the financial viability analysis.

5.4 The financial model will build in various functionalities such as different options for tariff increase, based on e.g., a pass through of fuel charge escalations, a full cost recovery through tariffs over a defined period or simply an input based on assessment of what is a sustainable annual increase acceptable to consumers. This draft model will be presented to the client for their inputs and feedback before being finalised.

5.5 Based on the inputs gathered over the period of study and the model created, the first draft of the financial viability action plan will be prepared and presented to the client in November 2015.

5.6 The next stage involves discussions with stakeholders across the spectrum to incorporate and fine-tune factors critically influencing the business plan of the future. In particular, policies and plans with regards to rural electrification, Gas Sector plans, and government policy on gas pricing as well as future policies for subsidy allocation shall be more robustly factored into the model to enhance its capability to assess future dynamics. The impact of fuel subsidy on the financial viability of the sector will be a major factor determining the profitable operation of all the utilities and therefore the model will be enhanced by adding these functionalities to evaluate its impact.

5.7 The impact of energy efficiency drivers and T&D system enhancement such as various plans and schemes to reduce T&D losses through investments in the distribution network as well as adoption of newer operational technologies shall also be carefully studied to evolve a T&D loss trajectory, which the sector aims to achieve.

5.8 The inputs from the various analyses performed over the project duration as well as the resultant model shall be utilized to prepare the final draft of the Financial Viability Action Plan to be finalized by February 2016.

5.9 The project duration will also mark extensive training sessions provided throughout, during each of the three planned visits to Myanmar. Training workshops, in each of these visits, shall be held as two-day programs, so that the participants are encouraged to familiarize themselves with the financial model and MS-Excel based operations over Day 1 and made to operate the model over Day 2.

5.10 A needs assessment will be performed to outline continuous training needs of the finance and economic department personnel in the various enterprises with regards to financial modelling / forecasting viability assessments.

A6: REVISED WORK PLAN

6.1 The revised work plan is provided in the table below:

No	Deliverables	Months									
		1	2	3	4	5	6	7	8	9	TOTAL[1]
D-1	**Project Kick Off and Inception Report**										
1.1	Project kick-off & discussions with counterpart team										0.5
1.2	Finalizing the Methodology, Action Plan and Time Schedule										0.5
1.3	Review of Existing Reports										1.5
1.4	**Submission of Draft Inception Report**										
1.5	Feedback & Inputs from Client and Incorporating Comments										0.5
1.6	**Submission of Final Inception Report**										
D-2	**Financial Model & Training on Financial Modeling**										
2.1	Review of Existing Financial Model of MEPE										1.5
2.2	Enhance the Financial Model of MEPE with forward looking financial analysis of power sector										1.5
2.3	Submission of Draft Financial Model										
2.4	Feedback & Inputs from Client and Updating the Model										3
2.5	**Submission of Final Financial Model**										
2.6	Training on Financial Model – during each site visit										
D-3	**1st Draft Financial Viability Action Plan**										
3.1	**Submit 1st Draft Financial Viability Action Plan**										
3.2	Feedback & Inputs from Client and Updating the Model										
3.3	**Submission of 2nd Mission Report**										
D-4	**2nd Draft Financial Viability Action Plan**										
4.1	Assessing the impact of Myanmar Electrification Plan on the Financial Viability Action Plan										0.5
4.2	Finalizing the Investment Plan outlook and the subsidy regime impact on the Financial Viability Action Plan										1.5

No	Deliverables	Months									
		1	2	3	4	5	6	7	8	9	TOTAL[1]
4.3	Incorporating Fuel Availability & Pricing impact on the Financial Viability Action Plan										1.5
4.4	Analyse Implications on Power Sector Financial Outlook										0.5
4.5	**Submit 2nd Draft Financial Viability Action Plan**										
4.6	Feedback & Inputs from Client and Updating the Model										
4.7	**Submission of 3rd Mission Report**										
D-5	**Final Draft Financial Viability Action Plan**										
5.1	Feedback & Inputs from Client and Incorporating Comments										1.5
5.2	Participate in Consultation Process with Stakeholders										1.5
5.3	**Submission of Final Draft Viability Action Plan**										
6	**Interaction with Client and Finalization of Report**										0.5

