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Republic of the Union of Myanmar: Institutional Strengthing of National Energy Management Committee in Energy Policy and Planning

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FINAL REPORT

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For the Oil & Gas Planning Department of the Ministry of Electricity & Energy

Asian Development Bank

The Republic of the Union of Myanmar
Ministry of Industry

NATIONAL ENERGY EFFICIENCY & CONSERVATION POLICY, STRATEGY AND ROADMAP FOR MYANMAR

TECHNICAL ASSISTANCE BY ASIAN DEVELOPMENT BANK
TA 8356-MYA:
INSTITUTIONAL STRENGTHENING OF NATIONA ENERGY MANAGEMENT COMMITTEE IN ENERGY POLICY AND PLANNING

2015

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Acronyms

ADB	-	Asian Development Bank
CFL	-	Compact Fluorescent Lamp
DSM	-	Demand Side Management
EDC	-	Energy Development Committee
EE	-	Energy Efficiency
EE&C	-	Energy Efficiency & Conservation
EMP	-	Energy Master Plan
FTL	-	Fluorescent Tube Light
JICA	-	Japan International Cooperation Agency
kWh	-	Kilo Watt Hour
LED	-	Light Emitting Diode
LPG	-	Liquefied Petroleum Gas
MWh	-	Mega Watt Hour
SHS	-	Solar Home Systems
SHW	-	Solar Hot Water
SME	-	Small and Medium Enterprises
SOE	-	State Owned Enterprise

National Stakeholders

MEPE	-	Myanmar Electric Power Enterprise
MES	-	Myanmar Engineering Society
MOAI	-	Ministry of Agriculture and irrigation
MOE	-	Ministry of Energy
MOECAF	-	Ministry of Environment, Conservation and Forestry
MOEP	-	Ministry of Electric Power
MOGE	-	Myanmar Oil and Gas Enterprise
MOI	-	
MOLFRD	-	Ministry of Livestock, Fishery and Rural Development
MOM	-	Ministry of Mines
MOST	-	Ministry of Science and Technology
MPE	-	Myanmar Petrochemical Enterprise
MPPE	-	Myanmar Petroleum Products Enterprise
NEMC	-	National Energy Management Committee
REAM	-	Renewable Energy Association Myanmar

Executive Summary

1. INTRODUCTION

The Asian Development Bank (ADB) is providing assistance to the Government of Myanmar (GoM) for capacity development for Institutional Strengthening of the National Energy Management Committee (NEMC) in Energy Policy and Planning. The focus is to increase the ability of NEMC to prepare policies and strategies in the energy sector and assist in the formulation of a long-term energy master plan. This report covers the EE Policy, Strategy, the proposed activities in the key sectors and the road map for implementation.

2. CURRENT ENERGY SITUATION IN MYANMAR

Overall, Myanmar has significant in-country energy resources such as hydropower as well as natural gas which it exports to countries in the region. It is ranked 34th globally in terms of hydrocarbon reserves. However, a significant amount remains unexploited but with greater energy demand and economic development these are likely to change. In 2011, domestic gas consumption was used mainly for gas-fired power plants (60%), fertilizer production (12%) and compressed natural gas (10%). In terms of hydro power, in 2012-2013, 2,780MW have been commissioned of an estimated potential of 100,000 MW. According to the National Energy Policy (2014) the electricity sector is expected to expand rapidly over the next decade with a target of 45% electrification by 2020-2021, 60% by 2025-2026. According to draft national electricity master plan cooperation with JICA and World Bank, target electrification ratio is 100% by 2030.

3. ELECTRICITY SUPPLY AND CONSUMPTION

The existing electricity capacity and infrastructure can only meet about 50% of the current electricity demand resulting in regular load shedding and challenges in electricity supply management. In 2012, the total electricity consumption in Myanmar was approximately 8,255 GWh representing about 135 kWh per capita per year which is amongst the lowest in Southeast Asia. Approximately 45% of electricity sales are in Yangon, followed by Mandalay with 16%. In 2011, the registered peak load was 1,533 MW; however this value does not reflect actual demand but rather limited available/firm capacity from power plants and operational limitations.

Electricity Generation

Total electricity generation has quadrupled over the last 20 years, particularly as a result of increasing hydropower generation which represented 72% of total electricity generation. Interestingly, thermal generation has fluctuated significantly on an annual basis, while diesel has remained almost constant and natural gas generation has gradually fallen since its peak in 2005-2006.

Table 1:1: Electricity Generation in Myanmar from 2000 to 2012 by Source (GWh)

	Year												
Source	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Thermal	662	550	642	634	124	387	385	418	394	223	278	438	506
Diesel	36	31	29	31	33	33	28	34	40	30	33	38	51
Hydro	1,838	1,943	2,065	1,920	2,350	2,951	3,277	3,572	4,510	5,224	6,152	7,469	7,722
Gas	2,528	2,100	2,287	2,685	2,983	2,398	2,025	1,891	1,897	1,205	1,734	2,118	2,377
Coal	-	-	-	-	60	244	401	436	220	250	391	312	265
TOTAL (GWh)	5,064	4,624	5,023	5,270	5,550	6,013	6,116	6,351	7,061	6,932	8,588	10,375	10,921

Source: Energy Planning Department, MOE.

Electricity Consumption by Sector

The Table below shows the breakdown of electricity production by sector, and in 2011 the residential sector accounted for 42% of total electricity consumption, followed by the industrial sector with 36% and commercial sector with 21%.

Table 1:2: Electricity Consumption in Myanmar from 2000 to 2012 by Usage (GWh)

	Year												
Sector	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Residential	1,361	1,245	1,431	1,612	1,662	1,812	1,614	1,647	1,799	2,015	2,653	3,378	2,681
Industrial	1,295	1,148	1,417	1,577	1,549	1,756	1,854	1,872	1,904	1,850	2,287	2,711	3,650
Commercial	527	564	552	578	613	695	827	864	945	1,071	1,306	1,531	1,643
Other	85	85	84	83	85	89	61	55	53	57	66	76	281
TOTAL (GWh)	3,268	3,041	3,484	3,850	3,909	4,353	4,355	4,438	4,701	4,993	6,312	7,696	8,254

Source: Energy Planning Department, MOE.

In 2011, the electrification rate in Myanmar was approximately 27% which is a significant increase compared to 2006 when the value was approximately 16%. The electrification rate is higher in urban areas such as Yangon, Nay Pyi Taw, Kayar and Mandalay.

Demand Forecasts

An Electricity Supply Plan is currently under preparation and the demand forecast provided by the Ministry of Electric Power (MOEP) is shown in the Table below. It sets an ambitious but yet achievable target for electrification rate from 27% in 2011-2012 to 80% by 2030. Electricity installed and generation capacity are expected to rise by a tenfold for the same period.

Table 1:3: Electricity Demand and Generation Forecast

Period	Population (million)	Demand Forecast (MW)	Required Generation (GWh)	Target Electrified Households (%)
2011-12	60.40	1,806	10,444	27
2012-13 to 2015-16	63.14	3,078	17,797	34
2016-17 to 2020-21	66.29	5,686	32,874	45
2021-22 to 2025-26	70.45	10.400	60,132	60
2026-27 to 2030-31	74.12	19,216	111,100	80

Source: Ministry of Electric Power, National Energy Policy, 2014

4. ENERGY EFFICIENCY POTENTIAL

Industrial Sector Assessment

The Table below provides a summary of the potential energy savings according to industrial sector. The highest average energy savings, percentage-wise, are estimated for the Iron & Steel Industry, Pulp & Paper and Sugar Mills due to their high electrical and thermal demands. The Ceramic and

Cement Industry share similar best practices and therefore the potential percentage energy savings are equivalent. Although the percentage energy saving potential for the thermal power plants is relatively low compared to other industries, the actual generation saving (GWh) would be extremely significant (probably higher than all the savings combined for the industrial sector) as thermal power plants in Myanmar operate as base load. For example, thermal power plants in Myanmar generated 640 GWh of electricity in 2010/2011 and therefore a 4% improvement in energy efficiency of the thermal power plant would enable it use fuel more efficiently and avoid a generation loss of 25.6 GWh per year (ignoring capacity factors, operation hours, T&D losses). It is important to note that these values are indicative and based on potential energy savings in the industrial sector of other neighboring Asian countries (particularly Thailand and Bangladesh) and international best practice (mainly from Europe). In addition, the table only includes the major industrial sectors in Myanmar and does not take into consideration investment costs required to apply these best practices. Detailed surveys and investment grade energy audits of the industrial sector in Myanmar are required to determine more accurately the potential energy savings and help establish energy efficiency targets for the sector.

Table 1:4: Potential Energy Savings in the Industrial Sector

Sub-Sector	Saving Potential (%)			EE Technologies Proposed
	Min	Max	Average	
Iron and Steel	5	65	45	Cogeneration, EE Boiler, Waste Heat Recovery, EE Furnace, High Efficiency Motors
Cement	3	43	23	High Efficiency Motors, EE Kilns, Cogeneration, Waste Heat Recovery, Variable Speed Drives
Pulp and Paper	50	80	65	Cogeneration, EE Boiler, Waste Heat Recovery, EE Furnace, High Efficiency Motors
Textile	5	20	12.5	High Efficiency Motors, EE Boilers, EE Lighting, EE Air Conditioners
Thermal Power Plants	3	5	4	High Efficiency Motors, Cogeneration, Combined Cycle Gas Turbines
Sugar Mills	25	45	35	Boilers, Waste Heat Recovery, Cogeneration, High Efficiency Motors
Rice Mills	-	35	-	Cogeneration, EE Boilers
Ceramic and Brick	15	25	20	Cogeneration, Waste Heat Recovery, EE Kilns, High Efficiency Motors

Commercial Sector Assessment

Initial observations in the commercial sector (office buildings, hotels etc) show a high usage of inefficient fluorescent lighting and electric hot water systems. Case studies from countries in the region show that significant savings could be achieved through the use of high efficiency fluorescent lighting and solar hot water (SHW) systems.

The use of solar water heating (SWH) in hotels and restaurants are extremely rare with electric hot water systems being the norm. The estimated EE potential in this sector is based on numerous case studies in the region, especially in Thailand, Philippines, India and Sri Lanka. The Table below provides a summary of energy saving potential in the commercial sector covering office buildings (AC and non-AC) and hotels/restaurants.

Table 1:5: Potential Energy Savings in the Commercial Sector

Sub-Sector	End-Use	% End Use Consumption	Saving Potential (%)	Weighted Overall Saving Potential (%)	EE Technologies
Office Buildings (AC)	Lighting	20	25	5.00	CFLs, T5, LED
	AC	50	25	12.50	Inverter Type AC
	Refrigeration	15	30	4.50	High Star Rating
	Other	15	20	3.00	High Star rated appliances
	Overall Savings (%)			25.00	
Office Buildings (non AC)	Lighting	40	25	10.00	CFLs, T5
	Fans	15	25	3.75	HE Fans
	Refrigeration	20	30	6.00	High Star Rating
	Other	25	20	5.00	High Star rated appliances
	Overall Savings (%)			24.75	
Hotels / Restaurants	Lighting	20	25	5.00	CFLs, T5
	AC	40	20	8.00	Inverter Type AC
	Hot Water	10	70	7.00	SWH
	Refrigeration	15	30	4.50	High Star Rating
	Other	15	10	1.50	High Star rated appliances
	Overall Savings (%)			26.00	

Residential Sector Assessment

The residential sector assessment includes two sub-sectors, namely, urban and rural households based on electrical end-use technologies used.

The current market penetration of EE products and appliances (lighting, air conditioning, refrigerators and other home appliances) is very low. There is potential for significant energy savings through the introduction of Minimum Energy Performance Standards (MEPS) and Energy Labelling schemes similar to most countries in the region (Thailand, Malaysia, India, Philippines, Vietnam and Sri Lanka).

The Table below provides a summary of the energy saving potential in electrified households.

Table 1:6: Potential Energy Savings in the Electrified Residential Sector

Sub-Sector	End-Use	% End Use Consumption	Saving Potential (%)	Weighted Overall Saving Potential (%)	EE Technologies
Urban Households	Lighting	20	25	5.00	CFLs, T5, LED
	AC / Fans	50	25	12.50	Inverter Type AC and EE Fans
	Refrigeration	15	30	4.50	High Star Rating
	Other	15	20	3.00	High Star rated appliances
	Overall Savings (%)			25.00	
Rural Households	Lighting	40	25	10.00	CFLs, T5
	Fans	15	25	3.75	HE Fans

Sub-Sector	End-Use	% End Use Consumption	Saving Potential (%)	Weighted Overall Saving Potential (%)	EE Technologies
	Refrigeration	20	30	6.00	High Star Rating
	Other	25	20	5.00	High Star rated appliances
		Overall Savings (%)		24.75	

Biomass (fuelwood) is the primary energy source for cooking and there is potential for market transformation to efficient wood stoves (EFS) by addressing the initial cost barriers. There are several case studies on EFS in Asia and South America. The potential energy savings are from the adoption of Fuel Efficient Stoves (FES) and the use of LPG primarily in the urban sector. Although LPG is not a EE measure but it is a more efficient use of Myanmar's natural resources and also lower GHG emissions than the use of biomass. It is noted that there is a wide variation in estimated fuelwood savings with FES in the various studies and in order to estimate the savings for the EE Policy the lower figure of 900 kg/HH/year is assumed. Based on the information in the Myanmar Energy Policy, the total number of households is 8,905,674 of which 2,556,714 households are electrified. The use of fuelwood for cooking is common even in electrified households and hence, the potential transformation to FES would include a majority of the electrified households in addition to the non-electrified households.

Public Sector Assessment

The Public Sector primarily includes office buildings, schools, hospitals and public lighting (street lighting) and the EE saving potential is similar to the Commercial sector. The hospitals may have potential for cogeneration applications which will have to be assessed separately. The potential in public lighting mainly involves the use of LED lighting systems or High Pressure Sodium (HPS) lamps in place of existing lamps which is a mixture of Mercury Vapor (MV) Lamps, fluorescent tube lights (FTLs), CFLs etc.

5. KEY ELEMENTS OF THE ENERGY EFFICIENCY POLICY

Energy Efficiency Policy Target

The estimation of energy saving potential is focused on two areas:

1. Electricity consumption in all sectors, and
2. Biomass consumption in the residential sector.

Overall Energy (Electricity) Saving Potential (%)

Sector	*2012 Energy Consumption (GWh)*	*End-Use Consumption (%)*	*Average Energy Saving Potential (%)*	*Weighted Average Saving Potential (%)*
Industry	3,650	44%	20%	8.84%
Commercial / Public	1,643	20%	25%	4.97%
Residential	2,681	32%	30%	9.70%
Other	281	3%	50%	1.7%
Total	**8,254**			**25.26%**

Achievable Energy Saving Potential 2020 – 2030 (%)

Sector	***Weighted Average Saving Potential (%)***	***Achievable Target by 2020 (%)***	***EE Policy Target – 2020 (%)***	***Achievable Target by 2025 (%)***	***EE Policy Target – 2025 (%)***	***Achievable Target by 2030 (%)***	***EE Policy Target – 2030 (%)***
Industry	8.84%	40	3.54	60	5.31	75	6.63
Commercial / Public	4.97%	40	1.99	60	2.98	80	3.98
Residential	9.70%	55	5.36	70	6.82	80	7.80
Other	1.7%	40	0.68	60	1.02	80	1.36
Total	**25.26%**		**11.7**		**16.1**		**19.77**
EE Policy Targets			**12**		**16**		**20**

Note: The above targets are based on the assumption that adequate resources are available for the implementation of the programs outlined in the Roadmap. In addition, significant investment is required in the Industrial sector for upgrading process equipment. Considering that the availability of resources are not clear at this stage, it is proposed that the achievable targets are halved in the interim and re-evaluated after 2 years.

Biomass Savings

	2016	***2017***	***2018***	***2019***	***2020***	***2025***	***2030***
Total Conversions to FES (cumulative)	142,320	284,640	426,960	569,280	711,599	1,423,199	2,134,798
Biomass Savings (mT)	128,088	256,176	384,264	512,352	640,439	1,280,879	1,921,318
ktoe	44.83	89.66	134.49	179.32	224.15	448.31	672.46
% Reduction from 2012 (Baseline)					**2.3**	**5**	**7**

6. ENERGY EFFICIENCY ROAD MAP

Proposed Activities by Sector: The following matrix provides a list of activities that could be undertaken under each strategic objective for the particular sector.

Sector: Industry Sector

Strategic Objectives		**Activities**	
#	Objective	#	Description
1	Energy Efficient process technologies are adopted in all industry sectors	1	Establishment of energy data collection procedures
		2	Implementation of energy audit program for enterprises
		3	Introduction of good energy management practices in industry
		4	Provide financial incentives for implementation of EE measures
2	The awareness of EE amongst industry owners, managers and engineers is increased	1	Increase awareness of technology best practices in the region
		2	Prepare Energy Efficiency Guidelines for major industries
3	Capacity building in EE&C in the industry sector is strengthened	1	Conduct organized training for technical and managerial staff
		2	Introduce Energy Auditor & Energy Manager certification programs
		3	UNIDO Program – Improvement of Industrial Energy Efficiency
		4	Support the Development of Energy Service Companies (ESCOs)

Sector: Commercial Sector

Strategic Objectives		Activities	
#	Objective	#	Description
1	Energy Efficiency is incorporated in new building design and refurbishment of existing buildings	1	Establishment of an Energy Efficiency Building Code
		2	Capacity building of architects/engineers in EE building design
2	Energy Efficiency technologies are implemented in the Commercial sector	1	Prepare Energy Efficiency Guidelines for Commercial Buildings
		2	Training in the conduct of detailed energy audits
		3	Provide financial incentives for implementation of EE measures
		4	Support local manufacture of EE equipment
3	Renewable Energy technologies are promoted in the Commercial sector	1	Promotion of Solar Water Heating systems in hotels and buildings
		2	Promotion of PV systems for supplementing on-grid supply
4	The awareness of EE and capacity building amongst key stakeholders is increased	1	Increase awareness of technology best practices in the region

Sector: Residential Sector

Strategic Objectives		Activities	
#	Objective	#	Description
1	Household energy costs are reduced through energy performance standards for appliances	1	Introduce EE performance standards and labeling for appliances
		2	Testing and certification facilities for appliances
		3	Introduction of incentives for EE equipment
		4	Phasing out of inefficient appliances from the market
		5	Promote efficient biomass cook stoves
2	Increased used of LPG is adopted by urban households	1	Increase consumer awareness of benefits in LPG for cooking
		2	Introduce EE labeling scheme for LPG cook stoves
3	Awareness of EE technologies are increased in the residential sector	1	Conduct of regular EE awareness campaigns in national media
		2	Training programs targeting educational institutions

Sector: Public Sector

Strategic Objectives		Activities	
#	Objective	#	Description
1	Use of EE technologies in public buildings are increased and overall energy costs are reduced	1	Implementation of energy audit program for public buildings
		2	Adoption of standard procurement guidelines for equipment
2	The awareness of EE is increased amongst public sector employees	1	Introduction of a Public Sector Energy Management Program
		2	Prepare Energy Efficiency Guidelines for public buildings
3	Capacity building of maintenance staff in EE&C in increased	1	Conduct organized training for maintenance staff

7. IMPLEMENTATION PLAN

The Implementation Plan proposed in this section consolidates the Program Activities outlined in Section 6 into main categories and ranked in priority order. The Table below provides a summary of the key activities to be undertaken and the resources required for implementation.

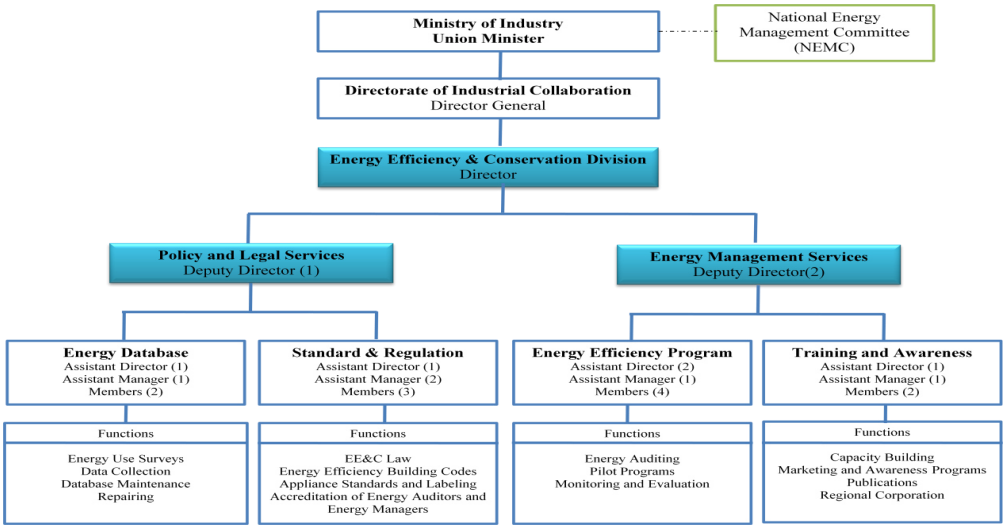
Table: Summary of Key Activities and Budget

Activity No:	Description	Scope	Estimated Budget (US$)	
			Internal	Development Partners
1	Establishment and Capacity Building of EECD and stakeholders	Staff Recruitment and capacity building	$200,000/yr	$450,000
2	Energy-use Database	Data collection from all sectors, analysis and reporting	$200,000	
3	Regulations	EE&C Building Codes; EE Performance Standards and Labelling for Appliances; Procurement Guidelines for Equipment; Testing & certification facilities for Appliances; Certification of Energy Auditors and Energy Managers; and EE&C Decree	Included in Activity 1	$1,250,000
4	Training and Capacity Building	Energy audit training in all sectors; Energy Management training; Training for Architects, maintenance staff and ESCOs; Training for Educational Institutions	Included in Activity 1	$800,000
5	Awareness Programs	EE Awareness programs in all sectors; Promotion of EE Cook Stoves; EE Guidelines in all sectors; Promotion of SWH and off-grid PV systems	$100,000/yr	$150,000
6	Financial Incentives for EE&C	Develop financial incentives for EE&C implementation in all sectors.	Included in Activity 1	$150,000

8. INSTITUTIONAL ARRANGEMENTS

A separate Directorate under the MOI is proposed for the management of all EE&C activities in Myanmar. The establishment of EECD was approved by the NEMC on 1st April 2014.

Figure 1:1: Proposed Organizational Structure for EE&C Division



The above structure, comprising of the approved 18 positions, is considered to be the basic requirement to commence the implementation of the Roadmap. It is recommended that an additional 10 positions are allocated in the next financial year – these are primarily in the technical or specialist category (classified as Members in the above structure) and include the following:

- Energy Data analysts (2)
- Legal Expert (1)
- EE Program Managers (4)
- Marketing and Communication (3)

The EECD will be responsible for the implementation of several common activities across the identified priority sectors that would ensure a sustainable approach to EE implementation in Myanmar. These activities include the following:

- Energy data collection and analysis
- Energy Efficiency awareness and education
- Monitoring & Evaluation
- Develop Energy Efficiency standards for Buildings and Appliances
- Accreditation scheme for Energy Auditors and Energy Managers
- Regional cooperation and networking
- Legal and Financial Framework for Energy Efficiency

1 INTRODUCTION

The Asian Development Bank (ADB) is providing assistance to the Government of Myanmar (GoM) for capacity development for Institutional Strengthening of the National Energy Management Committee (NEMC) in Energy Policy and Planning. The focus is to increase the ability of NEMC to prepare policies and strategies in the energy sector and assist in the formulation of a long-term energy master plan.

There are several activities under this Technical Assistance (TA) resulting in the development the Energy Master Plan (EMP). The National Energy Efficiency (EE) Policy component would include all energy end-uses – electricity, oil, gas, coal and biomass. The ADB contracted two independent EE Experts (Felix Gooneratne – International; Than Aye – National) to undertake the task of preparing the EE policy.

The Inception Report provided information on the current energy sector regulations, policies, programs and activities, stakeholders, the overall energy efficiency potential and the approach and schedule for the preparation of the EE policy for Myanmar.

This report covers the EE Policy, Strategy, the proposed activities in the key sectors and the road map for implementation. A workshop to present the draft report was held in Nay Pyi Taw on 30th September 2014 and the comments/suggestions provided at the workshop has been incorporated in this report.

1.1 Report Structure

The Report is structured as follows:

Section 1: Energy Efficiency Activities in Myanmar – provides information on the primary energy consumption, electricity supply, demand and forecast; and the EE related programs and activities undertaken to date with support from international donor agencies.

Section 2: Energy Efficiency Potential – this section provides a detailed assessment of the EE potential in all the key sectors (Industrial, Commercial, Residential, Public Sector) based on current practices and international best practices in the region. Proposed EE targets for inclusion in the EE Policy and barriers to implementation are also provided.

Section 3: Energy Efficiency Policy for Myanmar – provides information on the rationale for the policy, identifies linkages to the National Energy Policy (2014) and other related policies. This section also provides information on achievable EE targets and the key sectors offering the greatest potential for EE.

Section 4: National Energy Efficiency Strategy – presents the vision for energy efficiency and conservation in Myanmar and the policy/strategic framework (goals and strategies) for the EE Policy. This section also includes the institutional framework for Energy Efficiency & Conservation (EE&C) in Myanmar.

Section 5: Energy Efficiency Roadmap – provides information of all sectoral activities to be undertaken over a period of 5 years towards achieving the EE policy objectives. This section also includes the structure and capacity building requirements of a new Division established for the management and implementation of the Roadmap.

Section 6: Conclusions and Recommendations – this section highlights the key issues encountered during the development of the EE policy and recommendations for addressing these to ensure that the objectives and schedule of EE implementation are met.

2 ENERGY EFFICIENCY ACTIVITIES IN MYANMAR

2.1 Introduction

Overall, Myanmar has significant in-country energy resources such as hydropower as well as natural gas which it exports to countries in the region. It is ranked 34th globally in terms of hydrocarbon reserves. However, a significant amount remains unexploited but with greater energy demand and economic development these are likely to change. In 2011, domestic gas consumption was used mainly for gas-fired power plants (60%), fertilizer production (12%) and compressed natural gas (10%). I In terms of hydro power, in 2012-2013, 2,780MW have been commissioned of an estimated potential of 100,000 MW.

According to the National Energy Policy (2014) the electricity sector is expected to expand rapidly over the next decade with a target of 45% electrification by 2020-2021, 60% by 2025-2026. According to draft national electricity master plan cooperation with Japan international Cooperation Agency and World Bank, targeted electrification ration is 100% by 2030. Currently, the per capita electricity consumption is around 180 kWh per year which is amongst in lowest in Southeast Asia.

2.2 Current Energy Situation in Myanmar

2.2.1 Summary of Energy Situation

Myanmar has abundant energy resources, particularly for hydropower and natural gas. It is estimated that the hydropower potential in Myanmar is more than 100,000 megawatts (MW). Offshore gas is presently the country's most important source of export revenues, currently supplying Thailand and a new gas pipeline to the People's Republic of China (PRC) is planned and for which a proper social impact assessment is currently pending. There is limited information on the primary energy supply in Myanmar; however, with the expansion of natural gas, coal and hydropower productions, the energy supply split according to sources will be changing significantly. Per capita energy consumption of electricity in Myanmar is among the lowest in Asia, and currently about 30 % of the total households have access to electricity.