Activities
Deliverables

1. Indicates total months to be spent on each line item and does not indicate man-month values.

ANNEXURE 1: INSTALLED CAPACITY

Plant	Installed Capacity (MW) – FY14	Installed Capacity (MW) – FY15
Hydro - HPGE		
Baluchaung 1	28.00	28.00
Baluchaung 2	168.00	168.00
Kinda	56.00	56.00
Sedawgyi	25.00	25.00
Zawgyi 1	18.00	18.00
Zawgyi 2	12.00	12.00
Zaungtu	20.00	20.00
Thaphanzeik	30.00	30.00
Mone	75.00	75.00
Paunglaung	280.00	280.00
Yenwe	25.00	25.00
Khabaung	30.00	30.00
Kengtwang	54.00	54.00
Yeywa	790.00	790.00
Shwegyin	75.00	75.00
Kun	60.00	60.00
Kyeeon Kyeewa	74.00	74.00
Nancho	40.00	40.00
Phyuu Chaung	0.00	40.00
Upper Paunglaung	0.00	140.00
Total	1860.00	2040.00
Hydro – IPP		
Shweli 1	600.00	600.00
Dapein No. 1	240.00	240.00
Thaukyekhat 2	120.00	120.00
Baluchaung 3	52.00	52.00
Chipwenge	99.00	99.00
Total	1111.00	1111.00
Coal		
Tygit	120.00	120.00
Gas - MEPE		
Hlawga GTCC	154.20	154.20
Ywama GT	70.30	70.30
Ahlone GTCC	154.20	154.20
Tharkayta GTCC	92.00	92.00
Thaton GT	50.95	50.95

Plant	Installed Capacity (MW) – FY14	Installed Capacity (MW) – FY15
Kyunchuang GT	54.30	54.30
Mawlamyaing GT	12.00	12.00
Myanaung GT	34.70	34.70
Shwedaung GT	55.35	55.35
Mann GT	36.90	36.90
Ywama 240	0.00	240.00
Total	714.90	954.90
Gas - IPP		
Myanmar Central Power Co Ltd. - Hlawga	27.30	26.65
Toyo Thai Power Myanmar Co Ltd. - Ahlong	84.00	94.00
UPP Power Myanmar Co. Ltd. - Ywama	52.00	52.00
Max Power Co. Ltd. - Thaketa	53.60	53.58
Myanmar Lightning - MawLamying	0.00	65.00
Total	216.90	291.23
Gas - Rental		
Kyauk Phyu	4.40	4.40
Kyauk Se - APR Energy	0.00	110.63
Kyauk Phyu - V Power	0.00	49.92
Total	4.40	164.95

ANNEXURE 2: LIST OF ASSUMPTIONS FOR THE FINANCIAL PROJECTIONS

Power Generation Forecasts

MEPE's Own Generation – Gas Plants

Parameter	Units	Assumption Value	Remarks
Existing Generation			
Generation Units from all Gas Plants	MUs		FY16 : Based on FY 15 data of Net Generation : 2830.81 FY17 onwards : PLF of Ywama (240 MW) is improved to 60%; Rest all plants based on PLF of FY15
Fuel Cost (Gas)	$/MMBtu	$5 – FY15, $7.5 – FY16	Annual escalation of gas prices based on historical data (global gas prices)
Heat Rate / Consumption of gas	BTU/kWh		Plant wise gas consumption has been received from GT Department, MEPE for FY15. The same is used to determine the heat rate of each plant. This heat rate will be used for projection of fuel cost in future.
Thaton			
Capacity	MW	109	Data received from GT Department, MEPE
Operational Year		FY 19	Currently EPC not awarded;
PLF	%	85%	Industry Benchmark
Heat Rate	BTU/kWh	6461	Data received from GT Department, MEPE
Capacity charge	cent/kWh		Based on Capital cost of 120 Mn USD
Fuel Cost (Gas)	$/MMBtu	$5 – FY15, $7.5 – FY16	Annual escalation of gas prices based on historical data (global gas prices)
Thilawa			
Capacity	MW	50	Data received from GT Department, MEPE
Operational Year		FY 17	EPC awarded (under construction)
PLF	%	85%	Industry Benchmark
Heat Rate	BTU/kWh	7800	Industry Benchmark
Capacity charge	cent/kWh		Based on Capital cost of 50 Mn USD
Fuel Cost (Gas)	$/MMBtu	$5 – FY15, $7.5 – FY16	Annual escalation of gas prices based on historical data (global gas prices)
Kyaukphyu			
Capacity	MW	50	GT Department, MEPE
Operational Year		FY 18	EPC awarded
PLF	%	85%	Industry Benchmark
Heat Rate	BTU/kWh	7800	Industry Benchmark
Capacity charge	cent/kWh		Based on Capital cost of 48 Mn USD
Fuel Cost (Gas)	$/MMBtu	$5 – FY15, $7.5 – FY16	Annual escalation of gas prices based on historical data (global gas prices)