A summary of the primary energy sources is given below.

2.2.1.1 Oil and Gas

Crude oil production reached 7,562 barrels per day in September 2011 with majority being produced in the Salin sub-basin. The government is aiming to increase oil production to 10,000 barrels per day to meet the growing demand for oil. In terms of natural gas production, it averaged about 1,865 Million cubic feet per day (Mcfpd) of which 48% from offshore Yadana, 27% from Shwe and 21% from Yetagun fields. About 80% of the gas produced is exported to Thailand and PRC which is an important source of revenue to the Government; and around 20% is allocated to the domestic market. A conservative estimate of the domestic natural gas demand in 2013 was about 700 Mcfpd and the current allocation meets only around 50% of the demand.

2.2.1.2 Coal

As of 2011, there were approximately 488.7 million tons of coal reserves in Myanmar. A total of 692,000 tons were produced in 2011, of which 52% was used by cement and steel companies and 42% for power generation, such as the 120 MW coal-fired power plant in Tigyit, and 4% for cooking

and heating in households. Annual coal production is projected to increase significantly to 2.7 million tons by 2016 and 5.6 million tons by 2031.

2.2.1.3 Hydropower

Myanmar has four main river basins - Ayeyarwaddy, Chindwin, Thanlwin, and Sittaung – which could potentially provide a significant amount of hydropower to the whole country. A total of 92 potential large hydropower projects have been identified with a total estimated installed capacity of 46,101 MW. In 2012-2013, hydro power represented 2,780MW (77%) of total installed capacity of 3,614 MW, which generated a total of 7,722 GWh. The key challenge for the government is to manage annual seasonal changes as the hydropower capacity diminishes significantly in the dry season with potential reductions of up to 400-500 MW. In terms of small hydropower projects, a total 26 micro-hydro and 9 mini-hydro power projects have been developed by Myanmar Electric Power Enterprise (MEPE) ranging from 24 kW to 5,000 kW, particularly in rural border areas without grid connection. An additional 5 micro-hydropower projects are planned from Eastern Shan State (3), Kachin State (1) and North Eastern Shan State (1).

2.2.1.4 Wind

There is currently limited information on the wind potential in Myanmar. Initial data shows that there is a technical potential for development of 4,032 MW of wind energy or 365 TWh particularly in the Shan and Chin States, high areas of the central region and along the coast. Ministry of Electric Power (MOEP) has signed the Memorandum of Understanding (MoU) with Thailand Gunkul Engineering Public Co., Ltd and China Three Gorges Corporation (CTG) for the feasibility study to implement the 1000 MW installed capacity wind power projects in Tanintharyi, Mon and Kayin States and 1102 MW installed capacity projects in Chin State, Rakhine State, Ayeyarwady Region and Yangon Region.

2.2.1.5 Solar

There is also limited information on the potential for solar energy in Myanmar. The overall solar energy available is estimated at 51,973 TWh per year and the highest potential would be in the Central Dry Zone Area of Myanmar. Small solar panels are being used in rural areas for households, water pumping and irrigation and commercial supply to hospitals. For example, a 220 kW hybrid solar-wind-diesel battery system provides electricity to 100 households in Chaungthar Village.

The Ministry of Industry (MOI) operates a small thin-film solar PV factory and there are four solar equipment suppliers in Myanmar. The solar home systems (SHS), now widespread in Lao PDR and Cambodia, are not yet common in rural areas in Myanmar. The Renewable Energy Association of Thailand and UNDP are undertaking an assessment of the replacement of candle light with Solar Lighting System with LED lights using a revolving fund.

2.2.1.6 Biomass

According to the Forest Resource Assessment (2010), 46.96% of the total land area of Myanmar is covered with forest and wood fuel, charcoal and biomass are traditional forms of energy use across the country. In 2007, biomass sources amounted to 63.9% of total primary energy consumed in Myanmar, of which wood fuel accounted for 43%, pigeon pea stalk for 26% and sesame stalk for 14%. The proportion of households using wood fuel for cooking is much lower in the urban areas than in the rural areas, where wood fuel is a major energy source (93% of rural households compared to 42% in urban households). Charcoal is used in 42% of urban households and 4% of rural households.

The potential annual yield of wood fuel is up to 19.12 million cubic tons and 18.56 million acres of land could generate residues, by-products or direct feedstock for biomass energy. Agricultural by-products such as pigeon peak stocks, sugarcane bagasse, rice straw, rice husks, sesame stalks, and

palm leaves, offer limited sources of energy. In addition, there is approximately 103 million head of livestock which generate animal waste which could be used for biogas.

2.2.1.7 Geothermal

MOEP has signed the MOU with Emerging Market Energy Pte., Ltd (EME) to do the feasibility study for the implementation of 200 MW installed capacity project in Tanintharyi, Sagaing, Magway and Mandalay Regions and Shan State.

2.2.1.8 Tidal

There are no studies on the potential for tidal energy in Myanmar despite a coastal line of 2,832 km. The first tidal power plant (3 kW) was installed in 2007 in Kanbalar village providing electricity to about 220 households (approximately 1,200 persons). A similar project was being implemented at a salt production site.

2.2.1.9 Waste to Energy

There is a significant opportunity to develop waste to energy projects in urban areas as the Myanmar Engineering Society (MES) estimates that there is a potential for at least 20 MW of waste-to-energy installed capacity.

2.2.2 Energy Supply and Consumption Characteristics

2.2.2.1 Primary Energy Supply

The Table 2.1 provides a summary of the total annual primary energy supply in Myanmar for the period 2000 – 2012. The figures in 2012 are considered the baseline energy demand for determining the EE potential.

Table 2:1: Primary Energy Supply in Myanmar from 2000 to 2012 by Source (ktoe)

Source	Year												
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Oil & PP	1,983	1,991	1,924	1,924	1,961	1,756	1,751	1,753	1,383	1,289	1,877	3,348	2,759
Natural Gas	1,205	1,033	1,264	1,428	1,512	1,480	1,582	1,775	1,812	1,325	1,747	2,283	2,060
Coal and Lignite	83	71	76	123	121	351	501	558	356	243	351	474	475
Hydro	728	772	743	788	926	1,154	1,278	1,416	1,566	2,024	2,380	2,901	2,986
Biomass (wood)	7,825	8,036	8,249	8,615	8,526	8,691	9,045	9,280	9,549	9,813	9,993	9,506	9,708
TOTAL – PRIMARY ENERGY (ktoe)	11,824	11,904	12,257	12,878	13,045	13,432	14,157	14,782	14,665	14,693	16,438	18,512	17,988

Source: Energy Planning Department, MOE. PP: Petroleum Products

2.2.2.2 Primary Energy Consumption

The Table 2.2 provides a summary of the total annual primary energy consumption in Myanmar for the period 2000 – 2012. The figures in 2012 are considered the baseline energy demand for determining the EE potential.

Table 2:2: Primary Energy Consumption in Myanmar from 2000 to 2012 (ktoe)

Source	Year												
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Petroleum Products	1,648	1,688	1,738	1,622	1,460	1,481	1,667	1,665	1,351	1,245	1,207	1,998	1,942
Natural Gas	381	294	414	465	422	475	568	664	734	642	617	713	519
Coal and Lignite	85	72	77	120	66	140	186	265	204	114	257	261	285
Hydro	255	237	272	300	305	339	339	346	366	389	482	2,288	2,440
Biomass (wood)	7,723	7,912	8,105	8,388	8,401	8,561	8,879	9,131	9,401	9,665	9,993	9,506	9,708
TOTAL – PRIMARY ENERGY (ktoe)	10,092	10,203	10,606	10,895	10,654	10,997	11,639	12,070	12,055	12,055	12,555	14,766	14,894

Source: Energy Planning Department, MOE.

2.2.3 Electricity Supply and Consumption

The existing electricity capacity and infrastructure can only meet about 50% of the current electricity demand resulting in regular load shedding and challenges in electricity supply management.

In 2012, the total electricity consumption in Myanmar was approximately 8,255 GWh representing about 135 kWh per capita per year which is amongst the lowest in Southeast Asia. Approximately 45% of electricity sales are in Yangon, followed by Mandalay with 16%.

2.2.3.1 Installed Capacity

The Table 2:3 shows the total electricity installed capacity in Myanmar from 2001 to 2012, with hydropower currently representing 77% of total capacity. The installed capacity of hydro has more than tripled from 2006 to 2012, while natural gas, thermal and diesel power plants have remained relatively unchanged from 2005 until 2012.

Table 2:3: Electricity Installed Capacity in Myanmar from 2001 to 2012 by Source (MW)

Source	Year												
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Thermal	216	216	216	216	183	195	165	165	165	165	165	165	165
Diesel	65	61	59	61	60	68	70	70	57	55	63	63	78
Hydro	360	360	390	465	745	745	770	800	854	1,454	2,559	2,693	2,813
Gas	530	523	524	523	561	561	558	559	559	550	549	549	550

Source	Year												
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Coal	-	-	-	-	120	120	120	120	120	120	120	120	120
RE	-	-	-	-	-	-	-	-	-	-	4	4	5
TOTAL (MW)	1,171	1,160	1,189	1,265	1,669	1,689	1,683	1,714	1,755	2,344	3,461	3,595	3,731

Source: Energy Planning Department, MOE.

In 2011, the registered peak load was 1,533 MW; however this value does not reflect actual demand but rather limited available/firm capacity from power plants and operational limitations. The actual value in 2012 was estimated at approximately 1,957 MW and the actual shortfall estimated at 500 MW which is managed through load shedding. More importantly, the hydropower capacity diminishes significantly in the dry season with potential reductions of up to 400-500 MW.

2.2.3.2 Electricity Generation

Total electricity generation has quadrupled over the last 20 years, particularly as a result of increasing hydropower generation which represented 72% of total electricity generation (Table 2:4). Interestingly, thermal generation has fluctuated significantly on an annual basis, while diesel has remained almost constant and natural gas generation has gradually fallen since its peak in 2005-2006.

Table 2:4: Electricity Generation in Myanmar from 2000 to 2012 by Source (GWh)

Source	Year												
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Thermal	662	550	642	634	124	387	385	418	394	223	278	438	506
Diesel	36	31	29	31	33	33	28	34	40	30	33	38	51
Hydro	1,838	1,943	2,065	1,920	2,350	2,951	3,277	3,572	4,510	5,224	6,152	7,469	7,722
Gas	2,528	2,100	2,287	2,685	2,983	2,398	2,025	1,891	1,897	1,205	1,734	2,118	2,377
Coal	-	-	-	-	60	244	401	436	220	250	391	312	265
TOTAL (GWh)	5,064	4,624	5,023	5,270	5,550	6,013	6,116	6,351	7,061	6,932	8,588	10,375	10,921

Source: Energy Planning Department, MOE.

2.2.3.3 Electricity Consumption by Sector

Table 2:5 shows the breakdown of electricity production by sector, and in 2011 the residential sector accounted for 42% of total electricity consumption, followed by the industrial sector with 36% and commercial sector with 21%.

Table 2:5: Electricity Consumption in Myanmar from 2000 to 2012 by Usage (GWh)

Sector	Year												
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Residential	1,361	1,245	1,431	1,612	1,662	1,812	1,614	1,647	1,799	2,015	2,653	3,378	2,681
Industrial	1,295	1,148	1,417	1,577	1,549	1,756	1,854	1,872	1,904	1,850	2,287	2,711	3,650
Commercial	527	564	552	578	613	695	827	864	945	1,071	1,306	1,531	1,643
Other	85	85	84	83	85	89	61	55	53	57	66	76	281
TOTAL (GWh)	3,268	3,041	3,484	3,850	3,909	4,353	4,355	4,438	4,701	4,993	6,312	7,696	8,254

Source: Energy Planning Department, MOE.

Approximately 70% of the population lives in rural areas. Due to the lack of adequate electricity supply, the residential sector, both in urban and rural areas, is dependent on biomass for energy. On average, each household in Yangon consumes approximately 1,760 kWh, while in Nay Pyi Taw and Mandalay it is about 1,270 kWh per household.

In 2011, the electrification rate in Myanmar was approximately 27% which is a significant increase compared to 2006 when the value was approximately 16%. The electrification rate is higher in urban areas such as Yangon, Nay Pyi Taw, Kayar and Mandalay. The proposed electrification plan is given in Section 2.2.4.

2.2.4 Electricity Demand Profile and Forecast

2.2.4.1 Demand Forecasts

An Electricity Supply Plan is currently under preparation and the demand forecast provided by the Ministry of Electric Power (MOEP) is shown in Table 2.6. It sets an ambitious but yet achievable target for electrification rate from 27% in 2011-2012 to 80% by 2030. Electricity installed and generation capacity are expected to rise by a tenfold for the same period.

Table 2:6: Electricity Demand and Generation Forecast

Period	Population (million)	Demand Forecast (MW)	Required Generation (GWh)	Target Electrified Households (%)
2011-12	60.40	1,806	10,444	27
2012-13 to 2015-16	63.14	3,078	17,797	34
2016-17 to 2020-21	66.29	5,686	32,874	45
2021-22 to 2025-26	70.45	10.400	60,132	60
2026-27 to 2030-31	74.12	19,216	111,100	80

Source: Ministry of Electric Power, National Energy Policy, 2014

According to draft national electricity master plan cooperation with JICA and World Bank, target electrification ratio is 100% by 2030.

2.3 Past and Current Energy Efficiency Activities

2.3.1 Past Energy Efficiency Initiatives and Outcomes

2.3.1.1 ADB Programs

The ADB has proposed a "Power Transmission and Distribution Improvement Project" (46390-002) to rehabilitate distribution network in five townships in Yangon, Mandalay, Sagaing and Magwe regions; and expand transmission and distribution systems. The project aims to reduce the system losses and increase reliable electricity supply to urban and rural consumers.

In December 2013, the ADB also approved a US$12 million project for "Enhancing Rural Livelihoods and Incomes" (47311-001), with support from the Government of Japan, which covers a number of tasks at rural level including rural electrification for households. The project focuses particularly on the Ayeyawady Delta, the Central Dry Zone, Taninthayi Region, and Shan State Plateau. The project will examine the feasibility of providing selected poor households with solar home systems and fluorescent tube lamps. Where this is not feasible, household solar lanterns might be considered.

This current project is part of the ADB's "Enhancing the Power Sector's Legal and Regulatory Framework" (46486-001), which was approved in October 2013. The ADB and Government of Norway are assisting the MOEP in updating the Myanmar Electricity Law and the Electricity Rules in order to reflect the current international standards and create an enabling regulatory framework for introducing an electricity regulator and respective institutional arrangements. This will involve the following:

a. Providing an improved regulatory framework for gradual future sector unbundling (generation, transmission, and distribution subsectors);

b. Encouraging greater private sector participation in generation projects and enabling third-party network access;

c. Establishing rules and regulations for small independent power producers to promote off-grid electrification;

d. Implementing rural electrification programs; and

e. Introducing an electricity regulator consistent with internationally recognized good practices.

Further projects are being proposed by ADB such as the "Off-Grid Renewable Energy Demonstration Project".

2.3.1.2 JICA/NEDO Programs

The Japanese Government and Japanese Development Agencies are actively supporting energy efficiency and renewable energy in Myanmar. In addition to the support provided under ADB, as mentioned above, in January 2012, the New Energy and Industrial Technology Development Organization (NEDO) reached an agreement for cooperation towards the introduction of renewable energy and energy conservation technologies in Myanmar which entails the following activities:

a. Formulation of an action plan for the introduction of renewable energy technologies in Myanmar

b. Introduction of stand-alone power systems using renewable energy technologies

c. Organization of seminars on renewable energy, energy conservation and environmental technologies.

In 2013, the Japan International Cooperation Agency (JICA) also provided a grant for Rehabilitation of Baluchaung No.2 Hydropower Plant.

2.3.1.3 ASEAN Programs

The Association of South East Asian Nations (ASEAN), with funding support from the European Commission under the Switch Asia Programme, setup the ASEAN Energy Management Scheme (AEMAS) with the objective of reducing the energy consumption of the manufacturing/industrial sector across the region. This is being implemented by training and certification of energy managers and the certification of energy end-users. In Myanmar, the training is being conducted with the support of the Myanmar Engineering Society (MES). From February to July 2013, MES organized one training for energy managers and has certified a total of 42 Energy Managers to date.

2.3.1.4 UNDP Programs

The UNDP has been carrying research on energy access in Myanmar and focusing particularly on rural communities. For example, UNDP supported a local community in Thicong village, Chin State, to setup a micro-hydropower plant in January 2010. Overall, 12 micro hydropower plants have been built in 12 villages in Myanmar by UNDP-facilitated community-based organizations.

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The Renewable Energy Association of Thailand and UNDP are currently undertaking an assessment for the feasibility of replacing candle light with Solar Lighting System with LED lights using a revolving fund.

2.3.2 Energy Efficiency and Conservation Activities of the Ministry of Industry

The following is a summary of EE&C activities of MOI:

- Energy Audit of Mann petroleum refinery (2001)
- PROMEEC Building Energy Audit Training(2003)
- PRPMEEC Energy Management Training (2004)
- Seminar- Workshop on EE&C for building Best Practices in South East Asia(2005)
- Energy Audit of Kyankhin Cement Plant (2006)
- Energy Audit of Thanlyan Oil Refinery Plant (2006)
- Energy Audit of Mayangone Textile Factory (2008)
- Energy Audit of Automobile Factory (2009)
- Energy Management of No.(14) Heavy Industry, Thagaya (2010)
- Energy Management of Earth Industrial (Myanmar)Co. Ltd, Yangon (2011)
- ASEAN-Japan Energy Efficiency Partnership(AJEEP) Scheme 3 Workshop and Training (2013)
- Improvement of Industrial Energy Efficiency Project - Awareness Workshop (2013)
- ASEAN-Japan Energy Efficiency Partnership(AJEEP) Scheme 3 Workshop and Training (2014)
- Improvement of Industrial Energy Efficiency Project - Awareness Workshop (2014)

Along with the Energy Audit Activities, Energy Management Practical Training and Seminar Workshop have also been arranged by Ministry of Industry. Energy Audits were conducted with the cooperation of ASEAN- Japan with the help of technical knowledge and testing equipments for energy audit activities. ASEAN Energy Management Handbook has been translated and published, 2011-12. The MOI has also played a key role in the ASEAN Energy Award Program in Myanmar.

The Table below provides a summary Awareness Raising Activities & Energy Management Handbook Training conducted by MOI.

Sr. No.	Date	Name of factory	Participants
1	10.5.11	HI(21) Tyre Factory	100
2	10.5.11	HI(22) Tyre Factory	65
3	5.10.11	HI(12) Automobile Factory	22
4	5.10.11	HI(16) Agricultural Machinery Factory	38
5	23.2.12	HI(25) Machine Tools Factory	40
Total			265

2.3.3 Planned Energy Efficiency Initiatives

2.3.3.1 World Bank

In January 2014, the World Bank Group announced a US$2 billion multi-year development program to improve access to energy and health care for poor people and support other key government development priorities. The energy component involves support for the development of a national electrification plan (under the Sustainable Energy for All initiative), enhance institutional capacity and promote regulatory reforms that are critical for sustainable private sector participation in power generation and distribution as well as scale-up of renewable energy for rural and off-grid electrification.

2.3.3.2 UNIDO

The United Nations Industrial Development Organisation (UNIDO) has setup a project called "Improvement of Industrial Energy Efficiency (IEnE) in Myanmar". The objective is to promote sustained greenhouse gas emission reduction in the Myanmar industry by improving policy and regulatory frameworks; institutional capacity building for industrial energy efficiency; implementation of energy management system based on ISO 50001; and optimization of energy systems in industry. The project components include policy support, capacity building and demonstrations and up-scaling. The project will commence in January 2015 and be completed by December 2019 (60 months).

3 ENERGY EFFICIENCY POTENTIAL

3.1 Introduction

This section assesses the EE potential in all the key sectors (Industrial, Commercial, Residential and Public) in Myanmar. The assessment is made on the basis of current Best Practices in the region and their applicability in Myanmar. The Table 3.1 provides a summary of the energy saving potential and EE technologies applicable for each of the above sectors.

Table 3:1: Energy Saving Potential and EE Technologies by Sector

Sector	*Sub-Sector*	*Main Fuel Used*	*Saving Potential (%)*			*EE Technologies Proposed*
			Min	*Max*	*Ave*	
Industry	Iron and Steel	Electricity	5	65	45	Cogeneration, EE Boiler, Waste Heat Recovery, EE Furnace, High Efficiency Motors
	Cement	Electricity	3	43	23	High Efficiency Motors, EE Kilns, Cogeneration, Waste Heat Recovery, Variable Speed Drives
	Pulp and Paper	Electricity	50	80	65	Cogeneration, EE Boiler, Waste Heat Recovery, EE Furnace, High Efficiency Motors
	Textile	Electricity	5	20	12.5	High Efficiency Motors, EE Boilers, EE Lighting, EE Air Conditioners
	Thermal Power Plants	Diesel / Electricity	3	5	4	High Efficiency Motors, Cogeneration, Combined Cycle Gas Turbine
	Sugar Mills	Bagasse / Electricity	25	45	35	Boilers, Waste Heat Recovery, Cogeneration, High Efficiency Motors
	Rice Mills	Electricity / Rice husks		35		Cogeneration, EE Boilers
	Ceramic and Brick	Biomass / Electricity	15	25	20	Cogeneration, Waste Heat Recovery, EE Kilns, High Efficiency Motors
Commercial	Office Buildings	Electricity	20	30	25	HE Lighting, ACs, Office Equipment through MEPS
	Restaurants	Electricity / LPG	20	35	25	HE Lighting, ACs, LPG cooking, Solar water heating
	Hotels	Electricity / LPG	20	35	30	HE Lighting, ACs, LPG cooking, solar water heating
Residential	Urban Households	Electricity / LPG / Biomass	25	40	30	HE Lighting, refrigeration, MEPS for appliances, SHW, LPG cooking
	Rural Households	Electricity / Biomass	25	40	30	HE Lighting, refrigeration, MEPS for appliances
Public Sector	Public Buildings	Electricity	20	30	25	HE Lighting, ACs, Office Equipment through MEPS
	Hospitals	Electricity / LPG	20	35	30	HE Lighting, ACs, LPG cooking, SWH, cogeneration
	Schools	Electricity / LPG	20	30	25	HE Lighting, ACs, Office Equipment through MEPS, Boilers, SWH
	Public Lighting	Electricity	35	65	50	LED, HPS street lighting

3.2 Industrial Sector – EE Best Practices and Technologies

3.2.1 Pulp and Paper Industry

3.2.1.1 Status of the Pulp and Paper Industry

Paper consumption in Myanmar has risen remarkably during the last few years. From 2002 to 2004, paper consumption rose over 35% but Myanmar still had to import two thirds of the paper used during 2004. Consequently, conditions under which the industry is being developed make it highly unlikely that this imbalance will be altered in the short term. Restrictions are also laid on the expansion of the industry by shortages of sufficient feedstock for small private factories and workshops that produce almost half of the paper and cardboard in the country. Many of these smaller plants still operate with antiquated machinery and their owners lack the necessary resources to import new equipment or upgrade old technologies.

In Myanmar, non-wood materials are widely used in the pulp and paper industry, particularly the cellulose fibre such as bamboo. In 2005 to 2008, Bamboo was exploited largely by a newly developed pulp and paper plant in Tharbaung, Myanmar's south-western Ayeyarwaddy division. This plant has the largest installed capacity and capable of producing 200 tonnes of pulp and paper per day - 150 tonnes will be exported. Combining this with around 25,000 tonnes from state-run factories and 27,000 tonnes of privately-owned factories, the installed capacity has reached around 60,000 tonnes annually. Nonetheless, this overall capacity only fulfils 40% of the total demand in the country.

3.2.1.2 Energy use in the Pulp and Paper Industry

In general, pulp and paper manufacturing is one of the most energy-intensive sectors. Energy is a significant component of production cost and could amount to 25% of the total cost through either conventional heating form or electricity form (Paprican, 2008).

The Ministry of Industry of Myanmar has been recording the energy profile of the pulp and paper industry. In 2011-12, the pulp and paper industry consumed 35 ktoe (1,465,380 GJ), ranking it amongst the top-ten most energy demanding businesses in Myanmar (IES, 2014). Table 3.2 shows the energy consumption of major pulp and paper plants in various areas in Myanmar. There is significant room for improvement in terms of its energy consumption.

Table 3:2: Energy Benchmarking in Pulp and Paper Industry in Myanmar

Year AVG	Factory / catagories	Tharbaung (Bleached)	Sittoung (Kraft)	Paleik (Recycling)	Yeni (Kraft,Card board)
2008 - 2013	Electricity (kWh)	15,898,678	14,082,301	2,975,137	5,732,587
	Gas (mcf)	896	646	40	-
	Oil	-	17,737	8,617	385,097
	Total Energy Demand (GJ)	58,205	53,805	11,924	72,933
	Total Output	15,261	2,845	2,676	2,225
	Electricity consumption (kWh/tonne)	1,041.8	4,949.3	1,111.6	2,576.9
	Thermal consumption (GJ/tonne)	3.06	15.35	3.66	30.93

Source: Ministry of Industry, Myanmar 2014

There are four plants, which produce by-products different to that shown in the Table 3.2: Print and Writing paper production in Tharbaung (Bleached method), Kraft paper production in Sittoung (Chemical method, using bamboo), newsprint plant in Paleik (recycling and deinking technology) and Kraft and card board production in Yeni (Mixed method). All of these plants are run by the state and the maximum capacity accounts for less than a quarter of total national demand.

In 2007, the Department of Alternative Energy Development and Efficiency of Thailand (DEDE) audited various paper companies in Thailand. The result is displayed in Table 3.3, showing that the average electricity consumption in the pulp and paper manufacturing process is around 500 to 800 kWh per tonne of by product.

Table 3:3: **Energy Benchmarking in Pulp and Paper Industry in Thailand**

Category	Manufacturing process	Energy Index	
		Electricity (kWh/tonne)	Heat (MJ/tonne)
Pulp	Materials preparation	25.43	-
	Pulping	142.8	2750
	Bleaching	135.3	1287
	Chemical recycle	168.6	5645
	Energy consumption in major processes	451.1	9885
	Total energy consumption	523.7	13525
Craft paper	Waste Plant	181.7	377
	Stock penetration	170	-
	Paper machine	255.4	4253
	Cutting	40.2	-
	Energy consumption in major processes	604.1	4631
	Total energy consumption	640.2	5757
Duplex paper	Waste Plant & Stock Preparation	402.9	-
	Paper machine	356.1	5509
	Energy consumption in major processes	758.9	5509
	Total energy consumption	780.3	6992
Plain Paper	Waste Plant & Stock Preparation	205.8	-
	Paper Machine	339.7	4950
	Energy consumption in major processes	568.4	4950
	Total energy consumption	625.2	6688
Tissue, napkins	De-inking Plant	468.2	1995
	Stock Preparation	420.4	-
	Paper Machine	491.9	6654
	Energy consumption in major processes	1447	7450
	Total energy consumption	1823	9227
Newspaper	Stock Preparation	375	-
	Paper Machine	442	3972
	Cutting	25	-
	Energy consumption in major processes	817	3972
	Total energy consumption	844.8	4593
Packaging	Corrugators	42.2	1053

Source: DEDE, Thailand

Heat is essential in pulp and paper manufacturing, with the average consumption ranging from 5 to 13.5 GJ/tonne in Thailand. Table 3.3 shows that heat is consumed greatly in the pulp making process; as a result, implementing energy efficiency measures are crucial for this process. The table also indicates that producing newsprint generally consumes more electricity than other by-products; however less heat is required in this process.

Energy consumption in Myanmar is often higher than the benchmark value in Thailand. Electricity consumption of Myanmar's paper factories can range from around 1,000 kWh/tonne to almost 5,000 kWh/tonne. In the same way, thermal consumption can vary between 4 GJ/tonne and 33 GJ/tonne. The data shows the potential savings of around 50% to 80% as compared to Thailand.

In general, the pulp and paper industry in Thailand requires around 80% of heat energy and 20% from electricity. In Myanmar, however, electricity is utilized to generate heat in many factories.

3.2.1.3 EE Technology/Practices/Measures and Potential Energy Savings

Ideally, pulp and paper industry should adopt Cogeneration or Combined Heat and Power (CHP) technology, however since high investment is needed for this technology, low-cost, high-impact plans are highlighted in Table 3.4.

Since steam is largely consumed in the pulp and paper industry, therefore energy efficiency initiatives that target at reducing steam system losses and improving the efficiency of process steam-using equipment are likely to reduce energy use in pulp and paper factories. In other words, minimizing the use of electricity can benefit the whole system as well. For example, minimizing the use of boiler blow down is one solution that is highlighted in Table 3.4.

Additionally, Table 3.4 shows the level of capitalisation and impact of the energy efficiency options covering boilers and furnaces in the United States. It should be noted that the payback figures are based on the US electricity tariffs (7-10 cents/kWh) while the industrial tariff in Myanmar is currently around 10 - 15 cents/kWh.

Table 3:4: Potential improvement for Pulp and Paper Industry

	Energy Efficiency options	capital	impact	payback	remarks
Boilers	Burner replacement			19 mths	- replacing circular oil burners with more efficient parallel throat burners with racer type atomizers had a payback period of approximately one year and a half.
	Boiler process control			<1.7 yrs	- optimising flame temperature, CO, O_2 and smoke - gas leakage detector
	Reduction of flue gas quantities	na		na	- flue gas leakage prevention, 2 to 5 percent saving is estimated
	Minimizing boiler blow down	na		na	- potential heat recovery is expected around 20 percent
	Improved boiler insulation			< 1 yr	- 6 to 20 percent saving is estimated
	Reduction of excess air			< 1 yr	- minimising air inlet at 15% or less, reparing air leaks, fixing broken baffles - 2.3 percent saving is estimated, or $70,000 saving a year
	Flue gas heat recovery			na	- 1 percent of fuel use is saved for every 45°F reduction in exhaust gas temperature - potentially reduce boiler fuel by around 3.5%
Chemical Recovery Furnaces	Recovery furnace deposition monitoring	na		na	- Better control of deposits on heat transfer surfaces in recovery furnaces can lead to higher operating efficiencies, reduced downtime (by avoiding plugging), and more predictable shutdown schedules.
	Black liquor solids concentration			4 yrs	- increasing the solids content in black liquor from 66 to 80 percent would lead to fuel savings of 3 MMBtu per hour of 100 tonne pulp mills, reflecting $55,000 saving - Using tube-type falling film evaporator can be produced higher solids content of black liquor up to 70% rather than 50% , 0.76 MMBtu of steam saving is estimated - $100,000 saving per year in 100 tonne daily pulp production

Source: USEPA, 2010

	High
	Med
	Low

Table 3.5 shows the energy efficiency options for the pulp and paper industry observed in Thailand that are applicable in Myanmar. It has been observed that some of these best practice methods, which have been applied in Thailand, considerably reduce the production cost for participating plants and have a typical Return on Investment value (ROI) of less than 3.5 years, which is generally considered attractive to investors.

Table 3:5: **Best practice examples in Pulp and Paper Industry in Thailand**

Process	Methodology	Description
Pulp making	Improving the internal combustion of recovery boiler	Altering small tertiary air ports to bigger tertiary air ports, improving the air flow, and providing better combustion (Q_{co}=1,166,133 m^3/h)
	Using multi-effect falling film evaporator to subside steam using	Set of Evaporator is used to evaporate and intersify black liquor for use as a fuel in a recovery boiler (Q_{steam}=77.4 kg/h)
	Using PLC to control the Chip bin motor	In wood chip preperation process, 18 kW hydrolic pump works continuously even without load, using PLC will reduce elctricity cost by minimising the use of hydrolic pump
	Substitution of MC Pump by Compact High Efficiency Mixer in pulp transportation	Using newly designed pump gives better velocity and flow rate with lower electricity consumption (from 13 kWh/ton-pulp to 2.6 kWh/ton-pulp)
Pulp preperation	Substitution double-disc refiner by conical refiner	Conical refiner (883 kW) consumes less amount of energy (double-disc consumes 1,233 kW) but gives equal productivity
	Selecting the suitable size of pulp refiner	Measure the load and use the appropriate size of the pulp refiner to gain the total efficiency of the system
	Applying Variable speed drive (VSD) to Screw press and Soaking Inking tower flow	Applying VSD to the 25 HP of screw press will make the system drive smoother than manually adjusting the damper
Kraft and Print paper making	Turning Bottom-Dump chest pump off when Kraft liner board is manufacturing	In mixed process, 50% kraft, 50% corrugating medium; 2 sets of BTM-Dump chest pump are used for stock preperation (55 kW and 75 kW). However, when kraft liner board is solely manufactured, BTM pump is not required.
	Using high efficiency hot plate	Corrugated paper making process requires a hot plate in order to dry the paper. Inproving the heat dissipation of the hot plate will increase the overall efficiency
Supported function	Installing inverter with IDF of boiler	6 units of 200 kW boiler are connected with Voltage Vecter Control and Variable Speed Drive tools in order to reduce losses
	Converting fuel oil boiler to biomass	Using cheaper fuel source would be an ideal but need to carefully consider their energy density. This project uses coconut seeds as fuel source at 12 tonne/hr, 13 bar
	Improving insulation of cogeneration boiler	2 units of 120 tonne/h boiler, 84 bar are equipped with efficient insulation (59 and 74 m^2 of surface areas)
	Combining cogeneration plant by using wood residue as a fuel source	Big pulp and paper plant requires huge amount of energy, generally served by fuel oil and electricity. By using another source of fuel can be proved benefits to the energy bill (BMK: 2.9 MW, 412000 litres/m)

Source: DEDE, Thailand 2008

3.2.2 Iron and Steel Industry

3.2.2.1 Status of the Iron and Steel Industry in Myanmar

The iron and steel industry is listed amongst the largest industries in Myanmar, and has an approximate total market demand of 1,000,000 tonnes per annum. Total production capacity of the private sector is estimated to be 100,000 tonnes per year. Myanmar's government is the dominant player in the iron and steel industry and government-owned mills account for 70% of the domestic capacity. However, the total capacity (public and private) does not currently meet the market demand. Accordingly Myanmar imports considerable amount of iron and steel for construction purposes. It is estimated that around 600,000 tonnes of steel are imported from Thailand, South Korea, India and the People's Republic of China. Myanmar's import of billet, at 117,000 tonnes in the first ten months of 2011 doubled in volume when compared to the same period in 2010 (SEAISI, 2012).

3.2.2.2 Energy use in the Iron and Steel Industry

As identified previously, energy consumption in this industry is significant, with 89 ktoe consumed between 2011 and 2012 (IES, 2014). Since information on the specific energy consumption is limited in Myanmar, the data in this analysis is based on data from neighbouring countries that have comparable technologies and infrastructure. A new ADB report published in 2014, discusses energy efficiency of the iron and steel industry in Bangladesh. The benchmarking data concerning energy consumption of the major types of steel in Bangladesh are shown in Table 3.6.

Table 3:6: **Benchmarking of energy consumption for producing primary types of steel in Bangladesh, Thailand and International**

Type of Industry	Bangladesh[1] (toe/ton)	Thailand[2] (toe/ton)	International range[1] (toe/ton)	Saving potential[3] (%)
Cold Rolling and Finishing	0.159	0.043	0.0382-0.066	58 - 76
MS Rod	0.091	0.084	0.046-0.088	3 - 49
MS Ingot	0.169	0.105	0.089-0.101	40 - 47

Source: ADB, 2014

Overall, the energy consumption of the steel industry in a developing country such as Bangladesh is significantly higher than the international average and that of Thailand. Accordingly, the Myanmar iron and steel industry is likely to apply similar processes and technology. In Myanmar, intermittent power outages are major constraint for the industrial sector and the iron and steel industry generally opts for the use of fossil fuel source instead. In 2011-12, this industry consumed 66 ktoe of coal and 23 ktoe of natural gas (IES, 2014)

3.2.2.3 EE Technology/Practices/Measures and Potential Energy Savings

Typically, iron and steel mills in Myanmar exploit heat from fossil fuel sources; coal and gas are the main energy sources to produce the required heat. The iron and steel industry in most developing countries has yet to show the significant outcomes, especially in terms of heat retention and equipment utilisation. Major savings can come through waste gas recovery systems, pressure recovery systems and furnace insulation. Based on the ADB study in Bangladesh (2014), the potential savings applicable to the iron and steel industry of Myanmar are highlighted as follows:

- 20% from Exhaust Gas Heat Recovery
- 5 – 10% by improving insulation, and
- 20 – 25% by Automation of Re-heating Furnace

A UNDP study in Bhutan states that a waste gas recovery project for a 900,000 tonnes per annum blast furnace is capable of saving 0.93 MWh/tonne or 3,348 MJ/tonne. In Direct Reduced Iron (DRI) or sponge iron, waste heat is used to transform water into high pressure steam. The steam is used to run a conventional condensing type of steam gas turbine for electricity generation. This practice can save 61,413 MWh per annum from 400 tonne per day of DRI production (UNDP, 2012).

3.2.3 Cement Industry

3.2.3.1 Status of Cement industry in Myanmar

The cement industry is commonly categorised as an inorganic ceramic industry. The most commonly used type of cement is Portland cement, which is prepared by heating limestone with small quantities of other materials (such as clay) to 1,450 °C in a kiln. There are two widely known processes: wet process and dry process, the latter one is more thermal efficient.

The construction business growth is closely linked with Gross Domestic Product growth. The cement industry, in turn, is inextricably linked with the construction business since most new constructions are built using concrete. Cement consumption in Myanmar has risen dramatically during the last few years, growing over 15% per year between 2011 and 2013. Myanmar's per-capita cement use is 70-80 kilogrammes per year. Considerable investments from various sources have been bolstering the industry to meet fast-growing demand. Nevertheless, Myanmar still had to import around two-third of its production in 2012. Currently, the cement industry of Myanmar has a total installed capacity around 17,000 tonne per day. However, due to the low production yield, Myanmar produced only 2.8 Million tonnes per annum (Mtpa) in 2012. The majority of imported cement was brought from Thailand. It is anticipated that Myanmar will increase the total domestic generation to 5.5 Mtpa within 2015, as a result of the operation of new large-cement mills (LVT, 2013).

The government of Myanmar still dominates the market, with total installed capacity of 9,900 tonnes per day, which accounts for around 60 percent. However, private sector is expanding rapidly and could overtake the state-owned within a couple of years. Since Myanmar is a naturally gas-rich country, most cement mills exploit natural gas as their primary fuel. In addition, the mills have been extensively subsidised over time, and could eventually cease to be competitive in the ASEAN Free Trade Zone under AEC obligation. As a result wet kilns will need to convert to the dry process to allow for improved efficiency to compete with other ASEAN countries, and natural gas may be substituted by coal due to costs (LVT, 2013).

3.2.3.2 Energy use in the Cement industry

Cement manufacturing is listed amongst the top-five energy intensive industries. Energy is a significant production-cost factor; 50-60% of the production cost is contributed to energy in either conventional heating or electricity. The typical electrical energy consumption of a modern cement plant is about 110–120 kWh per tonne of cement. Majority of the thermal energy is used during the burning process, while electrical energy is used for cement grinding (N.A. Madlool et al., 2011).

There are 16 cement plants in Myanmar. Table 3.7 shows the two first plants in Myanmar: Thayet which was founded before the Second World War, and Kyangin, which was built few years later. The total energy consumption of these plants is around 5 to 6 GJ per tonne of cement production. Both plants use wet process which generally consumes more thermal energy than the dry process.

Table 3:7: **Baseline of specific energy consumption in Major Cement Plants**

Year AVG	Factory catagories	Thayet (Wet)	Kyangin (Wet)
2008 - 2013	Electricity (kWh)	15,237,292	38,206,715
	Gas (mcf)	1,024	2,954
	Oil (litres)	4,676,509	11,240,485
	Total Energy Demand (GJ)	55,963	1,667,201
	Total Output (tonne)	130,003	334,530
	Electricity consumption (kWh/tonne)	117.2	114.2
	Thermal consumption (GJ/tonne)	4.89	4.57
	Total consumption (GJ/tonne)	**5.32**	**4.98**

Source: Ministry of Industry, 2014

Table 3.8 displays the specific energy consumption of the cement industry in Thailand and International range compared with Myanmar. In general, Myanmar's cement industry still has a significant potential for improving its overall efficiency and yield. It is observed that around 42% of the energy consumption can be saved if the industry adopts energy efficient manufacturing technologies. The cement industry in Myanmar is currently close to the top end of the international benchmarking range and approximately only 13% below Thailand. If Myanmar were to reach best practice the total consumption value would have to improve by approximately 74%.

Table 3:8: **Benchmarking of specific energy consumption in cement industry in Myanmar, Thailand, International and Best Practice**

Type of Industry	Total consumption (GJ/tonne)	Total consumption (toe/ton)
Myanmar	5.15	0.123
Thailand	4.48	0.107
International range	3.31 - 5.11	0.079 - 0.122
Best practice	**2.954**	**0.071**

Source: DEDE, 2008, N.A Madlool et al., 2011

3.2.3.3 EE Technology/Practices/Measures and Potential Energy Savings

Grinding is a highly energy intensive process in the cement industry. Approximately 60 – 70% of total electricity used in a cement plant is utilised for grinding raw materials, coal and clinker (N.A. Madlool et al., 2011). Since the majority of cement mills in Myanmar use a wet process, the suggested solutions below will focus particularly on wet process technologies; however, the industry should eventually consider the dry process due to recent improvement in dry process technologies.

Significant opportunities for energy conservation exist in the cement sector in terms of the technology, processes, and the energy efficiency options. These are highlighted in Table 3.9 and categorised by the level of investment. The high investment, high impact options are shown in Table 3.10. Although high capital is needed for both options, the energy savings will enable relatively short pay-back periods for the lifetime of the equipment. The payback periods have been calculated based on various assumptions outlined in the reference journal (DEDE, 2008; N.A. Madlool et al., 2011).

Table 3:9: **Low and medium investment practices for improved energy efficiency in the Cement Industry**

	Energy Efficiency options	capital ($/ton)	Energy Saving	payback (yrs)	remarks
Low investment	Process control	0.3-1.0	0.1-1kWh/ton	< 0.5	- Control the process parameters and audit regularly
	Seal replacement, Kiln combustion replacement	0.3-1.7	0.1-0.2 GJ/ton	< 2	
	Variable Speed Drive for Kiln Fan	0.23	0.021-0.06 GJ/ton	2-3	- Proved to be very mature technology
	Improving refractories for clinker	0.25	0.12-0.6 GJ/ton	2	
	Changing product feedstocks: Use of Steel Slag in kilns	0.4	0.15-0.19 GJ/ton	<2	
	High-efficiency motors and drivers	0.2	3-8% 0.02-0.06 GJ/ton	<1	
Medium investment	Heat recovery for power generation for clinker making in rotary kilns	1.8-3.3	0.22 GJ/ton 17-22 kWh/ton	<3	
	Upgrading pre-heater kilns in rotary kilns	9.4-28	0.16-0.7 GJ/ton	5	
	High-efficiency classifiers (Dry process)	2-2.2	0.01-0.03 GJ/ton	>10	Used to separate the finely ground particles from the coarse particles

Source: DEDE, 2008; N.A. Madlool et al., 2011

Table 3:10: **Best Available Technologies for energy efficiency options in the Cement Industry**

	Energy Efficiency options	capital ($/ton)	Energy Saving	payback (yrs)	remarks
Best Available technologies	Vertical Roller mill (VRM), High pressure roller grinding (HPGR)	5-8	12-43% 0.2-0.29 GJ/ton 7-25 kWh/ton	< 2	
	Retrofit uni-flow burner with Multi-Stage preheater burner	20-41	0.9-4.1 GJ/ton	>10	much better possibilities for flame shape control, a high momentum, and the flexibility to use different types of fuels

Source: N.A. Madlool et al., 2011; CSI, 2013

Table 3.11 briefly summarizes the potential energy saving in various energy efficiency choices as aforementioned.

Table 3:11: **Energy Savings Potential – Cement Industry**

EE choices	Potential Energy Savings
High Efficiency Motors and Drivers	3 - 8%
Seal replacement, Kiln combustion replacement	5 - 10%
VSD for Kiln fans	30 %, electricity
Heat recovery	5 - 10%
Replace Ball mill with VRM	12 - 43%
Multi-stage preheater burner	10 - 40%

Source: N.A. Madlool et al., 2011; CSI, 2013

3.2.4 Textile and Garment Industry

3.2.4.1 Status of the Textile and Garment industry

Asia is the world's garment factory, and this industrial sector provides employment to millions of people. Following anticipated, political and economic reform, the textile and garment industry in Myanmar is expected to grow exponentially. Myanmar has abundant cotton fields, with approximately 203,000 acres, capable of producing 25,000 million tonnes of cotton per annum (Aung Kyaw Soe, 2012) and a large low-wage workforce. However, the country still lacks a strong foundation for the industry such as subsidies, incentives and advanced technologies. Moreover, the country generally delivers poor-quality finished goods and as a result it still lags behind Bangladesh, People's Republic of China and India. Nonetheless, this industry is expected to make a huge contribution to the economy in the near future and, as a result, increase the overall energy use of the country.

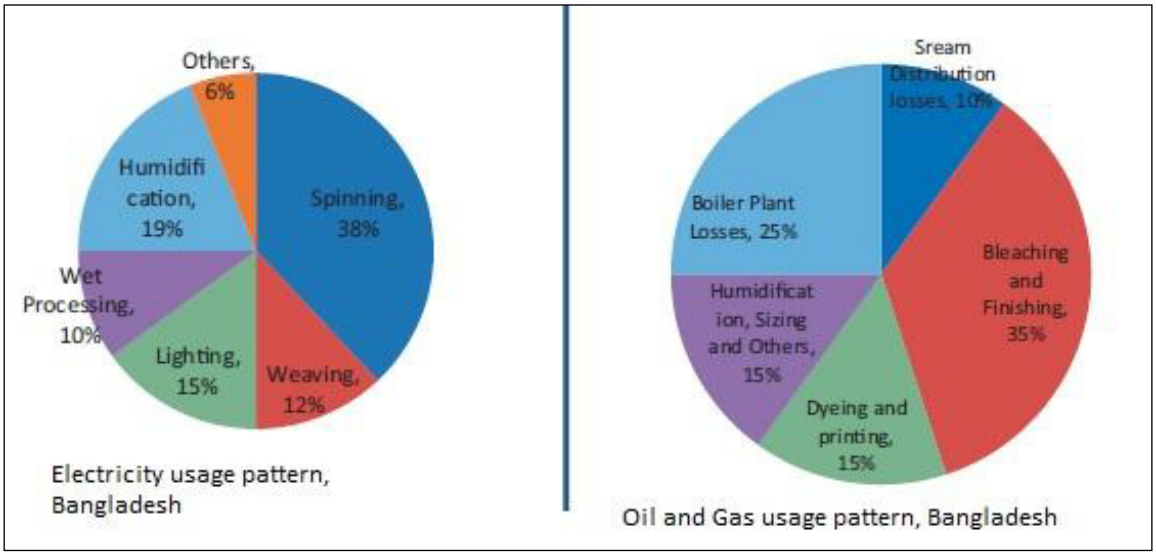
The textile sector currently comprises of over 1,300 factories and continues to grow. Eleven (11) of them are the State-owned enterprises and according to the Ministry of Industry in 2011, Textile and Garment industry contributed to 8.26% of the total exports. In 2011 – 2012, the garment industry brought 1.7 billion USD to the country, and the annual growth rate during 2007 to 2012 was 14%.

3.2.4.2 Energy use in the Textile industry

Energy in the textile industry is commonly used through electricity (as a common power source for machinery, cooling systems, lighting, etc), while oil and natural gas are used to generate steam, for bleaching and finishing.

Figure 3.1 shows the breakdown of energy use in the garment industry of Bangladesh. It indicates that electricity is mainly consumed in the spinning process, and thermal energy is mainly consumed by the bleaching and finishing process. While, a study of the Cambodian garment industry held in 2009, shows similar trends.

Figure 3:1: **Breakdown of energy end users in the Textile Industry in Bangladesh**



Source: ADB, 2014

There is limited information on the current status of the textile industry in Myanmar; however, the International Finance Corporation (2010) and ADB (2014) have released reports on industrial energy efficiency for Cambodia and Bangladesh, respectively. These reports act as the best existing guideline for the textile industry of Myanmar. According to the IFC report, the average specific energy consumption for textile manufacture of Cambodia is 42 GJ per tonne of garment produced, which accounts for around 16.7% of total production costs. Biomass is the main source of energy, accounting for 43.3% of total energy use, followed by diesel and electricity at 27.9% and 24.5%, respectively. However, electricity accounts for the largest proportion of energy cost at 52% for producing a tonne of product.

Table 3.12 shows the specific energy consumption of the textile industry in Bangladesh, Cambodia and International range. It is anticipated that the specific energy consumption in textile industry of Myanmar will range between 333 and 351. Based on this, the textile industry in Myanmar could reduce their energy consumption by approximately 25 to 29% of energy consumption if adopting energy efficient manufacturing technologies.

Table 3:12: **Benchmarking of specific energy consumption in textile industry in Bangladesh, Cambodia and International**

Type of Industry	Bangladesh (toe/million units produced)	Cambodia (toe/million units produced)	International range (toe/million units produced)
Textile industry	333	351	250 - 300

Source: IFC, 2010; ADB, 2014

3.2.4.3 EE Technology/Practices/Measures and Potential Energy Savings

Although the majority of energy consumption of the garment industry comes from thermal processes, the energy efficiency technologies presented focus on the efficient use of electricity, fuel and steam due to the cost of use. Since there is limited information on the current status of the garment industry in Myanmar, the energy efficiency technologies will be based on the data from Bangladesh and Cambodia as shown in Table 3.13. The main findings of both reports suggest that:

- **Motor efficiency:** motors are the main component of the garment industry, however most motors observed in those countries are old and inefficient. It is estimated that high efficiency motors have 10 – 20% greater efficiency than the currently used motors.

- **Lighting:** the share of lighting in total electricity use can range between 15 and 23%. Studies also suggest that T8 Fluorescent Tubes (FTs) are used in most factories. By changing T8 FTs to T5 FTs, energy used in lighting is expected to reduce by 20% on avearge.

- **Boiler Efficiency:** Air dampers are not regularly adjusted even when load fluctuates; poor insulation and low boiler efficiency are observed as well. Replacing obsolete boilers with three pass boilers will increase the boiler efficiency by 15 – 20%.

- **Humidification and air-conditioners:** Low efficiency air-conditioners are observed in office areas, cooling in open areas are observed as well. By controlling air leakage and renovating the working space, 5 – 10% potential saving is expected.

Table 3:13: **Energy Savings Potential – Textile and Garment Industry**

EE choices	Potential Energy Savings
High Efficiency Motors and Drivers	10 - 20%
Energy Efficient Boilers	15 - 20%
Lighting	20%
Air-conditioners and layout	5 - 10%

Source: IFC, 2010; ADB, 2014

3.2.5 Sugar Industry

3.2.5.1 Status of Sugar Industry

There is significant production of sugarcane in Myanmar and production and consumption has been on the rise (Ministry of Agriculture, 2001). Small and medium enterprise (SMEs) sugar producers dominate the sugar business in Myanmar accounting for more than 60% of total output in 2006-07, while the remainder is through state-owned producers. Table 3.14 shows the production of State-owned enterprises fluctuated slightly between 2002 and 2007, with only 1% growth, while the private sector grew 5% during the same period (Kudo T and San Thein, 2008).

Table 3:14: **Current status of sugar industry of Myanmar**

(million tonnes)

	2002-03	2003-04	2004-05	2005-06	2006-07	Growth
State-owned enterprises	88,852	64,701	82,897	71,450	92,598	1%
Private Sector	127,199	141,779	129,382	154,314	159,963	5%
Total	216,051	206,480	212,279	225,764	252,561	3%

Source: Kudo T. and San Thein, 2008

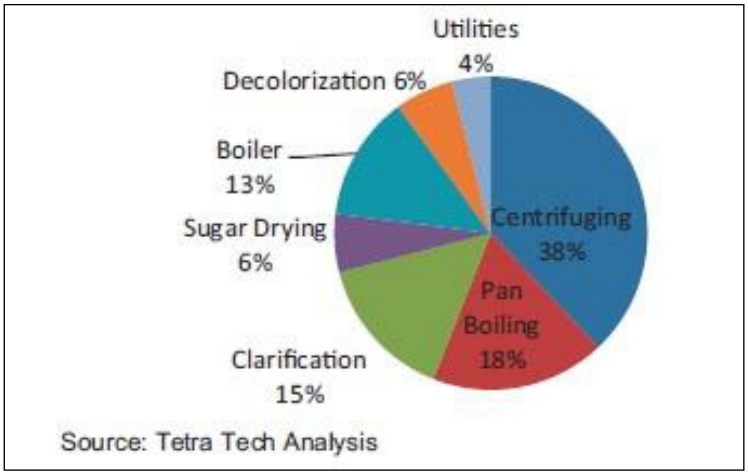
3.2.5.2 Energy usage of Sugar Industry

The sugar industry is relatively heat intensive, with heat occupying around 95% of its total energy consumption. Typically, steam generation pressure and temperature parameters are set in the range from 20 – 30 bar and 300 – 360° C, respectively; the turbines consumption can vary from 1,020 – 1,570 MJ per tonne of cane. In Thailand, the average specific steam consumption is about 1,330 MJ

per tonne of cane and the average electricity consumption at 22 kWh per tonne per cane (Sumate Sathitbun-anan et al., 2012)

In Bangladesh, most of the sugar mills have their own power generation units and use them as a primary source of energy. Around half of the units have their own captive power plant, utilising diesel and gas as fuel sources. Figure 3.2 shows energy consumption by end use in selected mills in Bangladesh. It can be seen that the centrifuging and boiling processes consume most energy at 38% and 18%, respectively.