HPGE's Own Generation - Hydro Plants

Parameter	Units	Assumption Value	Remarks
HPGE			
Installed Capacity	MW	2160	Data received from Thermal Planning Department, Department of Electric Power Planning. FY14 : 1980 MW & FY15 : 2160 MW
PLF	MUs	35%	Based on PLF for FY15

Power Purchase – Hydro Plants

Parameter	Units	Assumption Value	Remarks
Shweli (1)			
Generation Units	MUs	1171.67	Based on average of last 5 year generation (FY11 to FY15)
Price	RMB/kWh	0.189	Existing PPA; RMB to Kyat conversion will be based on historical data; Any depreciation of Kyat will also be based on historical data 15% free Power; 10% profit distribution
Dapien 1			
Capacity	MW	240	Data received from DHPP
Operational year			Already in Operation
PLF	%		Currently only 9MW is operational due to transmission capacity constraint. Gradually increased to reach 40% PLF by FY18
Price	cent/kWh	Less than 5.5	Negotiation Stage
Myanmar's share	%	100%	8% free power from 1-25 years and 10% free power from remaining years; 92% at <5.5 US Cent/kWh; 15% profit distribution
Thaukyekyat (2) Golden Energy Pte. Ltd (IPP)			
Capacity	MW	120	Data received from DHPP
Operational year			Already in Operation
PLF	%	38%	Based on FY15 Data
Price	Kyat/kWh	70	Data received from DHPP
Myanmar's share	%	100%	0% free Power; 100% at 70
Balchaun (3) - Future Energy Co., Ltd (IPP)			
Capacity	MW	52	Data received from DHPP
Operational year			Already in Operation
PLF	%	50%	FY14 – 11%; FY15 - 62%
Price	Kyat/kWh	64.5	Data received from DHPP
Myanmar's share	%	100%	0% free Power; 100% at the price mentioned above
Chipwenge - Upstream Ayeyarwady Co. Ltd.			
Capacity	MW	99	Data received from DHPP
Operational year			Already in Operation

Parameter	Units	Assumption Value	Remarks
PLF	MUs		Currently 20MW is in operations; Gradually increased from current level to reach 40% by FY17
Price	Kyat/kWh	60	Data received from DHPP
Myanmar's share	%	100%	No free power; 15% profit distribution
Kaunlong			
Capacity	MW	1400	Data received from DHPP
Operational year		FY22	Construction Period : 6.5 years
PLF	%		20% in FY 22 and 40% thereafter
Price	cent/kWh	4.3	Data received from DHPP
Myanmar's share	%	50%	10% free Power; 40% at the price mentioned above; 15% profit distribution
Nandapak Cascade 1			
Capacity	MW	140	Data received from DHPP
Operational year		FY21	Construction Period : 5 years
PLF	%		30% in FY21 and 40% thereafter
Price	cent/kWh	5.5	Data received from DHPP
Myanmar's share	%	100%	10% free Power; 90% at the price mentioned above; 15% profit distribution
Nandapak Cascade 2			
Capacity	MW	141	Data received from DHPP
Operational year		FY21	Construction Period : 5 years
PLF	%		30% in FY21 and 40% thereafter
Price	cent/kWh	5.5	Data received from DHPP
Myanmar's share	%	100%	10% free Power; 90% at the price mentioned above; 15% profit distribution
Dapein 2			
Capacity	MW	140	Data received from DHPP
Operational year		FY19	Construction Period : 3.5 years
PLF	%	40%	20% in FY19 and 40% thereafter
Price	cent/kWh	5.5	Data received from DHPP
Myanmar's share	%	100%	10% free Power; 90% at the price mentioned above; 15% profit distribution
New Plants			
New Capacity Addition Y-o-Y	MW		
PLF	MUs	40%	Data received from DHPP
Price	cent/kWh	5.5	Data received from DHPP
Myanmar's share	%	100%	10% free Power; 90% at the price mentioned above