Figure 3:2: **Energy consumption by End Use of Energy for Sugar Industry in Bangladesh**



Source: ADB, 2014

3.2.5.3 EE Technology/Practices/Measures and Potential Energy Savings

There is limited information on the status of sugar mills in Myanmar. However, the ADB (2014) report for Bangladesh, highlights the following issues:

- Heat recovery: most factories do not deploy waste heat from gas engine generators
- Cogeneration: the absence of attractive policy for feeding-in tariffs discourages factories from developing higher efficiency plants
- Steam: most factories rely too much on steam generation, especially by fossil fuel sources

It can be inferred that most sugar mills in Myanmar rely heavily on fossil fuels. Since fuel oil and diesel are costly, the production cost of such industries becomes high and any possible energy savings can prove substantial in reducing of overall costs. Table 3.15 shows energy efficiency solutions that have been applied to Thailand's sugar industry.

Table 3:15: **Energy efficiency options for sugar industry**

Process/ Equipment	Methodology	Description	Saving Potentials (%)
Boiler	Extended period of blow down inside the boiler	Controlling the allowable limit of TDS at 3,000 ppm. by extending from 12 to 18 hours	**0.2 - 1%**
	Bagasse dryer	Reducing the moisture content of Bagasse give better thermal efficiency	**2 - 9 %**
	Replace steam turbine drive by motor drive for ID fan	Motor drives have better control, easier maintenance, and are more energy-efficient.	**1.5 - 6.5%**
	Replace steam turbine drive by motor drive for boiler feed-water pumps	Motor drives have better control, easier maintenance, and are more energy-efficient.	**0.40%**
Juice extraction	Replace steam turbine drive by AC motor drive for cane cutting knives	Motor drives have better control, easier maintenance and are more energy efficient.	**1.80%**
	Optimal hot water for cane crushing	The optimum hot water is 28% by weight of cane. This measure is used by almost all sugar factories in Thailand but they may use more than 28% of hot water, which is not optimum.	**10 - 11%**
	Replace open gears by planetary gears	Higher efficiency planetary gears give smooth drive	**5.5 - 7%**
Crystallisation	Electric DC motor drives	One of the methods of increasing the cogeneration power in a sugar mill is to replace the smaller, low efficiency mill turbines (25-30% efficiency) with more efficient DC motors or hydraulic drives. The power turbines (multi-stage steam turbines) can operate at efficiencies of about 65 - 70% (Energy measurement, 2007)	**5 - 10%**

Source: Sumate Sathitbun-anan et al., 2012

3.2.6 Rice Milling Industry

3.2.6.1 Status of Rice Milling Industry

The agricultural sector plays a crucial part in Myanmar's economy for both national consumption and export. Myanmar is likely to improve its position as a major world rice exporter because of the favorable climate and abundant cultivatable land. In 2011, the total area of paddy fields was reported at 18.76 million acres, which accounted for 34 percent of total agricultural area. In general, rice farming can be done only twice a year (Monsoon season and summer season); however, due to technological advancements, some countries cultivate their fields 3 to 4 times a year. In 2011-12, the rice production yields in monsoon and summer seasons were reported at 71.91% and 89.36% respectively. The yields per acre of aforementioned seasons were reported at 1.5 and 1.86 tonnes per acre; these figures reflect that the rice production yield of Myanmar is lower than Asia's average (U Htin A. S. and U Kyaw Myint, 2012).

There was a substantial increase in the level of exports reported in 2012-13, due to growing demand from the People's Republic of China and the low-cost of Myanmar's rice. It is estimated that the rice exports will only grow slightly in the next coming years, due to the significant accumulated stocks in Thailand, and the saturation of the rice market (David Dapice, 2013).

3.2.6.2 Energy use in the Rice Milling Industry

Rice milling involves the removal of husk and bran from rough rice to produce white rice. It is composed of two main units - de-husking and whitening. In steam-engine rice mills, the mechanical milling equipment (for example, the husker, whitener and polisher) is driven by a steam engine. In electrical rice mills, all equipment is powered by electricity. However, steam-engine rice-mills still require electricity for some functions, such as, the packaging machine, colour sorter and lighting in the mill.

Currently, there are approximately 30,000 commercially active rice mills in Myanmar (NEDO, 2013). Majority have dilapidated milling facilities and equipment, mostly a mixture of Chinese and local technology. The obsolete processing units lead to quantity losses of about 15-20%, and quantity loss during milling. The average milling ratio is estimated to be 60 percent, lower than in Cambodia and many other neighboring countries (World Bank, 2014).

Due to limited information about the current energy profile of the rice milling industry in Myanmar, information of Thailand's rice milling industry will be used as reference:

- Most rice mills require less than 1 MW, and the reciprocating steam engine is suitable for power generation up to 1 MW
- Many rice mills opt for the electrical mills because of its simplicity in operation; however, most of them have suffered from the increases in price of the electricity
- Husk-fired steam engines are proven to be technological viable and cost effective, however not many mills are currently using this technology

Globally, Specific Electricity Consumption for typical rice mills range from 22 – 45 kWh per tonne of paddy and the Specific Energy Consumptions range from 13.2 – 15.8 MJ per kg. For example, in Thailand, a study in 2004 reported that 14.4 MJ was used to produce 1 kg of rice.

3.2.6.3 EE Technology/Practices/Measures and Potential Energy Savings

There is also limited information about the EE technologies used in the rice milling industry of Myanmar; this study will report the benchmarking value from Thailand. Most of the boilers used in the Thai steam rice mills are 3-pass fire-tube boilers with inclined step-grate furnaces. The efficiency of such boilers is very low - around 40%. Since rice milling technologies have been developing continually, the potential savings provided by different options are highlighted as follows:

- 20% savings by replacing the obsolete boilers with traveling-grate stoker water-cooled furnace wall fire-tube boiler (Chanoknun S. et al., 2007)
- 15% savings by using rice husks as a source of fuel (IFC, 2010)

Higher savings could be obtained through Cogeneration, also known as Combined Heat and Power (CHP), using biomass boilers and gas turbines, which would provide electricity and thermal energy simultaneously. The steam is used for paddy drying, and the fuel source can be obtained from the rice husk residue. This technology is proved to be financial viable and has a potential saving around 15%.

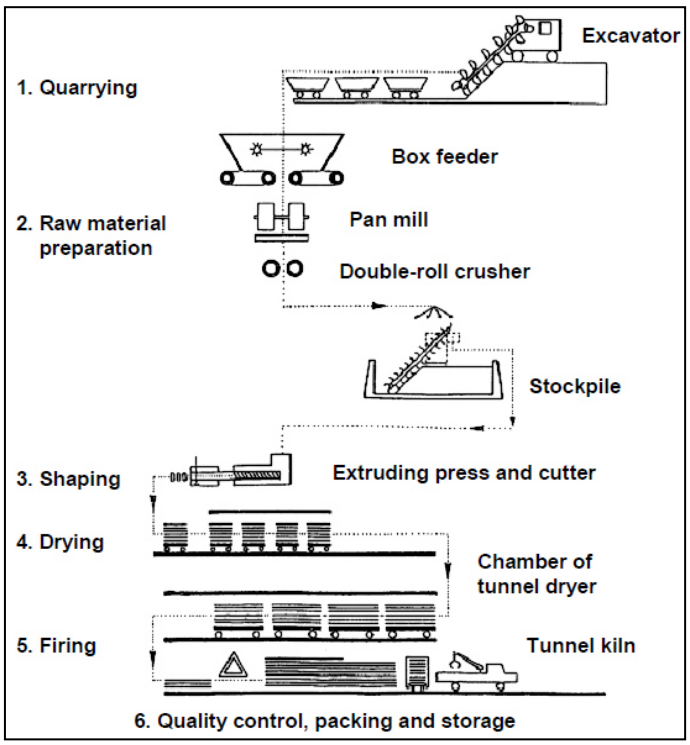
3.2.7 Ceramic and Brick Industry

3.2.7.1 Status of the Ceramic and Brick Industry

The Ceramic Industry comprises of a number of different product manufacturing such as tiles, household ceramics, sanitary ware, clay pipes, refractory products, etc. In this process, the ceramic products are manufactured by the use of mostly inorganic materials made up of non-metallic compounds and made permanent by a firing process. The Brick Industry generally falls under the Ceramic Industry and applies similar manufacturing processes. The manufacture of ceramic products can take place in different type of kilns, with a wide range of raw materials and in numerous shapes, sizes and colours. However, the general manufacturing process is relatively uniform with often multiple stage firing process depending on the end-product. The typical main stages of ceramic manufacturing include mixing, shaping, pressing, drying and firing, and product finishing (Figure 3.3). Basically the raw materials are mixed and cast, pressed or extruded in to shape. Water is regularly used for a thorough mixing and shaping. This water is evaporated in dryers and the products are either placed by hand in the kiln – especially in the case of periodically operated shuttle kilns – or placed onto carriages that are transferred through continuously operated tunnel or roller hearth kilns. For the manufacture of expanded clay aggregates, rotary kilns are used. During the firing process, accurate temperature gradient is required. Thereafter, a controlled cooling is applied if necessary (EC, 2007).

In the brick industry, in the drying process, chamber and tunnel dryers are commonly used and provide temperatures between 75 to 90 degrees Celsius and with drying times of 8 to 72 hours. The firing process can be conducted in a range of different types of kilns (see Table 3.16) with temperatures above 800 degrees Celsius and operating between 45 to 60 hours continuously. The dryers can be heated by the excess heat from the kiln or some cases by fuel oil burners.

Figure 3:3: **Schematic view of preparation of extruded bricks in masonry brick manufacture**



Source: EC, 2007

Overall, the ceramic industry is relatively energy intensive due to the firing process and the share of energy/fuel costs can vary from 15% to 40% depending on the raw material, manufacturing process and product type and firing techniques applied. The energy source, firing technique and heat recovery method are critical for the design of the kiln and the energy efficiency of the manufacturing process.

In Asia, the typical fossil fuels used in the ceramic sector include LPG, oil, kerosene and coal oil, while the brick industry uses coal, heavy fuel oil, gas, coal and petroleum coke. Biomass can also be used such as rice husk, paddy husks, saw dust and firewood (e.g. Sri Lanka and Vietnam). Electricity is utilized by electric motors for the preparation of raw materials through milling and pressing as well as blowers for the drying and firing process. There is currently limited information on the energy use and technology in the ceramic industry in Myanmar. However, the ADB (2014) has published a report on industrial energy efficiency on the ceramic and brick industry in Bangladesh and highlights the present practice as follows:

- Most factories do not deploy waste heat recovery systems for the furnaces and kilns in the drying process.
- For factories using electric motors, these are typically over-sized and low efficiency and when at the end of their lifetime, the factory owners tend to prefer to have them rewired rather than purchasing new motors.
- No parameters are measured in the drying chamber such as temperature, humidity and duration – based exclusively on experience. Inappropriate drying can cause products to crack or break.

According to an AIT study (2003), in the Philippines, 25% of the heat supplied to the kiln is used in actual production and 75% of heat supplied is lost in the exhaust, due to improper combustion, radiation, and convection losses in kiln walls.

Table 3.16 provides specific energy consumption of different brick making technologies in Asia, showing that the tunnel kiln is generally the most efficient process. A continuous tunnel kiln running on oil or gas will have efficiencies ranging from 45 to 76%. A Vertical Shaft Brick Kiln can provide equivalent or higher efficiencies than tunnel kilns. In China, in 2000, 85% of the brick manufacturers were still using annular kilns which are less efficient than tunnel kilns. The specific energy consumption for ceramic industry depends very much on the energy source, firing technique and heat recovery method and therefore can vary significantly. For example, in the Philippines, from 1996 to 1999, the specific energy consumption for typical ceramic factories ranged from 5.3 to 147.2 MJ/kg of product if using LPG and 0.22 to 1.35 MJ/kg of product if using electricity. The LPG related values are particularly high as the factories considered had inefficient fuel combustion, defective insulation and low firing capacity. Table 3.17 shows the specific energy consumption for ceramic industry in Thailand.

Table 3:16: **Specific Energy Consumption for Brick Making Processes in Asia**

Country	Technology	Specific Energy Consumption (MJ/kg of product)
China	Intermittent kiln	2.47
	Natural drying and annular kiln	1.16 – 1.46
	Artificial drying and annular kiln	1.39 – 1.56
	Tunnel kiln	1.29 – 1.52
India	Intermediate kiln	3.0 – 11.0
	Scotch kiln	1.5 – 7.0
	Bull's Trench kiln	1.8 – 4.2
	Hoffmann kiln	1.5 – 4.3
	Tunnel kiln	**1.5 – 2.0**
Thailand	**Tunnel kiln**	0.94
Vietnam	Vertical kiln	6.15 – 9.23
	Beastly kiln	4.11 – 6.37
	Annular kiln	2.19 – 3.08
	Tunnel kiln	2.42

Source: AIT, 2003

Table 3:17: **Specific Energy Consumption for Ceramic Industry in Thailand (DEDE, 2008)**

Types	Specific Energy Consumption (SEC) Benchmark		
	SEC Electricity (kWh/ton)	SEC Thermal (GJ/ton)	Total Energy consumption (GJ/ton)
Tableware, Fine and Bone	1336.59	28.11	38.8
Tableware, Hotelware	755.63	25.1	31.15
Tableware, Earthware	443.17	18.8	22.35
Sanitary ware	516	9.1	13.23
Quarry Tile	138.8	4.63	5.74
Tile	118.3	3.13	4.08
Porcelain insulator	705	17.5	23.14

Source: DEDE, 2008

The information mentioned above for neighbouring countries probably provides a glimpse of the Ceramic and Brick Industry in Myanmar. Comparatively, in Europe, Specific Energy Consumption for the Ceramic Industry, including Brick Industry, from 1980 to 2003 is provided in the Table 3.18. The specific energy consumption for drying and firing for facing bricks is about 1.6 – 3.0 MJ per kg for tunnel kilns and is similar to that of the Asian countries.

Table 3:18: **Specific Energy Consumption for Ceramic Industry in Europe from 1980 to 2003 in GJ/t**

Sector	1980	1985	1990	1995	2000	2003
Brick and roof Tiles	2.65	2.45	2.19	2.06	2.38	2.31
Wall and floor Tiles	11.78	9.16	6.76	5.45	5.74	5.60
Refractory products	4.88	4.96	6.51	4.91	5.41	5.57
Sanitary ware	26.56	24.21	22.27	22.76	20.88	21.87
Vitrified clay pipes	-	-	5.75	5.77	6.10	5.23
Table and ornamental ware	-	-	47.56	38.91	43.46	45.18
Technical ceramics	-	-	-	-	34.72	50.39

Source: EC, 2007

3.2.7.2 EE Technology/Practices/Measures and Potential Energy Savings

To reduce energy consumption in the ceramic and brick industry, the standard best available techniques include (EC, 2007):

- Improved design of kilns and dryers
- Recovery of excess heat from kilns, especially from their cooling zone
- Applying a fuel switch in the kiln firing process (substitution of heavy fuel oil and solid fuels by low emission fuels)
- Modification of ceramic bodies
- Cogeneration

To complement the above, and based on DEDE (2008), the following potential savings could be achieved in the Ceramic Industry in Thailand:

- High Investment
    - Gas-Assisted Microwave Firing System: a modern kiln that can deliver up to 39-44% savings against standard technology. This system adjusts the suitable microwave frequency for sanitary ware but is considered a high investment.
- Low Investment:
    - A waste heat recovery system could deliver about 11% energy savings (based on actual audit). It is considered low investment.
    - Reduction of compressed air leakage could deliver 8-10% energy savings.

Majority of the ceramic and brick manufacturers in Europe use hot air recovered from the cooling zones of tunnel kilns and usual supplement these with hot air from a gas burner which can provide significant energy savings. The only additional costs would refer to pipe insulation. According to the ADB study in Bangladesh (2014), the potential savings applicable to the ceramic and brick industry could include:

- 10 - 15% savings using waste heat from exhaust flue gas for the dyers and
- 5 - 10% by replacing existing motors with high efficiency motors.
- 3 – 7% through jacket cooling of gas engine exhaust.

According to the ADB study, the international best practice for ceramics industry is 0.6 toe/ton (25 GJ/ton) and in Bangladesh the value is at 1.23 toe/ton (51.5 GJ/ton) indicating there could be a potential saving of approximately 50% by applying a series of best practices. This value is not comparable with the Specific Energy Consumption figures from the AIT and the European Commission probably due to different definitions of end-product. For example, the IEA (2007) states that the specific energy consumption for the brick industry in China is 0.628 t standards coal per 10,000 bricks (0.78 GJ/ton). However, the European Commission's Specific Energy Consumption figures can be compared with the AIT figures and roughly highlights the potential savings that could be made by applying best practices and technologies in the Ceramic and Brick Industry.

It is important to note that higher savings could be obtained through cogeneration, using diesel engines or gas turbines, which would provide simultaneous electricity and heat to the process. The excess heat could be used for the production of hot air for the drying process and mixed with the kiln excess heat.

Alternatively, changing from heavy fuel oil to gaseous fuels can also lead to an improvement in the firing efficiency and the modification of ceramic body composition could reduce the necessary drying and firing period and therefore reducing the energy use.

3.2.8 Thermal Power Plants

3.2.8.1 Status of Thermal Power Plants

Thermal power plants only accounted for 8% of total installed capacity in Myanmar in 2010-2011. There are both coal and thermal power plants and these typically perform below standard efficiencies as a result of poor maintenance. The age of existing thermal power plants ranges from 40 years (1974) to 10 years (2005). The average capacity factor of these thermal power plants is 70% and they are supplying base load and running continuously (Table 3.19). In addition, the natural gas power plants have a lower generation output than excepted due to the calorific value of Myanmar's gas and low pressure without gas compression. The typical technologies utilized for these thermal

power plants include Gas Engines, Gas Turbines, Steam Turbines and Combined-Cycle Gas Turbines. Majority of the thermal power plants in Myanmar are Gas Turbines.

Table 3:19: Installed and Available Electricity Generation Capacity in Myanmar (2012)

Power Plant	Installed Capacity		Firm Capacity		Annual Production	
	MW	%	MW	%	GWh	%
Hydro	2,660	76	1,504	77	13,268	75
Coal-Fired	120	3	27	1	600	3
Gas Turbine	715	21	427	22	3,946	22
TOTAL	3,495	100	1,958	100	17,814	100

Source: Ministry of Electric Power

3.2.8.2 EE Technology/Practices/Measures and Potential Energy Savings

For Myanmar, the upgrade and rehabilitation of existing thermal power plants should be one of the main priorities to enhance the overall efficiency. According to ADB (2013), the rehabilitation and upgrading of 1 coal and 10 gas-fired power plants is necessary and the available capacity of both gas and coal power plants are low due to poor maintenance. For example, the 120 MW (2x60 MW) coal power plant in Tigyit has an average capacity factor of 31% when it should actually be 75%-80% for a standard energy efficient coal power plant. This example clearly highlights the potential savings from enhancing the existing power plants.

Combined Cycle Power Plants apply the best commercially available technologies which comprises of two thermodynamic cycles, with the gas turbine burning natural or synthetic gas from coal/oil, and its hot exhaust gas powering a steam power plant. The latest combined cycle technology allows for net efficiencies of 52% to 60% (lower heating value) and has been achieved in existing power plants in Germany and South Korea. Comparatively single cycle gas power plants have efficiencies around 35 to 42% (WEC, 2013). These enhancements in efficiencies are due to significant improvements in the turbine technology. In some cases, the Combined Cycle Power Plants can be applied as Combined Heat Power Plants to enable the use of excess heat for neighbouring industries and providing additional energy savings.

Table 3.20 and 3.21 highlight the thermal and electrical efficiencies for current and new power plants under different combustion technologies and fuel source. Comparing thermal and electrical efficiencies of existing power plants in Myanmar with the tables below will enable to determine the potential energy savings. As there is limited information on the current net thermal efficiencies, it was assumed these are around 36% and therefore gains of at least 10% net thermal efficiencies should be achievable with technology upgrades. In terms of electrical efficiency, gains in efficiency of at least 5% should be achievable in Myanmar. Overall, efficiency gains could amount to 15% which is significant for a thermal power plant.

Table 3:20: Levels of thermal efficiency achievable for coal and lignite fired combustion plants

Fuel	**Combined Technology**	**Unit Thermal Efficiency net (%)**	
		New Plants	Existing Plants
Coal and Lignite	Cogeneration (CHP)	75 - 90	75 – 90
Coal	Pulverised Combustion (dry bottom boiler and wet bottom boiler)	43 – 47	The achievable improvement of thermal efficiency depends on the specific plant but as an
	Fluidised Bed combustion	>41	
	Pressurized Fluidised Bed	>42	

Fuel	Combined Technology	Unit Thermal Efficiency net (%)	
		New Plants	Existing Plants
Lignite	Combustion		indication, a level of 36% – 40% or an incremental improvement of more than 3% points can be seen as associated with the use of Best Available Techniques for existing plants
	Pulverised Combustion (dry bottom boiler)	42 – 45	
	Fluidised Bed combustion	>40	
	Pressurized Fluidised Bed Combustion	>42	

Source: EC, 2006

Table 3:21: Efficiency of gas-fired combustion plants associated with Best Available Technologies

Fuel	Electrical Efficiency (%)		Fuel Utilisation
	New Plants	Existing plants	New and Existing Plants
Gas Turbine	36 - 40	32 – 35	-
Gas Engine	38 – 45	-	-
Gas Engine with Heat Recovery Steam Generator (HRSG) in CHP Mode	>38	>35	75 – 85
Gas-fired boiler	40 - 42	38 – 40	-
Combined cycle with or without supplementary firing (HRSG) for electricity generation only	54 - 58	50 – 54	-
Combined cycle without supplementary firing (HRSG) in CHP mode	<38	<35	75 – 85
Combined cycle with supplementary firing in CHP Mode	<40	<35	75 – 85

Source: EC, 2006

It is important to note that high efficiency power plants will have high capital costs and that the highest efficiencies are only achieved with extremely high steam parameters used in base load plants (which is the case with the current thermal power plants in Myanmar). Peak-load plants with frequent start-up cycles have to be designed with lower steam parameters resulting in lower efficiencies. In addition, the above efficiencies depend on operational load, quality of the fuel, cooling system of the power plant, its geographical location and energy consumption of the flue-gas cleaning system. There is limited information available on the technologies and efficiency of existing thermal power plants in Myanmar to enable a more detailed determination of the potential energy savings.

In addition to the technological improvements mentioned above, there are also several techniques to increase the efficiency of existing power plants (EC, 2006):

- Combustion: minimising the heat loss due to unburned gases and elements in solid wastes and residues from combustion
- The highest possible pressure and temperature of medium pressure steam. Repeated super heating of the steam to increase net electrical efficiency

- The highest possible pressure drop in the low pressure end of the steam turbine through the lowest possible temperature of the cooling water (fresh water cooling)
- Minimising the heat loss through the flue gas (utilisation of residual heat)
- Minimising the heat loss through the slag
- Minimising the heat loss through conduction and radiation with isolation
- Minimising the internal energy consumption by taking appropriate measures, e.g. scorification of the evaporator, greater efficiency of the feed-water pump
- Preheating the boiler feed-water with steam

3.2.9 Summary of Potential Energy Savings in Industrial Sector

The Table 3.22 below provides a summary of the potential energy savings according to industrial sector. The highest average energy savings, percentage-wise, are estimated for the Iron & Steel Industry, Pulp & Paper and Sugar Mills due to their high electrical and thermal demands. The Ceramic and Cement Industry share similar best practices and therefore the potential percentage energy savings are equivalent. Although the percentage energy saving potential for the thermal power plants is relatively low compared to other industries, the actual generation saving (GWh) would be extremely significant (probably higher than all the savings combined for the industrial sector) as thermal power plants in Myanmar operate as base load. For example, thermal power plants in Myanmar generated 640 GWh of electricity in 2010/2011 and therefore a 4% improvement in energy efficiency of the thermal power plant would enable it use fuel more efficiently and avoid a generation loss of 25.6 GWh per year (ignoring capacity factors, operation hours, T&D losses).

It is important to note that these values are indicative and based on potential energy savings in the industrial sector of other neighboring Asian countries (particularly Thailand and Bangladesh) and international best practice (mainly from Europe). In addition, the table only includes the major industrial sectors in Myanmar and does not take into consideration investment costs required to apply these best practices. Detailed surveys and investment grade energy audits of the industrial sector in Myanmar are required to determine more accurately the potential energy savings and help establish energy efficiency targets for the sector.

Table 3:22: Potential Energy Savings according to Industrial Sector

Sub-Sector	Saving Potential (%)			EE Technologies Proposed
	Min	Max	Average	
Iron and Steel	5	65	45	Cogeneration, EE Boiler, Waste Heat Recovery, EE Furnace, High Efficiency Motors
Cement	3	43	23	High Efficiency Motors, EE Kilns, Cogeneration, Waste Heat Recovery, Variable Speed Drives
Pulp and Paper	50	80	65	Cogeneration, EE Boiler, Waste Heat Recovery, EE Furnace, High Efficiency Motors
Textile	5	20	12.5	High Efficiency Motors, EE Boilers, EE Lighting, EE Air Conditioners
Thermal Power Plants	3	5	4	High Efficiency Motors, Cogeneration, Combined Cycle Gas Turbines
Sugar Mills	25	45	35	Boilers, Waste Heat Recovery, Cogeneration, High Efficiency Motors
Rice Mills	-	35	-	Cogeneration, EE Boilers
Ceramic and Brick	15	25	20	Cogeneration, Waste Heat Recovery, EE Kilns, High Efficiency Motors

3.3 Commercial Sector Assessment

Initial observations in the commercial sector (office buildings, hotels etc) show a high usage of inefficient fluorescent lighting and electric hot water systems. Case studies from countries in the region show that significant savings could be achieved through the use of high efficiency fluorescent lighting and solar hot water (SHW) systems.

The use of solar water heating (SWH) in hotels and restaurants are extremely rare with electric hot water systems being the norm. The estimated EE potential in this sector is based on numerous case studies in the region, especially in Thailand, Philippines, India and Sri Lanka. Table 3.23 provides a summary of energy saving potential in the commercial sector covering office buildings (AC and non-AC) and hotels/restaurants.

Table 3:23: Potential Energy Savings in the Commercial Sector

Sub-Sector	End-Use	% End Use Consumption	Saving Potential (%)	Weighted Overall Saving Potential (%)	EE Technologies
Office Buildings (AC)	Lighting	20	25	5.00	CFLs, T5, LED
	AC	50	25	12.50	Inverter Type AC
	Refrigeration	15	30	4.50	High Star Rating
	Other	15	20	3.00	High Star rated appliances
	Overall Savings (%)			25.00	
Office Buildings (non AC)	Lighting	40	25	10.00	CFLs, T5
	Fans	15	25	3.75	HE Fans
	Refrigeration	20	30	6.00	High Star Rating
	Other	25	20	5.00	High Star rated appliances
	Overall Savings (%)			24.75	
Hotels / Restaurants	Lighting	20	25	5.00	CFLs, T5
	AC	40	20	8.00	Inverter Type AC
	Hot Water	10	70	7.00	SWH
	Refrigeration	15	30	4.50	High Star Rating
	Other	15	10	1.50	High Star rated appliances
	Overall Savings (%)			26.00	

3.4 Residential Sector Assessment

The residential sector assessment includes two sub-sectors, namely, urban and rural households based on electrical end-use technologies used.

The current market penetration of EE products and appliances (lighting, air conditioning, refrigerators and other home appliances) is very low. There is potential for significant energy savings through the introduction of Minimum Energy Performance Standards (MEPS) and Energy Labelling schemes similar to most countries in the region (Thailand, Malaysia, India, Philippines, Vietnam and Sri Lanka).

The Table 3.24 provides a summary of the energy saving potential in electrified households.

Table 3:24: Potential Energy Savings in the Electrified Residential Sector

Sub-Sector	End-Use	% End Use Consumption	Saving Potential (%)	Weighted Overall Saving Potential (%)	EE Technologies
Urban Households	Lighting	20	25	5.00	CFLs, T5, LED
	AC / Fans	50	25	12.50	Inverter Type AC and EE Fans
	Refrigeration	15	30	4.50	High Star Rating
	Other	15	20	3.00	High Star rated appliances
	Overall Savings (%)			25.00	
Rural Households	Lighting	40	25	10.00	CFLs, T5
	Fans	15	25	3.75	HE Fans
	Refrigeration	20	30	6.00	High Star Rating
	Other	25	20	5.00	High Star rated appliances
	Overall Savings (%)			24.75	

Biomass (fuelwood) is the primary energy source for cooking and there is potential for market transformation to efficient wood stoves (EFS) by addressing the initial cost barriers. There are several case studies on EFS in Asia and South America. The potential energy savings are from the adoption of Fuel Efficient Stoves (FES) and the use of LPG primarily in the urban sector. Although LPG is not a EE measure but it is a more efficient use of Myanmar's natural resources and also lower GHG emissions than the use of biomass. Methodologies adopted in recent studies in Myanmar have been used for estimating savings. The Table 3.25 provides a summary of surveys conducted in rural households and the potential savings estimated from switching from traditional stoves to FES.

Table 3:25: Estimated Savings from Fuel Efficient Stoves (FES)

Source	*% HH with FES*	*Fuel Savings with FES (%)*	*Savings with FES (Kg/HH/year)*
MercyCorps Study	12 - 50	25-30	1000
UNFCCC Proposal		32	3,470

It is noted that there is a wide variation in estimated fuelwood savings with FES in the various studies and in order to estimate the savings for the EE Policy the lower figure of 900 kg/HH/year is assumed. Based on the information in the Myanmar Energy Policy, the total number of households is 8,905,674 of which 2,556,714 households are electrified. The use of fuelwood for cooking is common even in

electrified households and hence, the potential transformation to FES would include a majority of the electrified households in addition to the non-electrified households.

There is a very low penetration of solar home systems (SHS) and as a result various forms of energy are used for lighting. Lead acid batteries are widely used in rural households which are mostly charged by roadside vendors using a solar panel or generator. Wider use of SHS and micro-hydropower could be considered as a part of the rural electrification program where on-grid connection is unfeasible.

3.5 Public Sector Assessment

The Public Sector primarily includes office buildings, schools, hospitals and public lighting (street lighting) and the EE saving potential is similar to the Commercial sector. The hospitals may have potential for cogeneration applications which will have to be assessed separately. The potential in public lighting mainly involves the use of LED lighting systems or High Pressure Sodium (HPS) lamps in place of existing lamps which is a mixture of Mercury Vapor (MV) Lamps, fluorescent tube lights (FTLs), CFLs etc.

3.6 Barriers to Energy Efficiency Implementation

Some of the main barriers to the adoption of EE&C in Myanmar are summarized below:

Regulatory

- Lack of clear policies and regulation to encourage adoption of EE&C
- Absence of mandatory policies with regard to energy performance of electrical appliances
- Lack of legal and financial infrastructure to support performance contracts between end-users and ESCOs

Financial

- Lack of funding for program implementation
- Lack of financial incentives to encourage private sector investment in EE&C
- High reliance on donor funding for program implementation
- Lack of experience of financial institutions on EE performance contracts

Institutional

- Lack of a dedicated government agency with adequate capacity to coordinate the implementation of EE&C programs.
- Lack or limited availability of good quality data required for energy planning
- Limited resources in responsible government agencies to implement programs
- Lack of coordination amongst multiple agencies responsible for EE and RE policies and implementation
- Limited or no mechanism for monitoring and verification of energy savings

Other

- Lack of technical capacity amongst end-users to initiate EE projects
- Limited ESCO services
- Limited availability of energy efficient technologies

- High penetration of low efficiency electrical appliances

3.7 Energy Saving Targets

This sections detail the approach adopted in calculating the energy savings targets to be included in the EE Policy.

3.7.1 Data Limitations

The primary energy consumption data in Table 2.1 provides the energy sources (crude oil, natural gas etc) but the end-use information is not available. It is also understood that the estimation of biomass consumption use rural fuelwood survey information conducted in the 1990s and number of rural households from information provided by the Ministry of Immigration and Manpower. There is no information on biomass consumption in the industrial sector. In addition, the primary energy includes transport sector which was not considered in determining EE options.

The information provided by MOEP on annual electricity consumption is at the sectoral level (Industrial, Commercial, Residential and Other). Data was collected at the sub-sector level in the Industrial category; however, it was difficult to reconcile this data with the overall sectoral consumption. There is no sub-sectoral (office buildings, hotels etc) information available for the commercial sector.

In the Residential sector there have been several studies conducted by various agencies (e.g. MercyCorps) in electrified and non-electrified households with limited scope and this information has been used for the estimation for the total population.

Considering the above, the establishment of an energy-use database has been proposed as a priority activity to be undertaken in Year 1 of the Road Map.

3.7.2 Approach

The estimation of energy saving potential is focused on two areas:

3. Electricity consumption in all sectors, and
4. Biomass consumption in the residential sector.

3.7.2.1 Electricity Savings

With the current rural electrification program it is estimated that the electricity consumption will increase by three-fold by 2020, six-fold by 2025 and by ten-fold in 2030 compared to the current consumption (Table 2.5). Technology assessments of the key industrial sub-sectors were undertaken using case studies in the region and the results are summarized in Section 3.2**.** These results were used in estimating the saving potential in the industrial sector (Table 3.22) .

The energy savings in the Commercial, Residential and Public sectors was determined from several case studies from recent projects in the region (Thailand, India, Vietnam, Sri Lanka and Philippines) including several funded by the ADB (TA 7194-THA, TA 7024-VIE, TA-7778- SRI, Loan 2507-PHI). Details of the EE potential in these sectors are given in Sections 3.3 to 3.4.

3.7.3 Energy (Electricity) Saving Potential by Sector

Sector	Sub-Sector	Saving Potential (%)			EE Technologies Proposed
		Min	Max	Average	
Industry	Iron and Steel	5	65	45	Cogeneration, EE Boiler, Waste Heat Recovery, EE Furnace, High Efficiency Motors
	Cement	3	43	23	High Efficiency Motors, EE Kilns, Cogeneration, Waste Heat Recovery, Variable Speed Drives
	Pulp and Paper	50	80	65	Cogeneration, EE Boiler, Waste Heat Recovery, EE Furnace, High Efficiency Motors
	Textile	5	20	12.5	High Efficiency Motors, EE Boilers, EE Lighting, EE Air Conditioners
	Thermal Power Plants	3	5	4	High Efficiency Motors, Cogeneration, Combined Cycle Gas Turbine
	Sugar Mills	25	45	35	Boilers, Waste Heat Recovery, Cogeneration, High Efficiency Motors
	Rice Mills		35		Cogeneration, EE Boilers
	Ceramic and Brick	15	25	20	Cogeneration, Waste Heat Recovery, EE Kilns, High Efficiency Motors
	Industrial Sector: Average Saving Potential (%)			**20%**	
Commercial	Office Buildings	20	30	25	HE Lighting, ACs, Office Equipment through MEPS
	Restaurants	20	35	25	HE Lighting, ACs, LPG cooking, Solar water heating
	Hotels	20	35	30	HE Lighting, ACs, LPG cooking, solar water heating
	Commercial Sector: Average Saving Potential (%)			**25%**	
Residential	Urban Households	25	40	30	HE Lighting, refrigeration, MEPS for appliances, SHW, LPG cooking
	Rural Households	25	40	30	HE Lighting, refrigeration, MEPS for appliances
	Residential Sector: Average Saving Potential (%)			**30%**	
Public Sector	Public Buildings	20	30	25	HE Lighting, ACs, Office Equipment through MEPS
	Hospitals	20	35	30	HE Lighting, ACs, LPG cooking, SWH, cogeneration
	Schools	20	30	25	HE Lighting, ACs, Office Equipment through MEPS, Boilers, SWH
	Public Lighting	35	65	50	LED, HPS street lighting
	Public Sector: Average Saving Potential (%)			**25%**	

3.7.4 Potential Biomass Savings

Assumptions

Parameter	Value	Unit
Biomass Savings per HH/yr	900	kg
Conversion factor	0.35	toe/mT
Population	8,905,694	#
Electrified HH	2,556,714	#
Non-electrified HH	6,348,980	#
Electrified HH with FES	30%	
Total FES Potential	7,115,994	#
Achievable Potential for FES	30%	
Target for FES	2,134,798	#
Period	15	years
Target per year	142,320	#
Biomass Savings /yr	128,088	mT

Biomass Savings

	2016	2017	2018	2019	2020	2025	2030
Total Conversions to FES (cumulative)	142,320	284,640	426,960	569,280	711,599	1,423,199	2,134,798
Biomass Savings (mT)	128,088	256,176	384,264	512,352	640,439	1,280,879	1,921,318
ktoe	44.83	89.66	134.49	179.32	224.15	448.31	672.46
% Reduction from 2012 (Baseline)					**2.3**	**5**	**7**

3.7.5 Calculation of EE Policy Target

3.7.5.1 Overall Energy (Electricity) Saving Potential (%)

Sector	2012 Energy Consumption (GWh)	End-Use Consumption (%)	Average Energy Saving Potential (%)	Weighted Average Saving Potential (%)
Industry	3,650	44%	20%	8.84%
Commercial / Public	1,643	20%	25%	4.97%
Residential	2,681	32%	30%	9.70%
Other	281	3%	50%	1.7%
Total	**8,254**			**25.26%**

3.7.5.2 Achievable Energy Saving Potential 2020 – 2030 (%)

Sector	Weighted Average Saving Potential (%)	Achievable Target by 2020 (%)	EE Policy Target – 2020 (%)	Achievable Target by 2025 (%)	EE Policy Target – 2025 (%)	Achievable Target by 2030 (%)	EE Policy Target – 2030 (%)
Industry	8.84%	40	3.54	60	5.31	75	6.63
Commercial / Public	4.97%	40	1.99	60	2.98	80	3.98
Residential	9.70%	55	5.36	70	6.82	80	7.80
Other	1.7%	40	0.68	60	1.02	80	1.36
Total	**25.26%**		**11.7**		**16.1**		**19.77**
EE Policy Targets			**12**		**16**		**20**

Note: The above targets are based on the assumption that adequate resources are available for the implementation of the programs outlined in the Roadmap. In addition, significant investment is required in the Industrial sector for upgrading process equipment. Considering that the availability of resources are not clear at this stage, it is proposed that the achievable targets are halved in the interim and re-evaluated after 2 years.

3.7.5.3 Achievable Energy Saving Potential 2020 – 2030 (GWh)

Sector	2020	2025	2030
Industry	129.13	193.69	242.11
Commercial / Public	32.66	49.00	65.33
Residential	143.69	182.87	209.00
Other	1.91	2.87	3.83
Total (GWh)	**307.39**	**428.43**	**520.26**

4 PROPOSED ENERGY EFFICIENCY POLICY

4.1 Current Energy Efficiency Related Policies

4.1.1 National Energy Policy

The draft national Energy Policy (2014) details the key objectives which are summarized below:

1. **Energy Security:** The main objective of the Myanmar Energy Sector Policy is to ensure energy security for the sustainable economic development in the country; and to provide affordable and reliable energy supply to all categories of consumers, especially to those living in the remote areas that are currently without electricity. The policy aims to achieve the Government's overarching objective of poverty reduction and improvement in the quality of life of its people. The policy also aims to increase foreign exchange earnings through energy exports after meeting the national demand.
2. **Expansion of Renewable Energy Infrastructure:** The Energy Sector Policy incorporates a framework to expand the renewable energy infrastructure that is based on fuel that is free and self-renewing: the sun, the wind, biomass, hydro, and geothermal, and gradually reduce the energy infrastructure that depends on fuel that continuously rises in price, is dirty, dangerous, causes global warming, and destroys the habitat of this planet. The government will encourage deploying green technologies in a range of sectors including energy and enact policies for clean energy development for low carbon economy.
3. **Community Based Renewable Energy Development:** The Energy Sector Policy places special emphasis on community – based renewable energy development projects in the remote areas of the country to help expand the rural development program, and to provide livelihood opportunities to the rural poor. Provision of community-level energy infrastructure development activities, with special provisions for women participation, is also intended to help improve children education, health, clean water supply, and reduce exposure to indoor air pollution, as well as overall rural environmental improvement.
4. **International Environmental Obligations:** Myanmar has made international commitments under the United Nations Framework Convention on Climate Change (UNFCCC) and the related Kyoto Protocol, which Myanmar ratified in 2003. The Government is fully aware that without adequate environmental and social safeguards, climate change mitigation and adaption policies, and energy efficiency regulations, Myanmar's energy and electric power sectors will continue to be vulnerable to environmental challenges.
5. **Integration of Social and Environmental considerations in Energy Planning:** The Energy Sector Policy aims to integrate the social and environmental considerations in the national energy planning and in the complete cycle of energy development.

4.1.1.1 National Energy Sector Policies

Based on the above objectives, the following nine (9) National Energy Sector Policies have been included:

1. To implement short term and long term comprehensive energy development plan based on systematically investigated data on the potential energy resources which are feasible and can be practically exploited, considering minimum impact on natural environment and social environment
2. To institute laws, rules and regulations in order to promote private sector participation and to privatize (100% FDI, Joint FDI, International IPP, local IPP/SPP/VSPP) State Energy Organizations in line with State Economic Reform Policy

3. To compile systematic statistics on domestic demand and supply of various different kinds of energy resources of Myanmar

4. To implement programs by which local population could proportionally enjoy the benefit of energy reserve discovered in the areas

5. To implement programs on a wider scale, utilizing renewable energy resources such as wind, solar, hydro, geothermal and bio-energy for the sustainable energy development in Myanmar

6. To promote Energy Efficiency and Energy Conservation

7. To establish R,D,D&D (Research, Development, Design, and Dissemination) Institution in order to keep abreast with international practices in energy resources exploration and development works and to produce international quality products in order to manufacture quality products and in order to conduct energy resources exploration works in accordance with international standard

8. To promote international collaboration in energy matters

9. To formulate appropriate policy for energy product pricing meeting economic security of energy producers and energy consumers

In relation to **Energy Efficiency and Energy Conservation (Policy No: 6)**, the objective and work plan proposed include the following:

(a) Objective

To implement on a priority basis the energy efficiency and conservation program in accordance with ASEAN targets

(b) Work Program

(i) Institute relevant laws, rules, and regulations (legal framework) required for implementation of energy efficiency and conservation program

(ii) Institute a dedicated department responsible for implementation of energy efficiency and conservation programs

(iii) Capacity building programs and awareness raising campaign are to be conducted to promote energy efficiency and conservation work

4.1.2 Other Related Policies

In terms of energy policy framework there are five main regulations: Electricity Act 1948 (amended in 1967); Myanmar Electricity Law (1984) (Amended in 2014); Electricity Rules (1985); The Petroleum Act (1934) and Petroleum Rules 1937 (amended in 1946); and the Mining Law (1994). All these are relatively out dated in terms of inclusion of energy efficiency regulations and there is no proper roadmap for energy efficiency. Major revisions to the Mining Law are planned to meet international standards while giving more opportunities for Myanmar companies to be engaged in the sector.

An Environmental Protection Law has just been promulgated. Under the law, a new Environmental Conservation Department is proposed, which will be responsible for environmental and social safeguards requirements. The law was promulgated in March 2012, but the regulations have not yet been approved. When approved an Environmental Impact Assessment Rule will be mandatory, requiring environmental and social impact reports for all major projects.

The development of Myanmar's climate change policy is under the responsibility of the National Environmental Conservation Department established in September 2013. Although Myanmar still lacks a national strategy and action plan for mitigating and adapting to climate change, several ministries are implementing sector-specific initiatives relevant to climate change.

4.2 Proposed Work Program for EE&C under the Energy Policy

4.2.1 Required Legal and Regulatory Frameworks to Support EE&C

The following legal and regulatory frameworks to support development and implementation of national EE policies should be considered by the Government of Myanmar:

1. Legal authority for the National Standards Body in MOI to promulgate compulsory standards and coordinate with other relevant agencies to enforce and integrate those compulsory standards into ministerial regulations issued by other Ministries.

2. Legal authority for the MOI to impose requirements for compilation and reporting of energy consumption by large energy consumers. Other requirements to be considered include appointment of a trained energy manager for a large facility, to monitor and report energy use within the facility, and to submit energy efficiency improvement plans.

3. Legal authority for the MOI to enforce Minimum Energy Performance Standards (MEPS) for selected electrical appliances and Energy Efficient Building Codes.

4.2.2 Dedicated Department of EE&C Implementation

The National Energy Policy has proposed the establishment of a new Directorate for Energy Efficiency Improvement and Conservation Program. The rationale is to ensure the highest level of focus on demand side activity and an entity that has the authority to plan and monitor implementation. In response, an Energy Efficiency & Conservation Division (EECD) was set up under the Directorate of Industry effective from 1 April 2014.

4.2.3 Capacity Building and Awareness Programs

The EE&C Policy would include a capacity building and awareness program covering all agencies and energy end-users.

4.3 Vision Statement

The National Energy Policy aims to *"systematically explore the available indigenous energy resources in order to supply the domestic demand and export as value added products for surplus resources with the ultimate aim of sustainably improving the living standards of people in the country"*. By means of this policy the Government of Myanmar (GoM) is aiming to:

- Ensure **energy security** for the sustainable economic development in the country;
- Provide **affordable and reliable energy supply** to all categories of customers, especially those living in remote areas that are currently without electricity;
- Achieve the government's overarching objective of **poverty reduction** and improve the quality of life of its people;
- **Increase foreign exchange earnings** through energy exports after meeting the national demand.

These visions can only be achieved through efficient and sustainable use of the available energy resources. EE&C will play a critical role in addressing energy security, environmental and economic challenges facing Myanmar. The current electrification rate is around 27% and plans are in place for an ambitious electrification plan with a target of 45% by 2020 and 80% by 2030. Hence, controlling

the national demand for energy resources in order to increase foreign exchange earnings through exports is one of the key challenges that could be addressed through EE&C.

According to available data, Biomass (firewood/charcoal) accounted for 65% of the total energy consumption in 2012 which is primarily consumed by the rural sector (around 70% of the population). Hence, the adoption of efficient technologies especially in cooking would make a significant contribution towards providing affordable and reliable energy supply to those living in rural areas and thus improving quality of life.

Currently, there is a shortfall in electricity generation during the dry season of around 500 MW resulting in load shedding, Hence, the adoption of demand side management (DSM) strategies and programs in all customer sectors would go a long way of addressing this shortfall and ensure reliable supply throughout the year.

The current market penetration of EE products and appliances (lighting, air conditioning, refrigerators and other home appliances) is very low. There is potential for significant energy savings through the introduction of Minimum Energy Performance Standards (MEPS) and Energy Labelling schemes similar to most countries in the region (Thailand, Malaysia, India, Philippines, Vietnam and Sri Lanka).

Biomass (fuelwood) is the primary energy source for cooking and there is potential for market transformation to fuel efficient stoves (FES) by addressing the initial cost barriers. There are several case studies on FES in Asia and South America. In addition, the options for fuel switching from fuelwood to LPG for cooking could also be considered. Although LPG is not a EE measure but it is a more efficient use of Myanmar's natural resources and also lower GHG emissions than the use of biomass.

There is a very low penetration of solar home systems (SHS) and as a result various forms of energy are used for lighting. Lead acid batteries are widely used in rural households which are mostly charged by roadside vendors using a solar panel or generator. Wider use of SHS and micro-hydropower could be considered as a part of the rural electrification program where on-grid connection is unfeasible.

Initial observations in the commercial sector (office buildings, hotels etc) show a high usage of inefficient fluorescent lighting and electric hot water systems. Case studies from countries in the region show that significant savings could be achieved through the use of high efficiency fluorescent lighting and solar hot water (SHW) systems.

The potential for energy saving in the industrial sector can only be determined once information of current industrial processes are available. Recent energy audits conducted in the Steel, Cement, Brick and Ceramic sectors in Vietnam have identified several EE process technologies that could be applicable in Myanmar.

4.3.1 Core Values of Energy Efficiency

Energy Efficiency can contribute to the sustainable economic and social development in Myanmar; and also, meeting its international environmental obligations. These include:

- The **economic values** of EE includes increased competitiveness of Myanmar's industrial sector through the adoption of efficient technologies resulting in lower unit costs of production; hence, increase in turnover and lower prices for end-users.

- The **social values** of EE includes improved living standards of consumers through the availability of affordable and reliable energy services following adoption of EE technologies across the whole spectrum of end-uses such as lighting, air conditioning, refrigeration and cooking.

- The **environmental values** include the reduction of greenhouse gas (GHG) emission from power plants, industrial processes and biomass use in residential and industrial sectors. In addition, efficient use of biomass contributes to the preservation of indigenous natural forest resources of Myanmar.

4.4 Goals and Objectives

4.4.1 National Energy Saving Potential

In the Business as Usual (BAU) case, the primary energy demand in Myanmar is projected to increase from 14 Mtoe in 2010 to 30.3 Mtoe in 2035, growing at an annual rate of 3.1%[1]. The corresponding per capita energy demand will increase from 0.29 toe in 2010 to 0.55 toe per person in 2035. In an alternative case (assuming use of advanced technologies by the end-uses, introduction of new and renewable energy (NRE) and nuclear power plants), the primary energy demand is projected to increase at an annual rate of 3.0% through to 2035 and the corresponding primary energy demand will reach 29.2 Mtoe which is 3.8% lower than the BAU case.

The initial target for EE set by MOE was the reduction of 5% of the total energy consumption (2005 level) by 2015 and 8% by 2020. The basis for these targets was in line with those set by ASEAN; and the draft National Energy Policy has not defined any targets for EE. However, the energy policy framework is aimed at the following:

- Maintaining the status of energy independence
- Promotion of wider use of new and renewable sources of energy,
- Promotion of Energy Efficiency & Conservation (EE&C); and
- Promotion of the use of alternate fuels for households

The energy consumption figures for 2012 (Table 2.2) show that biomass (firewood/charcoal) accounted for 65.2% (9,708 ktoe) of the total consumption. The other contributors were petroleum products 13.0% (1,942 ktoe), hydroelectricity 16.4% (2,440 ktoe), natural gas 3.5% (519 ktoe) and coal 1.9% (285 ktoe). It should be noted that the energy consumption figures include transport and the EE options in this sector is not included in the EE Policy. Hence, in determining the EE Policy targets two end-use sectors, namely electricity and biomass, are considered.

Based on the analysis conducted in all sectors, a realistic EE target would be 12% of total energy (electricity) consumption by 2020 with 2012 as the baseline (similar to the baseline used in the Energy Master Plan); and targets of 16% and 20% by 2025 and 2030 respectively.

It should be noted that obtaining baseline energy consumption was a difficult task and the estimation of energy saving potential in some sectors were based on international best practices (particularly in the region); and to enable proper energy planning an Energy Use Database has been included as one of the short-term activities in the roadmap.

Based on an emission factor of 0.256 kg CO_2/kWh the overall reduction of CO2 emissions in 2020 will be 78,690 tons.

4.4.2 Overall Policy Goal for Energy Efficiency

Based on the calculated energy saving potential the National Energy Efficiency Policy objective using 2012 as the baseline is as follows:

[1] ABD: Myanmar Energy Outlook 2013.

- ***Reduce that national electricity demand by 12% in 2020 compared to the baseline demand in 2012***

- ***Reduce the biomass consumption by 2.3% in 2020 compared to the baseline biomass demand in 2012.***

- ***Reduce national CO2 emissions by 78,690 tons in 2020.***

To reach the overall energy efficiency objective, the Alternative Case outlined in the Myanmar Energy Outlook (2013) was adjusted by the results of the assumed energy efficiency in the following sectors identified as priority areas for the national EE policy, strategy and action plan:

- Energy Efficiency in Industry
- Energy Efficiency in Commercial Sector
- Energy Efficiency in Residential Sector (Urban and Rural)
- Energy Efficiency in Public Sector

In determining the priority areas the transport sector has been excluded as it would be the subject of a separate assessment. Considering the high rural electrification targets (45% by 2020 and 80% by 2030) the electricity demand is set to increase from 1,806 MW (2011) to 19,216 MW (2030) and the corresponding generation from 10,444 GWh (2011) to 111,100 (2030). Hence, an effective DSM strategy in the electricity sector including the use of renewable technologies should be considered. It is expected that the high use of biomass (fuelwood/charcoal) is expected to continue in the residential sector. However, conversion of LPG for cooking especially in the urban sector is an option to be considered in an overall EE strategy.

4.5 Strategic Objectives

The strategic objectives for the implementation of the national EE Policy are outlined in the National Energy Efficiency Strategy (Section 5) considering the economic, social and technology rationales and define specific goals for each sector.

4.6 Monitoring and Evaluation

Monitoring and Evaluation (M&E) of the implementation process is critical in determining if the goals set out in the National EE Policy are being achieved. A procedure for M&E is outlined in the National EE Strategy and Roadmap.

5 PROPOSED ENERGY EFFICIENCY ROADMAP

5.1 Background

This EE Roadmap outlines the activities to be undertaken in each of priority sectors in conjunction with the strategic objectives of the national EE policy. These activities compliments the common activities (cross-cutting activities) identified as described in Section 5.4.

The activities in the roadmap need to be prioritized and carried out over an initial timeframe of 5 years. The timeframe could be revised annually based on progress and budget availability.

5.2 Proposed Activities by Sector

The following matrix provides a list of activities that could be undertaken under each strategic objective for the particular sector.