Power Purchase – Coal Plants

Parameter	Units	Assumption Value	Remarks

Parameter	Units	Assumption Value	Remarks
Yanmazu			
Capacity	MW	500	Data received from DHPP
Operational Year		FY 21	Currently at MOA Negotiation Stage
PLF	%	85%	Industry Benchmark
Price	cent/kWh	7	Free Power is 2.5%; profit share is 8%; Data received from DHPP
Myeik			
Capacity	MW	2460	Data received from DHPP
Operational Year		FY 22	Currently at MOA Negotiation Stage
PLF	%	85%	Industry Benchmark
Price	cent/kWh	7	Negotiation stage
Toyo Thai			
Capacity	MW	1280	Data received from DHPP
Operational Year		FY 20	MOA Finished
PLF	%	85%	Industry Benchmark
Price	cent/kWh	7	Negotiation stage
Kalewa			
Capacity	MW	540	Data received from DHPP
Operational Year		FY 20	MOA Negotiation Stage almost finished
PLF	%	75%	Proposal from Investor
Price	cent/kWh	7	Negotiation stage
New Coal Plants			
New Capacity Addition Y-o-Y	MW		No new coal plants have been considered apart from the ones who are in the MOA stage
PLF	%	85%	Industry Benchmark
Price	cent/kWh	7	Negotiation stage

Power Purchase – Gas Plants

Parameter	Units	Assumption Value	Remarks
Myanmar Central Power Co Ltd. – Hlawga			
Capacity	MW	26.65	Data received from GT Department, MEPE
Operational Year			Already operational
PLF	%		Gradually increased to 75% in FY16 from current level of 36% in FY14 and 74% in FY15
Heat Rate	BTU/kWh	10471	Based on heat rate for FY15
Capacity charge	cent/kWh	3.40	
Cost of Fuel	$/MMBtu	$5 – FY15, $7.5 – FY16	Annual escalation of gas prices based on historical data (global gas prices)
Toyo Thai Power Myanmar Co Ltd. – Ahlong			
Capacity	MW	121.60	94 Mw in FY 15 and 121.6 MW in FY16; Data received from GT Department, MEPE
Operational Year			Already operational
PLF	%		Gradually increased to 75% in FY17 from

Parameter	Units	Assumption Value	Remarks
			current level of 32% in FY14 and 70% in FY15; PLF for FY16 considered as 61% due to capacity addition
Heat Rate	BTU/kWh	10515	Based on heat rate for FY15
Capacity charge	Kyat/kWh	24.32	Based on average of last 2 years data – MEPE Statistics Report
Cost of Fuel	$/MMBtu	$5 – FY15, $7.5 – FY16	Annual escalation of gas prices based on historical data (global gas prices)
UPP Power Myanmar Co. Ltd. – Ywama			
Capacity	MW	52	Data received from GT Department, MEPE
Operational Year			Already operational
PLF	%		Kept at 78% in FY16 from current level of 11% in FY14 and 78% in FY15
Heat Rate	BTU/kWh	9433	Based on heat rate for FY15
Capacity charge	cent/kWh	3.40	
Cost of Fuel	$/MMBtu	$5 – FY15, $7.5 – FY16	Annual escalation of gas prices based on historical data (global gas prices)
Max Power Co. Ltd. – Thaketa			
Capacity	MW	53.584	Data received from GT Department, MEPE
Operational Year			Already operational
PLF	%		Gradually increased to 75% in FY16 from current level of 15% in FY14 and 74% in FY15
Heat Rate	BTU/kWh	9480	Based on heat rate for FY15
Capacity charge	cent/kWh	3.40	
Cost of Fuel	$/MMBtu	$5 – FY15, $7.5 – FY16	Annual escalation of gas prices based on historical data (global gas prices)
Myanmar Lightning Co. Ltd.			
Capacity	MW	152	65 MW in FY15 and 152 MW in FY16 Data received from GT Department, MEPE
Operational Year			Already operational
PLF	%		Gradually increased to 75% in FY17 from current level of 40% in FY15; PLF for FY16 considered as 40% due to capacity addition
Heat Rate	BTU/kWh	14011	Based on heat rate for FY15
Capacity charge	cent/kWh	3.40	
Cost of Fuel	$/MMBtu	$5 – FY15, $7.5 – FY16	Annual escalation of gas prices based on historical data (global gas prices)
Kanpauk			
Capacity	MW	100	Data received from GT Department, MEPE (Limited to 100 MW due to non-availability of gas)
Operational Year		FY 20	PPA negotiation Stage
PLF	%	86.39%	Based on Feasibility Report (Average over the project life)
Heat Rate	BTU/kWh	7636	Based on Feasibility Report (Weighted