Sector: Industry Sector

Strategic Objectives		Activities	
#	Objective	#	Description
1	Energy Efficient process technologies are adopted in all industry sectors	1	Establishment of energy data collection procedures
		2	Implementation of energy audit program for enterprises
		3	Introduction of good energy management practices in industry
		4	Provide financial incentives for implementation of EE measures
2	The awareness of EE amongst industry owners, managers and engineers is increased	1	Increase awareness of technology best practices in the region
		2	Prepare Energy Efficiency Guidelines for major industries
3	Capacity building in EE&C in the industry sector is strengthened	1	Conduct organized training for technical and managerial staff
		2	Introduce Energy Auditor & Energy Manager certification programs
		3	UNIDO Program – Improvement of Industrial Energy Efficiency
		4	Support the Development of Energy Service Companies (ESCOs)

Sector: Commercial Sector

Strategic Objectives		Activities	
#	Objective	#	Description
1	Energy Efficiency is incorporated in new building design and refurbishment of existing buildings	1	Establishment of an Energy Efficiency Building Code
		2	Capacity building of architects/engineers in EE building design
2	Energy Efficiency technologies are implemented in the Commercial sector	1	Prepare Energy Efficiency Guidelines for Commercial Buildings
		2	Training in the conduct of detailed energy audits
		3	Provide financial incentives for implementation of EE measures
		4	Support local manufacture of EE equipment
3	Renewable Energy technologies are promoted in the Commercial sector	1	Promotion of Solar Water Heating systems in hotels and buildings
		2	Promotion of PV systems for supplementing on-grid supply
4	The awareness of EE and capacity building amongst key stakeholders is increased	1	Increase awareness of technology best practices in the region

Sector: Residential Sector

Strategic Objectives		Activities	
#	Objective	#	Description
1	Household energy costs are reduced through energy performance standards for appliances	1	Introduce EE performance standards and labeling for appliances
		2	Testing and certification facilities for appliances
		3	Introduction of incentives for EE equipment
		4	Phasing out of inefficient appliances from the market
		5	Promote efficient biomass cook stoves
2	Increased used of LPG is adopted by urban households	1	Increase consumer awareness of benefits in LPG for cooking
		2	Introduce EE labeling scheme for LPG cook stoves
3	Awareness of EE technologies are increased in the residential sector	1	Conduct of regular EE awareness campaigns in national media
		2	Training programs targeting educational institutions

Sector: Public Sector

Strategic Objectives		Activities	
#	Objective	#	Description
1	Use of EE technologies in public buildings are increased and overall energy costs are reduced	1	Implementation of energy audit program for public buildings
		2	Adoption of standard procurement guidelines for equipment
2	The awareness of EE is increased amongst public sector employees	1	Introduction of a Public Sector Energy Management Program
		2	Prepare Energy Efficiency Guidelines for public buildings
3	Capacity building of maintenance staff in EE&C in increased	1	Conduct organized training for maintenance staff

5.3 Common Activities

The EECD will be responsible for the implementation of several common activities across the identified priority sectors that would ensure a sustainable approach to EE implementation in Myanmar. These activities include the following:

1. Energy data collection and analysis
2. Energy Efficiency awareness and education
3. Monitoring & Evaluation
4. Develop Energy Efficiency standards for Buildings and Appliances
5. Accreditation scheme for Energy Auditors and Energy Managers
6. Regional cooperation and networking
7. Develop Legal and Financial Framework for Energy Efficiency

Action Items	Activity 1: Energy Data Collection and Analysis			
	Industry	Commercial	Residential	Public Sector
Identification of agencies for data collection	MOI, MOE, MOEP, Industry associations	MOEP, sub-sector associations, building managers	MOEP, MOE, MOECAF, Housing Associations	MOE, MOEP
Establish procedures for data collection and templates	Annual energy consumption reports by individual industries	Building managers submit annual reports and verified by MEP	Electricity consumption data from MEP and biomass data from MOECAF.	Annual reports from individual ministries and verified by MEP
Design of energy use database, data entry and analysis	Database managed by EECD	Database managed by EECD	Database managed by EECD	Database managed by EECD
Annual publication of energy consumption	National Energy Balance published by MOE; Also, included in Myanmar Statistical Yearbook	National Energy Balance published by MOE; Also, included in Myanmar Statistical Yearbook	National Energy Balance published by MOE; Also, included in Myanmar Statistical Yearbook	National Energy Balance published by MOE; Also, included in Myanmar Statistical Yearbook

Action Items	Activity 2: Energy Efficiency Awareness and Education			
	Industry	Commercial	Residential	Public Sector
Prepare scope for EE Awareness Program	Target the larger energy intensive industries	Separate programs for each sub-sector: office buildings, hotels, shopping malls, restaurants etc	Separate programs for urban and rural households focusing both on electricity and biomass.	Common program for all public sector employees
Identification of national and regional training programs	Review scope ASEAN training program and identify other training activities			
Preparation of promotional material	Publication of Best Practices for various industry sectors	Publication of EE Guidelines for various sub-sectors	Publication of "Home Energy Guide" for distribution to all households	Publication of EE Guidelines for Public Buildings

Action Items	Activity 3: Monitoring and Evaluation			
	Industry	Commercial	Residential	Public Sector
Establish Monitoring & Evaluation Procedures	Establish baselines and M&E procedures for EE projects.	Establish baselines and M&E procedures for EE projects.	EE programs will be undertaken by a central agency (e.g. YESB, MEME)	Establish baselines and M&E procedures for EE projects.
Coordination of M&E Results	Prepare templates for reporting results	Prepare templates for reporting results	Reports from the implementing agencies	Reports from each ministry
Publication of Results	Results will be presented against the overall EE&C targets established in the EE policy	Results will be presented against the overall EE&C targets established in the EE policy	Results will be presented against the overall EE&C targets established in the EE policy	Results will be presented against the overall EE&C targets established in the EE policy

Action Items	Activity 4: Energy Efficiency Standards for Buildings and Appliances			
	Industry	Commercial	Residential	Public Sector
Review of international Codes and Standards		EEBC in India, Thailand and Vietnam could be relevant	Appliance Standards & Labeling Programs in Thailand, India, Philippines to be reviewed	EEBC in India, Thailand and Vietnam could be relevant
Development of EE Building Codes	Code to cover new and retrofits of existing buildings	Code to cover new and retrofits of existing buildings		Code to cover new and retrofits of existing buildings
Development of EE Appliance Standards and Labelling Scheme	Standards to include HE motors	Standards to include lighting, ACs and other major office appliances	Standards to include lighting, ACs, Fans, refrigerators, freezers, washing machines and LPG cook stoves.	Standards to include lighting, ACs and other major office appliances

Action Items	Activity 5: Accreditation Scheme for Energy Auditors & Energy Managers			
	Industry	Commercial	Residential	Public Sector
Review schemes in the region	Evaluate schemes in India and Sri Lanka	Evaluate schemes in India and Sri Lanka		Evaluate schemes in India and Sri Lanka
Develop accreditation scheme for Energy Auditors	The scope of expertise should cover industrial processes	The scope of expertise should cover commercial offices, hotels and restaurants.		The scope of expertise should cover office buildings, hospitals and educational institutions.
Develop accreditation scheme for Energy Managers	Mandate the appointment of an Energy Manager in each industrial site above a particular energy consumption	Mandate the appointment of an Energy Manager in each building above a particular energy consumption		Mandate the appointment of an Energy Manager in each Ministry

Action Items	Activity 6: Regional Cooperation and Networking			
	Industry	Commercial	Residential	Public Sector
Establish Working Group for coordination	EECD could be the focal point with support from MOE and MOI	EECD could be the focal point with support from MOE, MEP, YESB and MEPE		EECD could be the focal point with support from MOE, MEP, YESB and MEPE
Planning and implementation of national activities	Conduct regular seminars through industry associations	Conduct workshops on energy management practices with support from MES		Conduct workshops for maintenance staff of public buildings
Regional activities and networking	Participate in other donor funded activities – ASEAN	Participate in other donor funded activities – ASEAN	Participate in other donor funded activities – ASEAN	Participate in other donor funded activities – ASEAN

Action Items	Activity 7: Legal and Financial Framework for Energy Efficiency			
	Industry	**Commercial**	**Residential**	**Public Sector**
Energy Conservation Decree	Mandatory Energy Audits and Energy Managers Mandatory reporting of annual Energy Consumption and Energy Savings Plans	Mandatory reporting of annual Energy Consumption and Energy Savings Plans	Enforcement of minimum energy performance standards (MEPS) and Energy Labelling for appliances. Phasing out of inefficient lighting (IBs, FTLs)	Mandatory reporting of annual Energy Consumption and Energy Savings Plans Standard Procurement Guidelines for equipment
Tax Incentives for EE	Tax incentives for investment in EE technologies and processes	Tax incentives for investment in EE technologies and processes	Tax concessions for import of high efficiency appliances	
Other Financial Incentives	Subsidies for purchase of EE technologies or energy audits	Subsidies for purchase of EE technologies or energy audits	Leasing schemes for Solar Home systems and other EE equipment Revolving funds for community based energy projects	

5.4 Capacity Building of EECD

Program	*Establishment and Capacity Building of EECD*
Rationale	*EECD is the core entity responsible for the management of the implementation of the EE Policy and a comprehensive capacity building program needs to be undertaken at the beginning of the program*
Strategy	*Develop and Implement a capacity building program targeting all staff recruited for EECD in all cross cutting activities identified.*
Participation	*All EECD Staff*
Program Description	*The training program will be structured to cover all aspects of the functions of EECD and conducted over a period of 1 year*
Tasks / Activities	*The program will include:* • *Energy surveys and analysis* • *Energy database design and maintenance* • *Energy Auditing* • *Energy Laws and Regulations* • *Development of Energy Standards and Labeling Program for appliances* • *Development of Energy Efficient Building Codes* • *Accreditation schemes for Energy Auditors and Energy Managers* • *Conduct of energy efficiency and awareness programs* • *Results monitoring*
Expected Outputs	*Fully resourced and trained staff at EECD*
Implementing Agency	*MOI*
Other Stakeholders	*NEMC*
Budget Estimate	*Annual Operating Budget: $200,000* *TA for Capacity Building : $450,000*
Implementation Time-frame	*Short Term (Commencing Year 1)*

5.5 Implementation Roadmap

The implementation Road Map outlines the activities to be implemented for each of the sectors specified in the strategic objectives, under the National EE policy. The prioritization of activities will be based on feasibility and impact over an implementation period. There will be several common activities across the sub-sectors especially in the following areas:

- Energy data collection and analysis
- Energy Efficiency awareness and education
- Monitoring & Evaluation
- Develop Energy Efficiency standards for Buildings and Appliances
- Accreditation scheme for Energy Auditors and Energy Managers
- Regional cooperation and networking
- Legal and Financial Framework for Energy Efficiency

The program activities are reported in a standard template as shown in Section 4.5 to 4.7.

The Road Map has been classified based on priorities, impacts and the ease of implementation to meet the overall targets of the National EE Policy. The proposed phases are as follows:

1. YEAR 1 – High Priority Initiatives;
2. YEAR 2 – Short Term EE Initiatives
3. YEAR 3 – Medium Term EE Initiatives ;
4. YEAR 4 – Long Term EE Initiatives ;

Following sub-sections give more detailed information on the different phases and activities of the EE Road Map.

5.6 Proposed Myanmar National EE Roadmap

5.6.1 Year 1 – Establishment of EECD, Capacity Building and MEPS for Appliances

The establishment of an Energy Efficiency & Conservation Division (EECD), as proposed in the National Energy Policy is considered to be the initial step in the EE Road Map. The MOI has already made recommendations to the NEMC for the establishment of this Division within its existing structure. Once established, it is important to prioritize the recruitment of staff (as proposed in Section 3.8.1) and undertake a comprehensive capacity building program in all the cross-cutting activities identified. Guidelines for a capacity building program for EECD are given in Section 3.8.2. The other activity in Year 1 is the development of EE Performance Standards and Labelling for Appliances. The Table 5.6.1 provides a summary of the activities proposed.

Table 5:1: Year 1 Activities in EE Roadmap

Activity No:	Title	Activity Objective / Description	Resources	Time Schedule (Year#)	Activity Duration (months)	Estimated Budget (US$)	Potential Source of Funds
A.1	**EECD Establishment**	Objective: Establishment of EECD with the existing structure of MOI and allocate adequate resources for its operation Description: EECD will be responsible for the coordination of all EE activities under the EE Policy with specific responsibilities for the cross-cutting activities identified. Recruitment shall be in accordance with the existing Public Service procedures. The annual budget includes conduct of awareness and EE promotion activities	**MOI and NEMC**	**1st Year**	**Continuous**	**200,000 per year**	**Internal budget of MOI**
A.2	**Capacity Building**	Objective: Conduct a comprehensive capacity building program for EECD staff and other identified stakeholders. Description: Following the completion of recruitment for EECD a training needs assessment will be undertaken. A training program covering all aspects of the EE Policy implementation will be designed and conducted.	**MES, MOI and International Consultants**	**1st Year**	**12 months**	**450,000**	**External Donor**
C.17	**Residential**	Introduce EE Performance Standards & Labeling for Appliances	**International Experts**	**1st Year**	**24 months**	**$300,000**	**External Donor**

5.6.2 Year 2 - Short Term Activities

The activities highlighted in the section would start in Year 2 and some would continue up to 5 years. It should be noted that the UNIDO Industrial Energy Efficiency Program (B.3) has already been approved and the program will commence is 2015. The Table 5.6.1 provides a summary of the activities proposed.

Table 5:2: Year 2 Activities in EE Roadmap

Activity No:	Sector	Activity Description	Resources	Time Schedule (Year#)	Activity Duration (months)	Estimated Budget (US$)	Potential Source of Funds
B.1	**Industry**	**Establishment of Energy Data Collection Procedures**	**MOI, MOE, MOEP**	Year 2	**6 months**	**200,000**	**Internal / External**
B.2	**Industry**	**Energy Auditor & Energy Manager Certification Program**	**MOI, MES, International Experts**	Year 2	**24 months**	**150,000**	**External**
B.3	**Industry**	**UNIDO – Improvement of Industrial Energy Efficiency**	**UNIDO**	Year 2	**60 months**	**2,830,000**	**GEF Grant**
B.4 (See Note 1	**Residential**	**Increase Awareness of Benefits of LPG Cooking**	**MOI**	Year 2	**24 months**	**50,000**	**Internal / External**
B.5	**Residential**	**Conduct Regular EE Awareness Campaigns in National Media**	**MOI**	Year 2	**24 months**	**50,000**	**Internal / External**
C.1	**Industry**	**Implementation of Energy Audit Program for Enterprises**	**MOI, MES, International Experts**	Year 2	24 months	**500,000**	**External**
C.3	**Industry**	**Develop Financial Incentives for EE Implementation**	**MOI, International Experts**	Year 2	6 months	**150,000**	**External**
C.9	**Commercial**	**Establishment of Energy Efficiency Building Code**	**International Experts**	Year 2	36 months	**500,000**	**External/ Internal**
C.12	**Commercial**	**Training in the Conduct of Detailed Energy Audits**	**MOI, MES, International Experts**	Year 2	24 months	**Included in C.1**	**External**
C.13	**Commercial**	**Develop Financial Incentives for Implementation of EE Measures**	**MOI, International Experts**	Year 2	6 months	**Included in C.3**	**External**
C.19	**Residential**	**Introduction of Incentives for EE Equipment**	**MOI, International Experts**	Year 2	6 months	**Included in C.3**	**External**
C.21	**Residential**	**Promote Efficient Biomass Cook Stoves**	**MOI**	Year 2	24 months	**Included in A.1**	**Internal**

Activity No:	Sector	Activity Description	Resources	Time Schedule (Year#)	Activity Duration (months)	Estimated Budget (US$)	Potential Source of Funds
C.24	**Public**	**Adoption of Standard Procurement Guidelines for Equipment**	**MOI**	Year 2	6 months	**Included in A.1**	**Internal**

Note 1: This program is optional. The use of LGP for cooking is strictly not an EE measure. However, LPG is more efficient than biomass in cooking and hence, it is considered more efficient use of Myanmar's natural resources and also lower overall GHG emissions.

5.6.3 Year 3 – Medium Term Activities

This section outlines the activities that would commence in Year 3 and some would continue till end of the current implementation period (5 years). The Table 5.6.3 provides a summary of the activities proposed.

Table 5:3: Year 3 Activities in EE Roadmap

Activity No:	Sector	Activity Description	Resources	Time Schedule (Year#)	Activity Duration (months)	Estimated Budget (US$)	Potential Source of Funds
C.2	**Industry**	**Introduction of Good Energy Management Practices**	**MOI**	Year 3	24 months	**Included in A.1**	**Internal**
C.4	**Industry**	**Increase Awareness of EE Technology Best Practices**	**MOI**	Year 3	24 months	**Included in A.1**	**Internal**
C.5	**Industry**	**Preparation of EE Guidelines for Major Industries**	**MOI, International Experts**	Year 3	6 months	**150,000**	**External**
C.6	**Industry**	**Conduct Organized Training for Technical and Managerial Staff**	**MOI, International Experts**	Year 3	24 months	**300,000**	**External**
C.14	**Commercial**	**Promote Solar Water Heating Systems in Hotels and Buildings**	**MOI, REAM**	Year 3	36 months	**Included in A.1**	**Internal**
C.15	**Commercial**	**Promote PV systems for Supplementing on-grid supply**	**MOI, REAM**	Year 3	36 months	**Included in A.1**	**Internal**
C.16	**Commercial**	**Increase Awareness of EE Best Practices in the Region**	**MOI**	Year 3	24 months	**Included in A.1**	**Internal**
C.18	**Residential**	**Testing & Certification Facilities for Appliances**	**MOI, International Experts**	Year 3	6 months	**300,000**	**External**
C.22	**Residential**	**Introduce EE Labeling Scheme for LPG Cook Stoves**	**MOI, International Experts**	Year 3	24 months	**Included in C.17**	**External**
C.23	**Public**	**Implementation of Energy Audit Program for Public Buildings**	**MOI, International Experts**	Year 3	24 months	**Included in C.1**	**External**
C.25	**Public**	**Introduction of Public Sector Energy Management Program**	**MOI**	Year 3	24 months	**Included in A.1**	**Internal**
C.26	**Public**	**Prepare EE Guidelines for Public Buildings**	**MOI, International Experts**	Year 3	6 months	**Included in C.5**	**External**

5.6.4 Year 4 - Long Term Activities

This section outlines the activities that would commence in Year 4 and some would continue till end of the current implementation period (5 years). The Table 5.6.4 provides a summary of the activities proposed.

Table 5:4: Year 4 Activities in EE Roadmap

Activity No:	Sector	Activity Description	Resources	Time Schedule (Year#)	Activity Duration (months)	Estimated Budget (US$)	Potential Source of Funds
D.1	**Industry**	**Support the Development of ESCOs**	**MOI, International Experts**	Year 4	24 months	**300,000**	**External**
D.2	**Commercial**	**Capacity Building of Architects /Engineers in EE Building Design**	**MOI, International Experts**	Year 4	24 months	**150,000**	**External**
D.3	**Commercial**	**Preparation of EE Guidelines for Commercial Buildings**	**MOI, International Experts**	Year 4	6 months	**50,000**	**External**
D.4	**Commercial**	**Support Local Manufacture of EE Equipment**	**MOI**	Year 4	24 months	**Included in A.1**	**Internal**
D.5	**Residential**	**Phase Out of Inefficient Appliances from the Market**	**MOI, International Experts**	Year 4	12 months	**Included in A.1**	**Internal**
D.6	**Residential**	**Training Programs Targeting Educational Institutions**	**MOI, International Experts**	Year 4	24 months	**Included in A.1**	**Internal**
D.7	**Public**	**Training Program for Maintenance Staff**	**MOI**	Year 4	24 months	**Included in A.1**	**Internal**

6 IMPLEMENTATION PLAN

The Implementation Plan proposed in this section consolidates the Program Activities outlined in Section 6.10 into main categories and ranked in priority order. The Table 6.1 provides a summary of the key activities to be undertaken and the resources required for implementation.

Table 6:1: Summary of Key Activities and Budget

Activity No:	Description	Scope	Estimated Budget (US$)	
			Internal	Development Partners
1	Establishment and Capacity Building of EECD and stakeholders	Staff Recruitment and capacity building	$200,000/year	$450,000
2	Energy-use Database	Data collection from all sectors, analysis and reporting	$200,000	
3	Regulations	EE&C Building Codes; EE Performance Standards and Labelling for Appliances; Procurement Guidelines for Equipment; Testing & certification facilities for Appliances; Certification of Energy Auditors and Energy Managers; and EE&C Decree	Included in Activity 1	$1,250,000
4	Training and Capacity Building	Energy audit training in all sectors; Energy Management training; Training for Architects, maintenance staff and ESCOs; Training for Educational Institutions	Included in Activity 1	$800,000
5	Awareness Programs	EE Awareness programs in all sectors; Promotion of EE Cook Stoves; EE Guidelines in all sectors; Promotion of SWH and off-grid PV systems	$100,000/year	$150,000
6	Financial Incentives for EE&C	Develop financial incentives for EE&C implementation in all sectors.	Included in Activity 1	$150,000

7 CONCLUSIONS AND RECOMMENDATIONS

This section outlines the key conclusions of the study and recommendations to ensure the current issues are addressed to meet the overall EE Policy objectives.

1. **Existing Energy Data:** The primary energy supply and demand data (Tables 2.1 and 2.2) show that the supply exceeds the demand. In the baseline year (2012) the consumption is 83% of the supply; and hence, the excess supply needs to be accounted. The contribution of biomass to the primary energy consumption is around 65%; however, it is understood that the methodology used for the estimation considers data from a rural fuelwood survey conducted in the 1990's and the number of rural households provided by the Ministry of Immigration and Manpower. Considering the significance of the contribution of biomass in the overall energy consumption it is recommended that the methodology used for its estimation is revised using current data.

2. **Data Requirements for EE Planning:** Data collection activities were undertaken to determine baseline energy consumption and current technologies (and appliances) in all the sectors. In the Industrial sector, data gathering at the sub-sector level (e.g. cement, textile etc) was undertaken by MOI using the questionnaires developed by the ADB consultants. However, it was impossible to reconcile the total sectoral electricity consumption with billing information obtained from MOEP. This fact was even acknowledged by MOI and the survey information had to be overlooked in preference to MOEP electricity billing data. Hence, an alternate approach had to be adopted to determine the EE potential in this sector (industrial) which included assessing best practices in the region, determining a range of savings, estimation of average savings per subsector and overall savings for the sector. For the commercial and residential sectors surveys were undertaken by the national consultants supporting the development of the Energy Master Plan. However, the information was deficient of end-use and appliance data which is critical for establishing EE targets. In order to address the current deficiencies, the establishment of a comprehensive energy use database has been recommended to be implemented as a primary activity in Year 1 of the Implementation Roadmap.

3. **Determination of EE Targets**: Due to the data limitations identified above the determination of EE potential in the key sectors had to rely on best practices in the region and case studies of several EE projects undertaken recently in economies similar to Myanmar. Considering that there has been very limited EE implementation to date in Myanmar, the EE Policy targets of 12% (2020), 16% (2025) and 20%(2030) compared to the 2012 baseline may seem modest. However, there were other factors considered in determining the targets, including the initial capacity building requirements of EECD, availability of financial incentives for EE implementation and capital investment requirements especially in the Industrial sector. It is recommended that these targets are reevaluated after the first two years of the Implementation Plan based on the progress made.

4. **Institutional Arrangements for EE Program Management**: There are eight ministries responsible for energy matters in Myanmar and are all represented in the National Energy Management Committee (NEMC). However, energy policy and planning, and energy efficiency activities are split between two ministries – Ministry of Energy (overall energy policy and planning) and Ministry of Industry (energy efficiency). This arrangement has recently (1st April 2014) been confirmed with the approval by the NEMC to the establishment of the EECD (Energy Efficiency & Conservation Division) with MOI. The limited EE activities undertaken by MOI have been focused on the industrial sector and there need to be a change in scope and emphasis for the implementation of the EE Road Map. The residential sector is currently the largest consumer of electricity (around 42%) and this trend is expected to continue with the current

electrification plans. It is understood that there are 18 staff positions approved for the EECD and it is recommended that the recruitment of staff is managed carefully to include expertise required for residential programs (e.g. social and gender specialists).

5. **Capacity Building of Stakeholders**: It is understood that the staff required for EECD will be sourced within existing employees of the relevant Ministries. The EECD has the overall responsibility of coordinating activities highlighted in the EE roadmap including the common activities covering all sectors. The EECD needs to have a range of skills (technical, financial, marketing, monitoring & verification, project management, IT, regulatory etc) to meet the requirements of the EE strategy. In addition to EECD, there are several other stakeholders who are likely to play an active role in EE implementation, these include, MOE, MOEP, YESB, MESE, MES and Myanmar Standards Institute. It is recommended that a comprehensive capacity building program (as outlined in 5.6.2) is undertaken in Year 1 of the implementation plan.

6. **Energy Use Database**: The data limitations experienced during the development of the EE policy has highlighted the need for a robust web-based energy use database covering all sectors and regularly updated. Such a database will assist in the design of EE programs and have credible baselines for determining energy savings. The biggest challenge would be in obtaining regular (annual) information from the respective customers as experienced by several countries in the region. There may be a need for regulations making reporting of energy data mandatory for specific type of customers.

7. **Resources for Implementation**: It is expected that MOI will provide annual budgets for the operation of the EECD which would include salaries and administration expenses. However, external assistance for capacity building, regulations, EE measurement equipment and other financial incentives for program implementation would be required. There are several donor agencies active in the energy sector in Myanmar and any assistance for the EE Implementation program should ensure that there is no overlap in funding and the activities (and schedule) are consistent with the EE objectives.

8. **Roadmap for Implementation**: The roadmap includes a total of 34 programs to be undertaken over a 5 year period with Year 1 primarily focusing on capacity building of EECD, energy database and public awareness activities. Most of the programs will commence in Years 2 and 3; and those commencing in Years 4-5 will continue beyond Year 5. There are also several common activities to be undertaken by EECD that will compliment the 34 programs. Hence, there is a need for an overall coordinated effort to achieve the objectives of the EE policy.

9. **Regulatory Requirements**: There are several regulatory issues that need to be addressed in the roadmap. Energy Conservation decrees need to be considered for reporting of energy consumption data and energy saving plans in industrial and commercial sectors; mandatory energy audits and energy managers in industry; enforcement of Minimum Energy Performance Standards (MEPS) and Energy Labeling Schemes for appliances; the phase-out of inefficient lighting products; and safe disposal of fluorescent lighting containing residual mercury. There are numerous examples of these regulations in countries in the region and these could be adopted to suit the local situation.

10. **Revision of EE Targets**: The targets proposed in the EE policy are conservative considering data constraints and the capacity to undertake a comprehensive EE Implementation plan. It is proposed that these targets are reviewed after Year 2 based on the progress made.

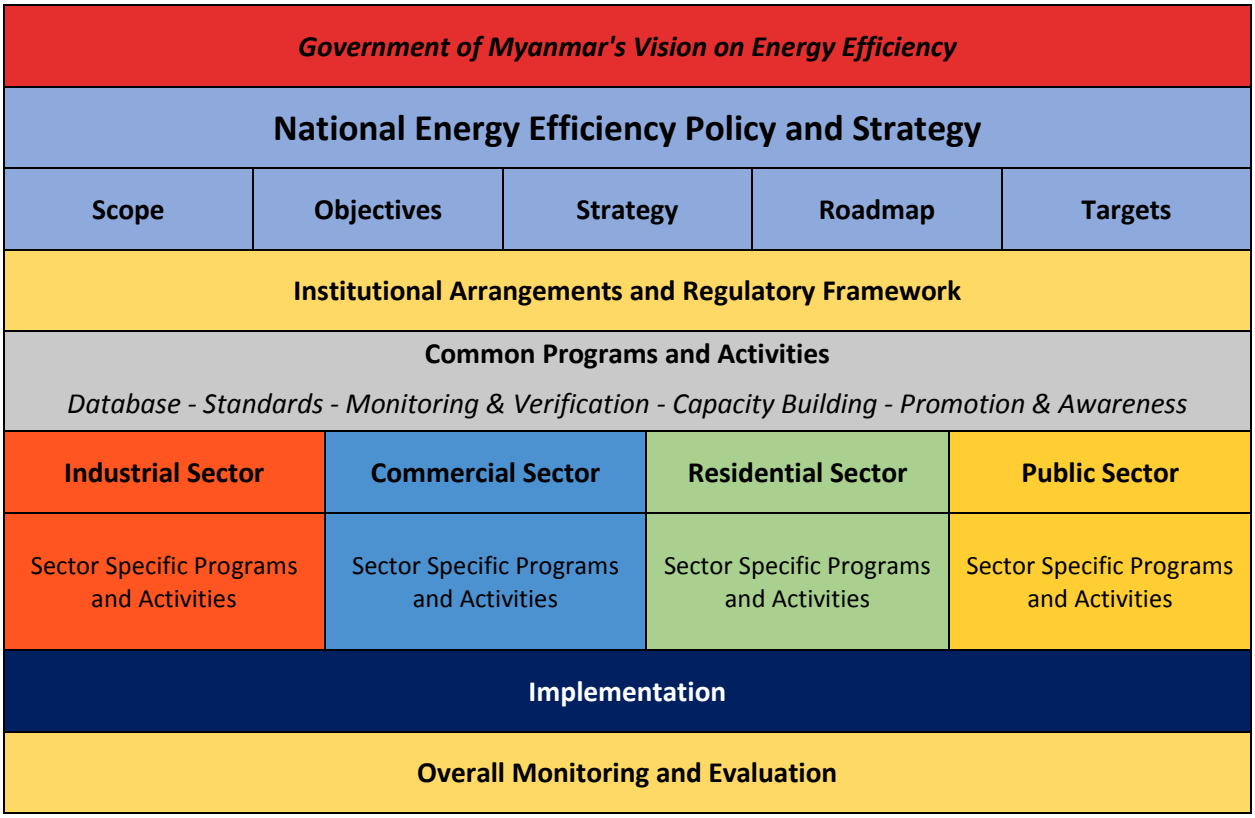
8 ANNEXES

8.1 Proposed Energy Efficiency Strategy

8.1.1 Introduction

The National Energy Efficiency Strategy aims to define the approaches to be adopted in meeting the goals established in the National EE Policy. The Figure 8:1: Components of the National Energy Efficiency Policy and Strategy in Myanmar below outlines the components of a National EE Strategy. The strategy will address the institutional arrangements for the implementation of the EE Roadmap and also the supporting legal framework. It is proposed that the cross-cutting activities amongst the key sectors should be coordinated centrally by the EECD to have the maximum impact. The sector specific activities could be implemented various agencies depending on their relevance and capacity.

Figure 8:1: Components of the National Energy Efficiency Policy and Strategy in Myanmar



8.1.2 Vision

The National Energy Policy aims to *"systematically explore the available indigenous energy resources in order to supply the domestic demand and export as value added products for surplus resources with the ultimate aim of sustainably improving the living standards of people in the country"*. By means of this policy the Government of Myanmar (GoM) is aiming to:

- Ensure **energy security** for the sustainable economic development in the country;
- Provide **affordable and reliable energy supply** to all categories of customers, especially those living in remote areas that are currently without electricity;
- Achieve the government's overarching objective of **poverty reduction** and improve the quality of life of its people;
- **Increase foreign exchange earnings** through energy exports after meeting the national demand.

8.1.3 Goals and Objectives

The initial target for EE set by MOE was the reduction of 5% of the total energy consumption (2005 level) by 2015 and 8% by 2020. The basis for these targets was in line with targets set by ASEAN; and the draft National Energy Policy (2014) has not defined any targets for EE. However, the energy policy framework is aimed at the following:

- Maintaining the status of energy independence
- Promotion of wider use of new and renewable sources of energy,
- Promotion of Energy Efficiency & Conservation (EE&C); and
- Promotion of the use of alternate fuels for households

Based on the calculated energy saving potential the National Energy Efficiency Policy objective using 2012 as the baseline is as follows:

- Reduce that national electricity demand by 12% in 2020 compared to the baseline demand in 2012
- Reduce the biomass consumption by 2.3% in 2020 compared to the baseline biomass demand in 2012.
- Reduce national CO2 emissions by 78,690 tons in 2020.

To reach the overall energy efficiency objective, the Alternative Case outlined in the Myanmar Energy Outlook (2013) was adjusted by the results of the assumed energy efficiency in the following sectors identified as priority areas for the national EE policy, strategy and action plan:

- Energy Efficiency in Industry
- Energy Efficiency in Commercial Sector
- Energy Efficiency in Residential Sector (Urban and Rural)
- Energy Efficiency in Public Sector (Buildings, Hospitals, Schools and Public Lighting)

8.1.4 Strategic Framework

8.1.4.1 Institutional Framework

There are eight ministries in Myanmar responsible for energy matters, with the Ministry of Energy (MOE) as the focal point for overall energy policy and coordination, including energy planning in liaison with the Ministry of National Planning and Economic Development. The other seven (7) ministries involved energy are listed below and their responsibilities include:

- Ministry of Electric Power (MOEP) – power generation, transmission, distribution and rural electrification;
- Ministry of Mines (MOM) - coal;
- Ministry of Agriculture and Irrigation (MOAI) – bio-fuels and micro-hydro for irrigation purposes;
- Ministry of Science and Technology (MOST) – other renewable energy such as solar and wind;
- Ministry of Livestock, Fishery and Rural Development – rural electrification;
- Ministry of Environmental Conservation and Forestry (MOECAF) - fuelwood, climate change, environmental safeguard requirements, and;
- Ministry of Industry (MOI) - energy efficiency.

The MOI is the lead agency for the implementation of energy efficiency in Myanmar and its current workplan includes:

- To develop required legal Framework for EE activities
- To set up dedicated department under current assigned in Ministry for successful implementation Energy Efficiency activities
- To promote public awareness raising and capacity building for EE activities
- To encourage EE implementation by cooperating and collaborating with experienced regional and international Organization
- To support National Energy Security and Sustainable Development with EE activities

8.1.4.2 Core Institution for EE Activities

The National Energy Policy has proposed the establishment of a new Directorate for Energy Efficiency Improvement and Conservation Program. The rationale is to ensure the highest level of focus on the demand side that has the authority to plan and monitor implementation. Based on the recommendation an Energy Efficiency & Conservation Division (EECD) under the Directorate of Planning at MOI was established in April 2014. The EECD will be responsible for coordinating all EE&C activities in Myanmar. The proposed structure and responsibilities of this Directorate is given in **Annexure 5.6.1**

The focal points are to be established at national, regional and sectoral levels for the coordination of specific activities under the EE&C Road map and the proposed agencies/ stakeholders are given in Table 8.1.

Table 8:1: National Focal Points and Stakeholders for EE Implementation

Primary Agency	**Ministry of Industry – Energy Efficiency & Conservation Division (EECD)**
Government Agencies	Ministry of Energy (MOE) Ministry of Electric Power (MOEP) Ministry of Mines (MOM) Ministry of Agriculture and Irrigation (MOAI) Ministry of Science and Technology (MOST) Ministry of Livestock, Fisheries and Rural Development Ministry of Environmental Conservation and Forestry (MOECAF)
Primary Stakeholders	Yangon Electricity Supply Board (YESB) Myanmar Electricity Supply Enterprise (MESE) Myanmar Engineering Society (MES) Myanmar Standards Institution
Other Stakeholders	End-Users – Housing associations Industry Groups – MIA, UMFCCI Association of Myanmar Architects Electrical Retailers Engineering Consultants

8.1.4.2.1 Capacity Building of EE Implementation Group

Following the establishment of the EE&C Division (EECD) and the recruitment of the relevant staff, a comprehensive capacity building program will be undertaken as one of the primary activities in the

Roadmap. The program will also include the other relevant agencies and stakeholders. The **Annexure 5.6.2** provides guidelines for the capacity building program.

8.1.5 Common Issues of the Energy Efficiency Strategy

The EECD will be responsible for the implementation of several common activities across the identified priority sectors that would ensure a sustainable approach to EE implementation in Myanmar. These activities include the following:

- Energy data collection and analysis
- Energy Efficiency awareness and education
- Monitoring & Evaluation
- Develop Energy Efficiency standards for Buildings and Appliances
- Accreditation scheme for Energy Auditors and Energy Managers
- Regional cooperation and networking
- Legal and Financial Framework for Energy Efficiency

Details of the scope of the above activities are provided in the EE Roadmap (Section 6)

8.1.6 Strategic Objectives per Sector

8.1.6.1 Industrial Sector

The industrial sector represents 35% (2011 – 2012) of the total electricity consumption. The contribution of the industry sector in current GDP is only 26% and the target is to increase this by 35% to 40% primarily through private sector investment. The removal of existing subsidies will provide an incentive to undertake EE&C interventions.

Increased investment in energy efficiency will help make Myanmar's energy sector more sustainable, affordable, and reliable. A growing number of countries in the region such as the People's Republic of China, India, and Thailand are already implementing energy efficiency initiatives as a least-cost solution to meeting rising power demand. Tapping the energy efficiency potential in existing industrial stock is essential in order to meet the energy efficiency objectives of the Government.

According to the National Energy Policy, a two-pronged approach is proposed, focusing on: (a) the development and implementation of viable technical and business models; and (b) strengthening the implementation of existing policies and regulations for promoting energy conservation investments. A well-conceived and a systematic program of industrial energy improvement and conservation will be initiated. The key energy-intensive industrial sub-sectors and energy conservation projects with significant potential for energy efficiency improvements include: (a) electricity generating power utilities, (b) petroleum refinery, (c) loss reduction in natural gas gathering and transmission pipeline system, (d) fertilizer and chemicals, (e) pulp and paper, and (f) cement.

The energy conservation program in these industrial sub-sectors will include:

- provision of modern process technologies replacing the old and obsolete,
- provision of energy saving industrial technologies such as more efficient industrial boilers, kilns, and heat exchange systems;
- recovery and utilization of by-product gas, waste heat and pressure;
- installation of highly efficient mechanical and electrical equipments, including motors, pumps, heating and ventilation equipments; and
- Industrial system optimization to reduce energy use.

The MOI in collaboration with the Myanmar Engineering Society (MES) are leading EE&C activities in the industrial sector mainly focussing in training with limited implementation. The proposed EE Policy will form the basis of future activities that would be supported by EE&C regulation.

Based on the above, the following strategic objectives are proposed:

No:	Strategic Objective	Outcome	Rationale
1	Energy Efficient process technologies are adopted in all industry sectors	Specific energy consumption reduced resulting in the reduction of unit production costs making industries more competitive.	It is reported that most industries have old inefficient equipment and badly need investment for refurbishment. International best practices in a range of industries indicate significant EE opportunities.
2	The awareness of EE amongst industry owners, managers and engineers is increased	Industry associations are established for the sharing of EE information including process technologies and financing options.	Most industry owners, managers and engineers have not had the opportunity to learn or understand EE opportunities relating to their business. Currently, there are no industry associations that could facilitate the sharing of energy saving opportunities.
3	Capacity building in EE&C in the industry sector is strengthened	The key industry stakeholders are aware of EE opportunities and are trained in energy management.	There have been very limited activities to date in training of key industry stakeholders in EE. Some international agencies have conducted short training programs on specific topics. There is a need for a sustained training program possibly conducted through a local institution.

8.1.6.2 Commercial Sector

The commercial sector includes office buildings, hotels, restaurants, shopping malls, supermarkets etc. It is envisaged that the key energy uses in this sector are electricity and LPG. Currently, this sector accounts for 21% of the total electricity consumption and the demand is expected to increase significantly with development in Myanmar, supported by aggressive electrification plans.

Currently, there are no codes that apply to commercial buildings that relate to energy efficiency either for new buildings or refurbishments. Energy Efficiency Buildings Codes (EEBC) have been adopted in many countries in the region, namely, India, Thailand and Vietnam; and regulations are in place for their adoption. In addition, Green Building certification similar to US Green Building Council's LEED (Leadership in Energy and Environmental Design) has been used in several countries (India and Sri Lanka) where savings averaging 20% of life-cycle costs have been estimated.

Initial observations in the commercial sector (office buildings, hotels etc) show a high usage of inefficient fluorescent lighting and electric hot water systems. Case studies from countries in the region show that significant savings could be achieved through the use of high efficiency fluorescent and LED lighting and solar hot water (SHW) systems.

Based on the above, the following strategic objectives are proposed for the Commercial Sector:

No:	Strategic Objective	Outcome	Rationale

1	Energy Efficiency is incorporated in new building design and refurbishment of existing buildings	Energy Efficiency Building Code (EEBC) is established for Commercial Buildings	Currently, there are no building codes or regulations covering EE for new and existing buildings. International experience has shown savings in the order of 20% in life-cycle operating costs.
2	Energy Efficiency technologies are implemented in the Commercial sector	Certification of Energy Auditors and Building Managers	Currently, energy audits are not conducted in commercial buildings due to scarcity of qualified staff. A certification program can be conducted to local engineers enabling them to provide such services. In addition, certification of building managers will also ensure that EE measures are implemented and maintained in existing buildings.
3	Renewable Energy technologies are promoted in the Commercial sector	Large scale adoption of solar water heating (SWH) systems	Electric water heaters are currently widely used in office buildings, hotels and restaurants. Solar water heating is considered to be a viable alternative with significant cost savings.
4	The awareness of EE and capacity building amongst key stakeholders is increased	Energy Management programs are implemented in the commercial sector.	Most stakeholders (owners and occupants) have not had the opportunity to learn or understand EE opportunities relating to their business. Currently, there are no energy management training programs undertaken in Myanmar.

8.1.6.3 Residential Sector

The residential sector is currently the major user of biomass (fuelwood/charcoal) in the country and this is mainly used for cooking in both rural and urban households. In terms of electricity, the residential sector accounts for 44% (2011 – 2012) of the total electricity consumption and this share is expected to be maintained or increased based on the rural electrification program.

The current market penetration of EE products and appliances (lighting, air conditioning, refrigerators and other home appliances) is very low. Most of the electrical products are imported mainly from China and India and have no certification on energy performance. Energy rated products from Thailand are available in some stores but their market share is extremely low due to the cost differential between these and the low efficiency products from China. There is potential for significant energy savings through the introduction of Minimum Energy Performance Standards (MEPS) and Energy Labelling schemes similar to most countries in the region (Thailand, Malaysia, India, Philippines, Vietnam and Sri Lanka).

It is understood that LPG is rationed to the household sector with each Public sector employee allocated a quota (5kg) of LPG each month which is sold at a subsidized price by approved distributors. In spite of this there is a general preference for using biomass (fuelwood) for cooking even in the urban sector. There is potential to promote the use of LPG for cooking especially in the urban sector through an awareness campaign.

Based on the above, the following strategic objectives are proposed for the residential sector:

No:	Strategic Objective	Outcome	Rationale
1	Household energy costs are reduced through energy performance standards for appliances	Minimum Energy Performance Standards (MEPS) and Labelling Scheme for appliances introduced	Currently, the market is dominated by electrical appliances from China and India that have no energy performance ratings. There are some appliances from Thailand that comply with their energy star rating scheme but their market share is small due to affordability.
2	Increased used of LPG is adopted by urban households	Market transformation from biomass cook stoves to LPG cooking in urban households	LPG is currently rationed to public sector employees but the trend has been to "re-sell" the quota to the Gas Retailers for on-selling to restaurants and hotels. The use of biomass for cooking has not declined although LPG is more efficient.
3	Awareness of EE technologies are increased in the residential sector	Residential awareness campaigns implemented.	There have been no awareness campaigns conducted in the residential sector and the knowledge of EE appliances is very low.

8.1.6.4 Public Sector

The public sector is categorized as "Government (office use)" in the electricity tariff schedule and this covers office buildings, schools and hospitals. It is observed that the government office complexes in Nay Phi Tay (NPT) were built in 2003 and the electrical equipment, especially lighting and air conditioning, uses old technologies with high consumption.

Case studies in the region show that EE lighting technologies can save around 25% in lighting consumptions and around 50% by the use of inverter-type AC units instead of the current units which do not have any performance standards and ratings.

Based on the above, the following strategic objectives are proposed for the public sector:

No:	Strategic Objective	Outcome	Rationale
1	Use of EE technologies in public buildings are increased and overall energy costs are reduced	Significant reduction in government energy costs	The lighting technologies currently in use are out-dated and significant cost savings are possible by retrofitting with latest lighting technologies such as T5 fluorescent lamps and LEDs. The use of inverter-type ACs than the current unlabelled units will also result in similar savings.
2	The awareness of EE is increased amongst public sector employees	Energy Management programs implemented in the public sector	Currently, public service employees do not have an incentive to save energy at work. Hence, motivation of employees through increasing their awareness of the benefits of EE will contribute t the overall goal of reducing government energy costs.
3	Capacity building of maintenance staff in EE&C in	Trained maintenance staff to sustain EE activities	The maintenance staff in government institutions have had limited or no

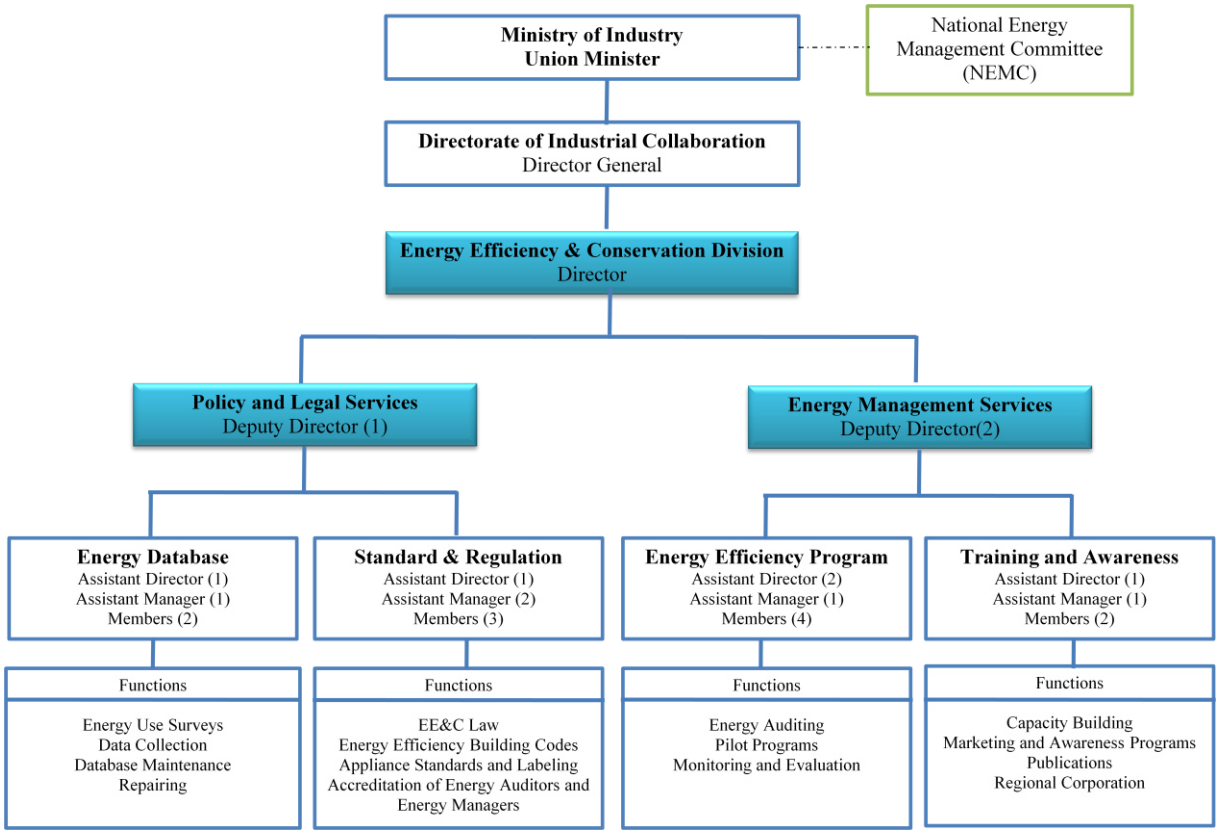
No:	Strategic Objective	Outcome	Rationale
	increased		opportunities for training in EE technologies and management. Trained staff will be able to assist in implementation of EE measures and sustain savings through improved maintenance.

8.1.7 Structure and Functions of EECD

8.1.7.1 Organizational Structure for EE&C Division

A separate Directorate under the MOI is proposed for the management of all EE&C activities in Myanmar. The establishment of EECD was approved by the NEMC on 1st April 2014. The proposed organizational structure is shown in Figure 5.2 based on the 18 positions approved.

Figure 8:2: Proposed Organizational Structure for EE&C Division



The above structure, comprising of the approved 18 positions, is considered to be the basic requirement to commence the implementation of the Roadmap. It is recommended that an additional 10 positions are allocated in the next financial year – these are primarily in the technical or specialist category (classified as Members in the above structure) and include the following:

- Energy Data analysts (2)
- Legal Expert (1)
- EE Program Managers (4)
- Marketing and Communication (3)

8.1.7.2 Mission and Objectives of EEC Division

The Mission of the DSM Cell shall be:

To assist the energy security of the nation and provide economic and environmental benefits to the nation by promoting energy efficiency and conservation activities in all sectors"

The proposed strategic and operational objectives of the EECD are:

Strategic Objectives

- Assist customers to reduce energy bills in a manner that will create benefits for customers and the nation.
- Provide value-added services to customers
- Promote the use of energy-efficient equipment and appliances
- Promote the use of renewable energy technologies
- Assist in meeting national and global environmental objectives

Operational Objectives

- Design, develop, and implement DSM/EE programs that provide benefits to customers, electricity utility and the nation
- Develop and maintain a database of customer energy use and market research data and information on energy-efficient technologies.
- Promote awareness of EE to all sectors through the conduct of awareness programs
- Develop energy efficiency standards and codes for appliances and buildings
- Promote efficient use of energy through workshops, seminars, newsletters, and web-sites
- Develop monitoring & evaluation protocols for DSM/EE programs
- Provide training for professionals in energy auditing and EE technologies

8.1.7.3 EEC Division Responsibilities

The primary responsibilities of the EECD include the following:

- Be the primary agency within Myanmar for design, development, implementation and evaluation of energy efficiency and conservation activities..
- Develop a strong capability in the technical, economic, financial and institutional aspects of EE.
- Collect data and develop databases on major market segments, customer characteristics and load patterns.
- Obtain, analyze and maintain information on EE technologies and options, including information form EE implementation in neighboring countries.
- Screen and assess alternative EE technologies and options to determine the short-term and long-term EE implementation strategies.
- Design and implement pilot and full-scale EE programs.
- Develop linkages, coordinate activities, and provide information and technical assistance to other agencies in Myanmar

- Develop linkages with external groups and coordinate activities with other ministries, customer groups, industry associations, equipment suppliers and manufacturers, financial institutions, energy service providers and others interested and involved in implementing energy efficiency programs in Myanmar.
- Manage donor funded activities related to energy efficiency.

8.1.7.4 Guidelines for Capacity Building Program for EECD and Other Stakeholders

Following the recruitment of the relevant staff for EECD, capacity building is considered to be the first task in the EE Policy implementation strategy. Considering that the EECD has the overall responsibility in coordinating the activities in the roadmap and also the cross-cutting activities, it is proposed that a comprehensive training program is developed including class-room type training, field activities and study tours to countries with similar programs.

8.1.7.5 Task Specific Training for EECD

The initial training program should cover all tasks/activities of EECD and the proposed task specific training is given in Table 8.2.

Table 8:2: Task Specific Training Plan

Task	*Training Areas*	*Training Period*
Energy Database	Data Gathering and entry	
	Historical analysis of energy consumption	3 days
	Development of load shapes	
	Reporting	
Regulations and EE Codes and Standards	Energy Efficiency & Conservation Law	
	EE Building Codes for new and retrofits	3 days
	Appliance Standards and Labeling Programs	
	Regional Laws, Codes and Standards	
Energy Auditing	Building selection	
	Building Inspections and data collection	
	Metering of energy consumption	1 week
	Conduct of Energy Audits	
	Use of Energy auditing Equipment	
	Analysis of EE options	
	Reporting	
Pilot Program Implementation	Selection of sites	
	Pre and Post installation monitoring	
	Procurement and installation	2 days
	Evaluation of Results	
	Reporting	
Awareness Campaign	Development of Themes	
	Preparation of Implementation Plan	
	Conduct of campaigns	2 days
	Case studies	
Program Results Monitoring	Development of questionnaires	
	Conduct of surveys and analysis	2 days
	Monitoring & Evaluation Procedures	
	Reporting	

8.1.7.6 Formal Training in DSM Concepts

This training program will cover specific activities on DSM methods, techniques, approaches, software and technologies. These concepts are applicable in the design of programs that would assist the electricity utilities in effectively managing this system load profiles to ensure the power plants operate with the optimum load factor and for demand reduction during the hottest months. In addition to the staff of EECD, the participants could include utility and industrial/commercial technical personnel. These training activities will generally be about half a day in duration and will cover specific topics as detailed in Table 5.3.

Table 8:3: Topics for DSM Training

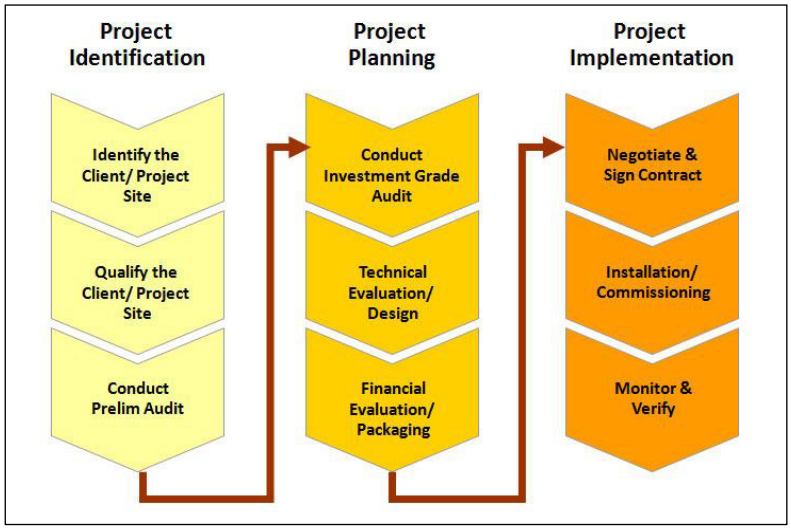
Topic	*Training Program Description*
DSM Planning	Introduction to DSM
	DSM Goals & Objectives
	DSM Planning and Analysis Framework
	Load and Market Research
DSM Program Design	Introduction to Program Design
	DSM Program Options Screening
	Benefit / Cost Analysis of DSM Programs
DSM Program Implementation	Implementation Approaches
	Marketing of DSM Programs
DSM Program Monitoring & Evaluation	Program Evaluation Approaches
	Impact, Process and Market Evaluation

8.1.7.7 Advanced Training in Energy Auditing

Following the initial training program, a more advanced training program is proposed to cover all aspects of the EE Project Development Steps as shown in Figure 8:3: Energy Efficiency Project Development Steps

. As the EECD evolves over time, it will be in a position to substantially expand its role and fully exploit its potential.

Figure 8:3: Energy Efficiency Project Development Steps



It is envisaged that the advance training program will be designed as a multi-level program addressing all necessary knowledge and skills required for the implementation of the EE&C programs in different end-use sectors in Myanmar.

The following enhanced training program, given in Table 8.4, is proposed.