Parameter	Units	Assumption Value	Remarks
			average over the life of the project)
Capacity charge	cent/kWh	3.4	Based on capacity charge for other negotiated Project
Cost of Fuel	$/MMBtu	$5 – FY15, $7.5 – FY16	Annual escalation of gas prices based on historical data (global gas prices)
Free Power	%	0%	Based on Feasibility Report
UREC – Thaketa			
Capacity	MW	106	Data received from GT Department, MEPE (Limited to 106 MW due to non-availability of gas)
Operational Year		FY 19	PPA negotiation Stage
PLF	%	70%	Based on Feasibility Report
Heat Rate	BTU/kWh	8323	Based on Feasibility Report (Weighted average over the life of the project)
Capacity charge	cent/kWh	3.4	Based on capacity charge for other negotiated Project
Cost of Fuel	$/MMBtu	$5 – FY15, $7.5 – FY16	Annual escalation of gas prices based on historical data (global gas prices)
Free Power	%	10%	Based on Feasibility Report
Myingyan (IPP – Competitive Bidding)			
Capacity	MW	230	Data received from GT Department, MEPE
Operational Year		FY 18	Currently at PPA Negotiation Stage
PLF	%	78%	Based on bid evaluation results PLF = 90% on 200 MW available capacity equates to 78% on 230 MW installed capacity.
Heat Rate	BTU/kWh	7394	Based on bid evaluation results (weighted average over the life of the project)
Capacity charge	cent/kWh	2.9	Based on bid evaluation results
Cost of Fuel	$/MMBtu	$5 – FY15, $7.5 – FY16	Annual escalation of gas prices based on historical data (global gas prices)
Shwetaung (IPP – Competitive Bidding)			
Capacity	MW	70	Data received from GT Department, MEPE
Operational Year		FY 19	Bid submission deadline – July 2015
PLF	%	78%	Considered same as Myingyan
Heat Rate	BTU/kWh	7394	Considered same as Myingyan
Capacity charge	cent/kWh	2.9	Considered same as Myingyan
Cost of Fuel	$/MMBtu	$5 – FY15, $7.5 – FY16	Annual escalation of gas prices based on historical data (global gas prices)
Kyauk Se – APR Energy (Rental)			
Capacity	MW	110.625	Data received from GT Department, MEPE
Operational Year			Already Operational; Contract till Oct-2015; No generation is considered post Oct, 2015
PLF	%		Based on PLF for FY15
Heat Rate	BTU/kWh	10555	Based on heat rate for FY15

Parameter	Units	Assumption Value	Remarks
Capacity charge	cent/kWh	3.4	Data received from GT Department, MEPE
Cost of Fuel	$/MMBtu	11.81	Based on weighted average fuel cost for FY15
Kyauk Phyu – V Power (Rental)			
Capacity	MW	49.92	Data received from GT Department, MEPE
Operational Year			Mar 2015 to Oct 2016 (20 months); No generation is considered post Oct, 2016
PLF	%		Based on PLF for 4 months in FY16
Heat Rate	BTU/kWh	9715	Based on heat rate for 4 months in FY16
Capacity charge	cent/kWh	2.65	2.5 – Rainy Season; 2.8 Summer season; average has been assumed Data received from GT Department, MEPE
Cost of Fuel	$/MMBtu	10.03	Assumed similar cost of Kyauk Se – APR Energy
Myingyan – Aggreko (Rental)			
Capacity	MW	103.04	Data received from GT Department, MEPE
Operational Year			May 2015 to Oct 2016 (18 months); No generation is considered post Oct, 2016
PLF	%		Based on PLF for 3 months in FY16
Heat Rate	BTU/kWh	11074	Based on heat rate for 3 months in FY16
Capacity charge	cent/kWh	3.4	Data received from GT Department, MEPE
Cost of Fuel	$/MMBtu	11.81	Assumed similar cost of Kyauk Se – APR Energy

Others

Parameter	Units	Assumption Value	Remarks
Commercial Parameters			
Energy Billed by Generation Entity (EPGE)	MUs		Sum of own generation and power purchase
Transmission Loss	%		From current level to 3% in a gradual manner.
Tariff for Own Generation	Kyat/kWh	Cost + RoE	Cost of all overheads and expenses related to Gas based own generation and hydro based generation shall be recovered. It is also assumed that in 2 years, a regulator will be established and fully functional. Once Regulator is established, a return on equity / reasonable return shall also be charged over and above the cost recovery.
Capital Expenditure			

Parameter	Units	Assumption Value	Remarks
Capital Expenditure			10 Mn USD – Thaton Project 50 Mn USD – Thilawa Project 48 Mn USD – Kyauk Phyu Project All other plants are assumed to be developed under IPP mode. Hence, contribution of Government funds is limited.
Capex funding			Thaton Project – 100% by world Bank Thilawa Project – 100% by JICA Kyauk Phyu Project – 95% by China Exim Bank and 5% by Government
Loan Details			
Multilateral Loans (incl JICA, WB, China EXIM bank)			
Interest Rate	%	1.5%	This is effectively much cheaper. We have assumed a hedging cost over and above the interest rate.
Moratorium Period	Years	5	
Repayment Period	Years	20	
Commercial Loans			
Interest Rate	%	10%	
Moratorium Period	Years	1	
Repayment Period	Years	12	
Depreciation			
Rate of Depreciation (Book)	%		Average of depreciation rate of last 5 years of generation assets of MEPE and HPGE
Maximum allowed Depreciation	%	90%	10% is assumed as residual value
O&M Cost			
Salaries and Wages	Mn Kyat	Past trend with certain adjustments	There has been no trend observed in past data analysis and CAGR is found to be significantly high; a 15% increase for initial few years and subsequently reduced to 10% is what has been assumed; Inflation is around 6%
Maintenance, Repairs and Other Expenses	Mn Kyat		The ratio of R&M expense to gross fixed assets related to generation is computed. This ratio is gradually reduced to 1.5%.
Working Capital Requirement			
Receivables	Days	60	Industry Benchmark
Maintenance Spare equivalent	% of O&M	30%	Industry Benchmark
O & M Expenses	Days	30	Industry Benchmark

Parameter	Units	Assumption Value	Remarks
for one month			
Fuel Cost	Days	30	Industry Benchmark
Interest on working Capital	%	12%	
Margin Money for WC	%	0%	

Power Transmission Forecasts

Parameter	Units	Assumption Value	Remarks
Commercial Parameters			
Annual Budget	Kyat/kWh	Cost + RoE	Budget / Government allocation is going to recover all costs which will include Capital Expenditure related costs and operations related costs. A second approach could be to recover part / full costs of the Transmission business from consumers by charging a unitary charge in tariff. This will be essential in future as Capex requirement will increase with increase in demand and to cover all expenses through Government budget, will put unnecessary pressure on the government exchequer Scenarios will be developed for covering both the options
Capital Expenditure			
Capital Expenditure			Based on 30 year Plan document shared by Power Transmission Project Department, MEPE. The planned capital expenditure may not be approved in entirety by the Government in the respective year budgets. Hence scenarios will be developed in the financial model to see the impact on fiscal conditions to accommodate the entire / part capex estimates.
Capex funding			For the next 10 years, it will be assumed that 100% of capital expenditure funding shall be through multilateral loans in the books of Government of Myanmar.
Loan Details			
Multilateral Loans			
Interest Rate	%	1.5%	
Moratorium Period	Years	5	
Repayment Period	Years	20	

Parameter	Units	Assumption Value	Remarks
Depreciation			
Rate of Depreciation (Book)	%		Average of depreciation rate of last 5 years of transmission assets of MEPE
Maximum allowed Depreciation	%	90%	10% is assumed as residual value
O&M Cost			
Salaries and Wages	Mn Kyat	Past trend with certain adjustments	MEPE's Salaries and Wages related to transmission is determined for last 5 years. There has been no particular trend observed and CAGR is found to be significantly high; a 15% increase for initial few years and subsequently reduced to 10% is what has been assumed; Inflation is around 6%
Maintenance, Repairs and Other Expenses	Mn Kyat		MEPE's Maintenance, Repairs and Other Expenses related to transmission is determined for last 5 years. The ratio of this expense to gross fixed assets related to transmission is computed. This ratio is gradually reduced to 1.5%.
Working Capital Requirement			
Maintenance Spare equivalent	% of O&M	30%	Industry Benchmark
O & M Expenses for one month	Days	30	Industry Benchmark
Interest on working Capital	%	12%	Market Information
Margin Money for WC	%	0%	

Power Distribution Forecasts

Yangon Electricity Supply Corporation (YESC)

Parameter	Units	Assumption Value	Remarks
Commercial Parameters			
Input Energy	MUs		Input energy is based on Energy available till there is constrained supply scenario. Post that, based on load growth. Allocation to YESC from EPGE (Generation entity) would be based on past trend of allocation to YESB from MEPE
Energy Billed	MUs		Constrained growth based on energy availability. After that load growth as per JICA.
Power Purchase Cost	Kyat/kWh		Based on generation tariff of EPGE (MEPE + HPGE) which is the weighted average cost from all Hydro, Coal and Gas plants including IPP plants.
Collection Efficiency	%		Based on past trend - fixed value for projection period.
Aggregate Technical & Commercial Loss	%		From current level to 10% in a gradual manner.
Tariff Principle			
Average Billing Rate / Tariff	Kyat/kWh	Cost + RoE	Going forward it has been assumed that tariff shall be determined based on cost + return basis; An independent regulator is assumed to be set up and fully functional within 2 years who will ensure cost recovery through regular tariff increase.
Category wise Tariff			The category wise tariff will be computed in such a way that the tariff for each category is within +/- 20% from average tariff within 5 years from the time the regulator will be established in the country.
Capital Expenditure			
Capital Expenditure	Mn Kyat		Following Scenarios of Capital Expenditure will be considered in the model: • Average of Ratio of capex to input energy for last 5 years is computed. This number is multiplied with the year-on-year input energy to determine the year-on-year capital expenditure. An alternate scenario will be developed by considering a benchmark capex to input energy ratio. • Budgeted capital expenditure

Parameter	Units	Assumption Value	Remarks
			planned by YESC and ESE shall be considered and scenarios in percentage achievement of the capex planned shall be developed. • Detailed capital expenditure plan based on network conditions and load growth shall also be attempted.
Capex funding			Multilateral Loan: 100% till the sanctioned Multilateral is used up (Assumption is till FY20, there will enough sanction of Multilateral loan to take up 100% financing requirement); 30% Equity/IRG, 40% Multilateral, 30% Commercial Loan in subsequent years
Loan Details			
JICA Loan			
Sanctioned	Mn USD	61	YESC Data
Interest Rate	%	1.5%	Assumed same as ADB Loan
Moratorium Period	Years	5	Assumed same as ADB Loan
Repayment Period	Years	20	Assumed same as ADB Loan
ADB Loan			
Sanctioned	Mn USD	24	YESB Data
Interest Rate	%	1.5%	ADB Loan Document; Ministry of Finance is the borrower. It is assumed that foreign exchange risks are being taken by Government of Myanmar and on lending to YESB is at local currency
Moratorium Period	Years	5	ADB Loan Document
Repayment Period	Years	20	ADB Loan Document
NEDA Loan			
Sanctioned	Mn USD	1.8	YESC Data
Interest Rate	%	1.5%	Assumed same as ADB Loan
Moratorium Period	Years	5	Assumed same as ADB Loan
Repayment Period	Years	20	Assumed same as ADB Loan
Other Multilateral Loan			
Interest Rate	%	1.5%	Assumed same as ADB Loan
Moratorium Period	Years	5	Assumed same as ADB Loan
Repayment Period	Years	20	Assumed same as ADB Loan
Commercial Loan			
Interest Rate	%	10%	Market Information
Moratorium	Years	1	Market Information

Parameter	Units	Assumption Value	Remarks
Period			
Repayment Period	Years	12	Market Information
Depreciation			
Rate of Depreciation (Book)	%	5.37%	Average of depreciation rate of last 5 years
Maximum allowed Depreciation	%	90%	10% is assumed as residual value
O&M Cost			
Salaries and Wages	Mn Kyat	Past trend with certain adjustments	There has been no trend observed and CAGR is found to be significantly high; a 15% increase for initial few years and subsequently reduced to 10% is what has been assumed; Inflation is around 6%
Maintenance, Repairs and Other Expenses	Mn Kyat		The expense is computed as a percentage of gross fixed assets which is then gradually reduced to 1.5%.
Working Capital Requirement			
Receivables	Days	30	1 month billing cycle
O & M Expenses for one month	Days	30	Industry Benchmark
Power Purchase Cost	Days	30	Industry Benchmark
Interest on working Capital	%	12%	Market Information
Margin Money for WC	%	0%	

Electricity Supply Enterprise (ESE)

Parameter	Units	Assumption Value	Remarks
Commercial Parameters			
Input Energy	MUs		Input energy is based on Energy available till there is constrained supply scenario. Post that, based on load growth. Allocation to ESE from EPGE (Generation entity) shall be based on past trend of allocation to ESE from MEPE till energy balance is achieved.
Energy Billed	MUs		Constrained growth based on energy availability. After that load growth as per JICA.
Power Purchase Cost	Kyat/kWh		Based on generation tariff of EPGE (MEPE + HPGE) which is the weighted average cost from all Hydro, Coal and Gas plants.
Collection	%		Based on past trend - fixed value for

Parameter	Units	Assumption Value	Remarks
Efficiency			projection period.
Aggregate Technical & Commercial Loss	%		From current level to 10% in a gradual manner.
Tariff Principle			
Average Billing Rate / Tariff	Kyat/kWh	Cost + RoE	Going forward it has been assumed that tariff shall be determined based on cost + return basis; An independent regulator is assumed to be set up and fully functional within 2 years who will ensure cost recovery through regular tariff increase.
Category wise Tariff			The category wise tariff will be computed in such a way that the tariff for each category is within +/- 20% from average tariff within 5 years from the time the regulator will be established in the country.
Capital Expenditure			
Capital Expenditure	Mn Kyat		Following Scenarios of Capital Expenditure is considered in the model: • Average of Ratio of capex to input energy for last 5 years is computed. This number is multiplied with the year-on-year input energy to determine the year-on-year capital expenditure. An alternate scenario will be developed by considering a benchmark capex to input energy ratio. • Budgeted capital expenditure planned by YESC and ESE shall be considered and scenarios in percentage achievement of the capex planned shall be developed. • Based on technical studies and due diligence conducted by World Bank team, as part of other assignment, 1100 Mn USD is considered as capex requirement for next 15 years
Capex funding			100% till the sanctioned Multilateral is used up (Assumption is till FY20, there will enough sanction of Multilateral loan to take up 100% financing requirement); 30% Equity/IRG, 40% Multilateral, 30% Commercial Loan in subsequent years
Loan Details			
Multilateral Loans			
Interest Rate	%	1.5%	
Moratorium	Years	5	

Parameter	Units	Assumption Value	Remarks
Period			
Repayment Period	Years	20	
Commercial Loans			
Interest Rate	%	10%	
Moratorium Period	Years	1	
Repayment Period	Years	12	
Depreciation			
Rate of Depreciation (Book)	%	5.37%	Average of depreciation rate of last 5 years
Maximum allowed Depreciation	%	90%	10% is assumed as residual value
O&M Cost			
Salaries and Wages	Mn Kyat	Past trend with certain adjustments	There has been no trend observed and CAGR is found to be significantly high; a 15% increase for initial few years and subsequently reduced to 10% is what has been assumed; Inflation is around 6%
Maintenance, Repairs and Other Expenses	Mn Kyat		The expense is computed as a percentage of gross fixed assets which is then gradually reduced to 1.5%.
Working Capital Requirement			
Receivables	Days	30	1 month billing cycle
O & M Expenses for one month	Days	30	Industry Benchmark
Power Purchase Cost	Days	30	Industry Benchmark
Interest on working Capital	%	12%	Market Information
Margin Money for WC	%	0%	

Common Assumptions

Parameter	Units	Assumption Value	Remarks
Other Income	Mn Kyat		Based on past CAGR
RoE	%	18.65%	Risk Free Premium (Rf) = 9.50 based on 5 year government bond yield Market risk premium (Re) = 5% as per Market Information / Analyst reports for Myanmar Beta assumed = 0.8; Utility volatility is less

Parameter	Units	Assumption Value	Remarks
			than market volatility and usually ranges from 0.6 to 0.8 in most countries. Assumed 0.8 in Myanmar because of lack of market information. Country risk premium (Rp) = 6.65%; considered for foreign investor - Myanmar's country risk premium not covered by any of six credit rating agencies; We have considered an average of the country risk premiums for Thailand, India, Indonesia, Bangladesh, Vietnam and Cambodia to reflect regional risk perception. This works out to 5.15%. We have added an additional country risk premium of 1.5% for Myanmar (as considered by ADB in appraising investments in Myanmar). Final Country Risk Premium for Myanmar works out to be 6.65%. Return on Equity is equal to Cost of Equity minus the additional country premium of 1.5% for Myanmar
Interest Rates on Cash Deficit Loan	%	12%	Only to be used in certain scenarios, if required
Tax Rate	%	25%	
State Contribution	%	0	No state Contribution considered
Exchange Rate	Kyat/USD	1210	Exchange Rate as on 15.07.2015; Depreciation of currency at 11.1% (Based on historical data of 2 years)