Table 8:4: Advanced Training Program

Module	*Description*	*Duration (days)*	*Participation*
1	Detailed Energy Auditing Procedures	5	EECD, Utilities, Industry/Commercial sector engineers and other stakeholders
2	Financial Analysis and Investment Appraisal	3	
3	Contracting, Monitoring & Verification	3	
4	Marketing & Communication	2	
5	Project Management	2	

8.2 Sectoral Activities - Industry

SECTOR		**INDUSTRY**				
Strategic Objective	1	**Energy Efficient process technologies are adopted in all industry sectors**				
Program / Activity	1	Establishment of energy data collection procedures				
Rationale		*Currently there is very limited data on energy consumption, production volumes, end-use technologies across all industrial enterprises. This is the sector that would require significant modernization to keep production costs in control. During the development of the EE Policy, there was inadequate data to determine specific EE opportunities.*				
Strategy		*Energy Managers are assigned to each industry with responsibility for reporting energy data to EECD on an annual basis using standard templates provided.*				
Target Market Segment		*All enterprises under the 'Industrial Use" electricity tariff category*				
Program Description		*An energy use database will be designed for the industrial sector and templates for each sub-sector (cement, textile etc) customized to the specific data requirements. Data collection will be assigned to a specific person (or position) in each enterprise and will be coordinated by EECD*				
Tasks / Activities		• *Design of energy-use data base and templates for each industrial subsector* • *Data collection and analysis* • *Establishment of benchmarks for each industry type* • *Publication of annual report on energy use*				
Expected Outputs		*A comprehensive database of energy use in the sector which could be used for design and implementation of EE activities.*				
Implementing Agency		*EECD*				
Other Stakeholders		*MOI, MOEP, MOE, YESB, MEPE, MPE, MPPE, IDC (Industrial Development Committee), UMFCCI (Union of Myanmar Federation of Chamber of Commerce), MIA (Myanmar Industrial Associations,) MES (Myanmar Engineering Society)*				
Monitoring Procedures		*Random checks by EECD on data accuracy*				
Budget Estimate		*$200,000 (training, IT Hardware/software, communications etc)*				
Implementation Time-frame		*Short-term*				
Roadmap Activity No:		***B.1***	*Commencement*	*Year 1*	*Duration (months)*	*6*

SECTOR		**INDUSTRY**				
Strategic Objective	**1**	**Energy Efficient process technologies are adopted in all industry sectors**				
Program / Activity	**2**	Implementation of energy audit program for enterprises				
Rationale		*Investment in EE in the Industrial sector has been very limited and it is reported that the industrial processes currently being used are out-dated. Investment in modernization of industries is critical to ensure competitiveness.*				
Strategy		*Using the initial information from the Energy Use Database an energy audit program of selected industrial categories will be undertaken. This program is complimented by the accreditation program for Energy Auditors proposed in the Roadmap*				
Target Market Segment		*Large industrial energy intensive industries – cement, copper, textile etc*				
Program Description		*Extensive training of key stakeholders in Energy Auditing will be undertaken as a part of the cross-cutting activities. The stakeholders will include MOI and technical staff of the selected industries and they would be required to be certified Energy Auditors under the accreditation program, prior to undertaking audits.*				
Tasks / Activities		• *Historical analysis of energy consumption and current end-use technologies* • *Initial energy audits to identify opportunities for EE* • *Investment grade energy audits of selected EE opportunities* • *Explore funding opportunities for implementation*				
Expected Outputs		*Investment Grade proposals for implementation*				
Implementing Agency		*MOI*				
Other Stakeholders		*Industry Engineers, MES*				
Monitoring Procedures		*Energy Audit reports submitted to MOI by each industry with an implementation plan. Annual reporting of progress.*				
Budget Estimate		*$500,000 (External experts, training costs)*				
Implementation Time-frame		*Medium term*				
Roadmap Activity No:		***C.1***	*Commencement*	*Year 2*	*Duration (months)*	*24*

SECTOR		**INDUSTRY**				
Strategic Objective	**1**	**Energy Efficient process technologies are adopted in all industry sectors**				
Program / Activity	**3**	Introduction of good energy management practices in industry				
Rationale		*Management and technical staff in industries have not been exposed to energy management practices. There have been several ad hoc programs conducted by international agencies in the past but they have not been comprehensive enough to enable participants to develop energy management programs in the workplaces*				
Strategy		*Conduct industry specific training programs focusing on energy management practices based on international standards such as ISO 50001 and assist in the preparation of energy management plans (EMP)*				
Target Market Segment		*All sectors*				
Program Description		*Promotion of good energy management practices in industrial enterprises and development of industry specific EMPs based on international standards*				
Tasks / Activities		• *Program for Senior Management – introduction to EM principles, commitment to EM Action Plan, identifying energy costs and savings options; and planning, implementation and review of EM Action Plans* • *Program for Utility/Process Managers – Integrated approach to energy management, concepts of process integration, preparation and implementation of EM Action Plans.*				
Expected Outputs		*Implementation of good energy management practices will result in achieving significant cost savings through an integrated approach using international best practices*				
Implementing Agency		*MOI*				
Other Stakeholders		*Industry Associations, Chamber of Commerce* *Industrial Development Committee (IDC),UMFCCI(Union of Myanmar Federation of Chamber of Commerce, MIA(Myanmar Industrial Associations, MES (Myanmar Engineering Society*				
Monitoring Procedures		*Review of EM Action Plans and annual reports on performance*				
Budget Estimate		*EECD Operating Budget*				
Implementation Time-frame		*Medium-term (commencing Year 3)*				
Roadmap Activity No:		***C.2***	*Commencement*	*Year 3*	*Duration (months)*	*24*

SECTOR		**INDUSTRY**				
Strategic Objective	**1**	**Energy Efficient process technologies are adopted in all industry sectors**				
Program / Activity	**4**	Provide financial incentives for implementation of EE measures				
Rationale		*There is a need for significant capital investment in the industry sector for modernization in order to be more energy efficient and maintain competitiveness. Currently, there are no financial mechanisms in Myanmar to support investments in EE.*				
Strategy		*Develop an EE Financing Model for Myanmar with the assistance from interested donor agencies*				
Target Market Segment		*All private and public enterprises*				
Program Description		*An Energy Efficiency Financial Model will be developed in consultation with the financial institutions, government ministries and international donor agencies. A capacity building program on EE Investments for financial institutions will also be undertaken.*				
Tasks / Activities		• *Interviews with industry management and financial institutions on criteria for EE investments* • *Interviews with relevant government ministries and international donor agencies on financing models that would be acceptable for Myanmar* • *Develop an EE Financing Model* • *Capacity building of local financial institutions on EE investments and international experience*				
Expected Outputs		*A customized EE Financing Model for consideration by international donor agencies as a sovereign or non-sovereign loan*				
Implementing Agency		*MOI and Ministry of Finance Central Bank of Myanmar, Small and Medium Industries Development Bank,*				
Other Stakeholders		*IDC(Industrial Development Committee),UMFCCI(Union of Myanmar Federation of Chamber of Commerce, MIA(Myanmar Industrial Associations, Financial Associations*				
Monitoring Procedures		*EE Financing Model established and approved by MOF*				
Budget Estimate		*$150,000 (External Finance Expert)*				
Implementation Time-frame		*Medium Term*				
Roadmap Activity No:		***C.3***	*Commencement*	*Year 2*	*Duration (months)*	*6*

SECTOR		**INDUSTRY**				
Strategic Objective	**2**	Awareness of EE amongst industry owners, managers and engineers is increased				
Program / Activity	**1**	Increase awareness of technology best practices in the region				
Rationale		*Industry management and engineers have had limited opportunity to engage in seminars and seminars in the region relating to EE and hence, are generally unaware of the current technologies practiced in their respective industries.*				
Strategy		*To promote interaction of industry groups in Myanmar with similar groups in the region and seek assistance from donor agencies to support participation in regional energy forums.*				
Target Market Segment		*All enterprises – owners and managers*				
Program Description		*The aim is to provide access to on information EE technologies applicable for various enterprises and sharing of results of any programs implemented in Myanmar and countries in the region*				
Tasks / Activities		• *Participation in energy seminars and workshops in the region* • *Site visits to enterprises outside Myanmar where EE technologies are in operation* • *Communication campaigns targeting owners and managers in enterprises through industry associations include the issue of e-newsletters on energy efficient best practices in Myanmar and the region.*				
Expected Outputs		*Owners and managers in industrial enterprises are aware of the benefits of application of various EE technologies*				
Implementing Agency		*MOI*				
Other Stakeholders		*MES, Donor Agencies, UMFCCI(Union of Myanmar Federation of Chamber of Commerce, MIA(Myanmar Industrial Associations,*				
Monitoring Procedures		*Number of programs conducted annually and the number of participants attending.*				
Budget Estimate		*EECD Operating Budget*				
Implementation Time-frame		*Medium term (Commencing Year 3)*				
Roadmap Activity No:		***C.4***	*Commencement*	*Year 3*	*Duration (months)*	*24*

SECTOR		**INDUSTRY**				
Strategic Objective	**2**	Awareness of EE amongst industry owners, managers and engineers is increased				
Program / Activity	**2**	Prepare Energy Efficiency Guidelines for major industries				
Rationale		*At present there are no technical publications in Myanmar that relate to manufacturing and hence, enterprises are not aware of process improvements that would benefit overall operations.*				
Strategy		*To develop industry specific EE Best Practices Guidelines including international case studies for specific energy intensive industries (e.g. cement)*				
Target Market Segment		*Selected energy intensive industries*				
Program Description		*The program covers research on EE best practices internationally, especially in the region and preparation of industry specific guidelines. Dissemination is achieved through the conduct of workshops.*				
Tasks / Activities		• *Market research on EE Best Practices and case studies of selected industrial sectors* • *Publication of Energy Efficiency Guidelines for each sector* • *Conduct workshops for dissemination of information to the relevant sectors*				
Expected Outputs		*The knowledge of EE best practices are increased amongst managers of enterprises and increased likelihood of adoption of these options.*				
Implementing Agency		*EECD*				
Other Stakeholders		*MOE, Ministry of Information, MES, ACE, ECCJ, UNIDO, ADB*				
Monitoring Procedures		*Number of Guidelines developed and distributed to the relevant sectors*				
Budget Estimate		*$100,000 (External Technical Experts)*				
Implementation Time-frame		*Medium Term*				
Roadmap Activity No:		***C.5***	*Commencement*	*Year 3*	*Duration (months)*	*6*

SECTOR		**INDUSTRY**				
Strategic Objective	**3**	Capacity building in EE&C in the industry sector is strengthened				
Program / Activity	**1**	Conduct organized training for technical and managerial staff				
Rationale		*There have been ad hoc training programs conducted by various agencies in the past, primarily through the ASEAN - Japan Energy Efficiency Partnership (AJEEP) covering on-site audits and energy management programs. However, implementation of EE measures has been very limited.*				
Strategy		*The aim is to have a structured training program for both managers and technical staff of industrial enterprises that would be detailed enough to facilitate investment in EE practices.*				
Target Market Segment		*All industrial enterprises*				
Program Description		*The objective is to have two training program. The first is for management focussing on EE investment opportunities and the second is for technical staff focussing on energy audits and evaluating EE opportunities.*				
Tasks / Activities		• *Review of past training programs conducted in Myanmar* • *Design and implementation of a customized program for industry management* • *Design and implementation of a program covering all aspects of EE Project Development Cycle*				
Expected Outputs		*Knowledge of EE investments improved amongst management. Technical staff in enterprise have the capacity to conduct site investigations and evaluate EE measures*				
Implementing Agency		*EECD*				
Other Stakeholders		*ACE, MOE, ECCJ, UNIDO, ADB, MES,*				
Monitoring		*Number of training courses conducted and the total number of trainees*				
Budget Estimate		*$300,000 (External Experts, training costs)*				
Implementation Time-frame		*Medium Term*				
Roadmap Activity No:		***C.6***	*Commencement*	*Year 3*	*Duration (months)*	*24*

SECTOR		**INDUSTRY**				
Strategic Objective	**3**	Capacity building in EE&C in the industry sector is strengthened				
Program / Activity	**2**	Introduce Energy Auditor & Energy Manager certification programs				
Rationale		*At present there are no accreditation schemes for energy service providers and hence, enterprises have difficulty in engaging professionals to conduct energy audits. On addition, it is proposed to appoint Energy Managers in enterprises to coordinate data collection and EE activities to be undertaken by EECD*				
Strategy		*Develop regulations for the accreditation of Energy Auditors and Energy Managers to ensure that EE activities are undertaken by certified professionals*				
Target Market Segment		*Professional engineers, consultants*				
Program Description		*Develop regulations for the accreditation of Energy Auditors and Energy Managers stipulating minimum qualification requirements and the process for the issuance of Certificate of Accreditation.*				
Tasks / Activities		*The regulations will stipulate the following:* • *The Board of Management responsible for the accreditation and maintain a Register of all accredited Energy Auditors and Energy Managers* • *The minimum qualifications and experience required* • *The process for submitting applications and evaluation* • *Requirements for formal training in energy management*				
Expected Outputs		*A Register of accredited Energy Auditors and Energy Managers for the provision of energy services.*				
Implementing Agency		*EECD*				
Other Stakeholders		*MES,MOE, ACE,, Ministry of Science and Technology*				
Monitoring Procedures		*Establishment of Board of Management, development of accreditation process; number of accredited auditors and Energy Managers*				
Budget Estimate		*$150,000 (External Experts, training materials)*				
Implementation Time-frame		*Short Term*				
Roadmap Activity No:		***B.2***	*Commencement*	*Year 1*	*Duration (months)*	*24*

SECTOR		**INDUSTRY**				
Strategic Objective	**3**	Capacity building in EE&C in the industry sector is strengthened				
Program / Activity	**3**	UNIDO Program – Improvement of Industrial Energy Efficiency				
Rationale		*This program has been approved by UNIDO to promote Green House Gas (GHG) in Myanmar industry by improving policy and regulatory frameworks, capacity building, implementation of Energy Management Systems and optimization of energy systems*				
Strategy		*To work with respective authorities in the areas of policy, capacity building, demonstration projects and up scaling.*				
Target Market Segment		*Industrial enterprises*				
Program Description		*The program has been approved for implementation from January 2015 to December 2019*				
Tasks / Activities		• *Support in the development of improved policies and regulatory frameworks, incentive schemes, support programs, energy data and awareness which facilitate sustainable energy efficiency improvements in Industry* • *Training in EMS and system optimization* • *Conduct of demonstration projects in selected factories using EMS and system optimization*				
Expected Outputs		*Increased capacity industry personnel in undertaking energy efficiency measures.*				
Implementing Agency		*UNIDO*				
Other Stakeholders		*MOI (National Executing Agency); MOECF (GEF Focal Point); MOE, MOST, UMFCCI; MIA, MES, Financial Institutions, Gender Groups, Civil Society Organizations; Indigenous Groups*				
Monitoring Procedures		*Progress against the project schedule*				
Budget Estimate		*$2,830,000 (GEF Grant – External Experts)*				
Implementation Time-frame		*Short Term*				
Roadmap Activity No:		***B.3***	*Commencement*	*Year 1*	*Duration (months)*	*60*

SECTOR		**INDUSTRY**				
Strategic Objective	**3**	Capacity building in EE&C in the industry sector is strengthened				
Program / Activity	**4**	Support the Development of Energy Services Companies (ESCOs)				
Rationale		*Implementation of EE measures in Industry has been hampered by the lack of energy service providers who have the skills in energy audits, implementation and project management*				
Strategy		*Develop the skills of interested firms or contractors to function as professional ESCOs*				
Target Market Segment		*Private sector firms or contractors*				
Program Description		*Develop and implement a customized training program with the objective of establishing ESCOs*				
Tasks / Activities		• *Seek Expressions of Interest (EOI) from firms wishing to provide energy services to industry* • *Develop a customized training program including the preparation of business plans for ESCOs* • *Develop a certification scheme for ESCOs*				
Expected Outputs		*A pool of certified ESCOs with expertise to provide EE services to industrial and Commercial sectors*				
Implementing Agency		*MOI*				
Other Stakeholders		*MOE, UMFCCI, MIA, MES*				
Monitoring Procedures		*Number of ESCOs established; number of projects implemented by ESCOs*				
Budget Estimate		*$300,000 (External ESCO Experts, training costs)*				
Implementation Time-frame		*Long Term*				
Roadmap Activity No:		***D.1***	*Commencement*	*Year 4*	*Duration (months)*	*24*

8.3 Sector Activities - Commercial

SECTOR		**COMMERCIAL**				
Strategic Objective	1	Energy Efficiency is incorporated in new building design and refurbishments				
Program / Activity	1	Development of an Energy Efficiency Building Code (EEBC)				
Rationale		*The existing building regulations do not have any criteria on energy efficiency. International experience show that around 20% of life cycle costs of operation could be saved through the introduction of EEBC*				
Strategy		*Review EEBCs developed in the region and adopt similar code for Myanmar*				
Target Market Segment		*New and Old Commercial Buildings*				
Program Description		*Review of building codes in the region and develop a similar code for Myanmar*				
Tasks / Activities		• *Conduct a review of EE Building Codes in the region especially those with similar climatic zones to Myanmar. These would include Thailand, Vietnam, Sri Lanka and India* • *Establish a Steering Committee for the development of the code* • *Prepare a draft building code incorporating energy efficiency criteria and compliance procedures.* • *Finalize the EEBC following public consultations* • *Conduct training for Field Inspectors*				
Expected Outputs		*EE Building Code for Myanmar based on experience in countries in the region*				
Implementing Agency		*MOI, Ministry of Construction,*				
Other Stakeholders		*City Development Committees, Association of Myanmar Architects (AMA), MOE, MOST, MES*				
Monitoring Procedures		*Progress against the Schedule*				
Budget Estimate		*$500,000 (External Building Experts, training , public consultations)*				
Implementation Time-frame		*Medium Term*				
Roadmap Activity No:		***C.9***	*Commencement*	*Year 2*	*Duration (months)*	*36*

SECTOR		**COMMERCIAL**				
Strategic Objective	**1**	Energy Efficiency is incorporated in new building design and refurbishment of existing buildings				
Program / Activity	**2**	Capacity Building of Architects and Engineers in EE Building Design				
Rationale		*Architects and Engineers need to be aware of the provisions of the EEBC*				
Strategy		*As a part of the EEBC develop a capacity building program for building designers and also building owners of EE technologies and operational benefits*				
Target Market Segment		*Architects, Building Developers, Building Engineers*				
Program Description		*A nationwide capacity building program will be developed to explain the provisions of the EEBC, design criteria and options for compliance; cost-benefit analysis and building permit approval procedures*				
Tasks / Activities		• *Review of scope of similar programs in the region* • *Develop and conduct programs for the key stakeholders nationwide*				
Expected Outputs		*Building owners and designers are aware of the provisions of the EEBC; and architects are trained for compliance with the code.*				
Implementing Agency		*MOI, Ministry of Construction, AMA, MES, EECD,*				
Other Stakeholders		*City Development Committees, Civil Society Organizations, Construction Companies*				
Monitoring Procedures		*Number of training programs conducted annually and the no: of participants in the programs*				
Budget Estimate		*$150,000 (External EE Building Experts, training costs)*				
Implementation Time-frame		*Long Term*				
Roadmap Activity No:		***D.2***	*Commencement*	*Year 4*	*Duration (months)*	*24*

SECTOR		**COMMERCIAL**				
Strategic Objective	**2**	Energy Efficiency technologies are implemented in the Commercial sector				
Program / Activity	**1**	Prepare Energy Efficiency Guidelines for Commercial Buildings				
Rationale		*At present there are no technical publications in Myanmar that relate energy efficiency in commercial buildings and hence, building owners and developers are not aware of applicable EE technologies that would reduce overall operating costs.*				
Strategy		*To develop EE Best Practices Guidelines for Commercial Buildings including international case studies*				
Target Market Segment		*Office Buildings, Hotels, Restaurants, Shopping Malls*				
Program Description		*The program covers research on EE best practices internationally, especially in the region and preparation of EE Guidelines. Dissemination is achieved through the conduct of workshops.*				
Tasks / Activities		• *Market research on EE Best Practices and case studies in Commercial Buildings* • *Publication of Energy Efficiency Guidelines for each sub-sector (Office Buildings, Hotels, Restaurants etc)* • *Conduct workshops for dissemination of information*				
Expected Outputs		*The knowledge of EE best practices are increased amongst managers of enterprises and increased likelihood of adoption of these options.*				
Implementing Agency		*EECD*				
Other Stakeholders		*MOC, MOE, AMA, MOST, Ministry of Hotels and Tourism , Ministry of Construction, City Development Committees*				
Monitoring Procedures		*Schedule for publication of Guideline and distribution*				
Budget Estimate		*$50,000 (Content, printing and dissemination)*				
Implementation Time-frame		*Long Term*				
Roadmap Activity No:		***D.3***	*Commencement*	*Year 4*	*Duration (months)*	*6*

SECTOR		**COMMERCIAL**				
Strategic Objective	**2**	Energy Efficiency technologies are implemented in the Commercial sector				
Program / Activity	**2**	Training in the conduct of detailed energy audits				
Rationale		*Currently building or hotel engineers do not have any formal training in the conduct of energy audits in their own enterprises*				
Strategy		*Conduct sub-sector focused energy audit training program to engineers and maintenance personnel*				
Target Market Segment		*Office buildings, hotels*				
Program Description		*The energy audit program will include a 3 phase program for each sub-sector – conduct of walk through audits, conduct of detailed energy audits and conduct of Investment Grade audits. The program will include classroom type training and on-site measurements.*				
Tasks / Activities		*The scope of training for each subsector will include:* • *Phase 1: Historical data collection and analysis; equipment inventory, initial survey of end-use equipment and preliminary estimation of EE opportunities* • *Phase 2: EE end-use technologies (lighting, ACs, water heating etc), cost-benefit analysis and reporting* • *Phase 3: Conduct of Investment grade audit including budget quotations for equipment/installation, monitoring & verification plan, sensitivity analysis and project cash-flow statements; and report preparation for submission to financial institutions for funding*				
Expected Outputs		*In-house capacity to conduct energy audits and implement EE measures*				
Implementing Agency		*EECD, MES,*				
Other Stakeholders		*Ministry of Construction, Construction Companies, AMA, UMFCCI*				
Monitoring Procedures		*Number of training programs conducted; Number of Trainees*				
Budget Estimate		*Included in C.1*				
Implementation Time-frame		*Medium Term*				
Roadmap Activity No:		***C.12***	*Commencement*	*Year 2*	*Duration (months)*	*24*

SECTOR		**COMMERCIAL**				
Strategic Objective	**2**	Energy Efficiency technologies are implemented in the Commercial sector				
Program / Activity	**3**	Provide financial incentives for implementation of EE measures				
Rationale		*Currently, the market is flooded with low efficiency electrical products (lighting, ACs, refrigerators & freezers) which has a significant market share compared to EE equipment due to low cost. Hence, in addition to introducing minimum energy performance standards (MEPS) for electrical appliances other financial incentives should be considered for market transformation to high efficiency products.*				
Strategy		*To introduce tax concessions for the use of EE equipment*				
Target Market Segment		*All sectors (industrial, commercial, residential, public)*				
Program Description		*There are various financial incentives to promote the adoption of EE technologies that has used in some countries in the region that could be considered for Myanmar. These include import duty concessions for EE equipment, higher duty for low efficiency equipment, tax incentives for implementation of EE projects etc.*				
Tasks / Activities		• *Market research to determine the price differentials between low and high efficiency products; and corresponding market share;* • *Review of financial incentives offered in countries in the region* • *Meetings with respective government agencies to determine what options could be considered;* • *Conduct cost/benefit analysis and determine options that would be feasible for the government.*				
Expected Outputs		*Range of financial incentives to promote the use of EE equipment*				
Implementing Agency		*MOI and Ministry of Finance, Central Bank of Myanmar*				
Other Stakeholders		*Financial Associations, Civil Society Organizations, MOC, Ministry of Commerce, City Development Committees, UMFCCI*				
Monitoring Procedures		*Schedule for development and introduction of Incentives*				
Budget Estimate		*Included in C.3*				
Implementation Time-frame		*Medium Term*				
Roadmap Activity No:		***C.13***	*Commencement*	*Year 2*	*Duration (months)*	*6*

SECTOR		**COMMERCIAL**				
Strategic Objective	**2**	Energy Efficiency technologies are implemented in the Commercial sector				
Program / Activity	**4**	Support local manufacture of EE equipment				
Rationale		*Almost all the electrical products are imported from the neighbouring countries without any consideration energy performance. There is potential for promoting local manufacture of EE products considering the size of the market*				
Strategy		*Provide incentives for the establishment of manufacturing facilities for EE equipment.*				
Target Market Segment		*All electricity consumers*				
Program Description		*Currently, there is one local manufacturer of LED lighting and a manufacturer of solar water heating systems. The aim is to encourage other investors to enter the EE equipment market for new products or in competition with the existing products (LED and SWH) ensuring minimum energy performance standards.*				
Tasks / Activities		• *Meetings with existing manufacturers to determine market barriers in promoting their products in the local market* • *Determine a package of incentives that could be offered to local manufacturers of EE products.* • *Assist local entrepreneurs in the establishment of new businesses.*				
Expected Outputs		*Local manufacturing capability of EE equipment*				
Implementing Agency		*MOI, Ministry of Commerce, Custom Department, UMFCCI, Ministry of Finance*				
Other Stakeholders		*Local Government, City Development Committee, Financial Associations,*				
Monitoring		*Number of enterprises established for production of EE equipment*				
Budget Estimate		*EECD Operating Budget*				
Implementation Time-frame		*Long Term*				
Roadmap Activity No:		***D.4***	*Commencement*	*Year 4*	*Duration (months)*	*24*

SECTOR		**COMMERCIAL**				
Strategic Objective	**3**	Renewable Energy technologies are promoted in the Commercial sector				
Program / Activity	**1**	Promotion of Solar Water Heating systems in hotels and buildings				
Rationale		*Most hotels have electric hot water systems which could be cost effectively replaced by Solar Water Heating (SWH)*				
Strategy		*Promote the benefits of SWH amongst potential users*				
Target Market Segment		*Hotels, Restaurants, Office Buildings, Hospitals*				
Program Description		*Prepare materials showing the cost comparisons of electric and solar hot water systems; and conduct seminars to the potential sub-sectors. Government incentives for conversion could also be considered.*				
Tasks / Activities		• *Evaluate the capital and operation costs of electric hot water systems and SWH* • *Review international experiences and case studies* • *Prepare promotional material* • *Conduct seminars to the potential sub-sectors* • *Evaluate financial incentives (e.g. tax rebates) that could be offered for SWH*				
Expected Outputs		*Increased use of SWH*				
Implementing Agency		*MOI, MOST, MOE, Ministry of Finance*				
Other Stakeholders		*Renewable Energy Association Myanmar (REAM), MES, Ministry of Finance, UMFCCI, MIA*				
Monitoring Procedures		*Number of promotion events conducted; Increase of market share of SWH*				
Budget Estimate		*EECD Operating Budget*				
Implementation Time-frame		*Medium Term*				
Roadmap Activity No:		***C.14***	*Commencement*	*Year 3*	*Duration (months)*	*36*

SECTOR		**COMMERCIAL**				
Strategic Objective	**3**	Renewable Energy technologies are promoted in the Commercial sector				
Program / Activity	**2**	Promotion of PV systems for supplementing on-grid supply				
Rationale		*Considering the generation capacity shortage and proposed increase in electrification there is potential to encourage the installation of individual PV systems and adopt Net-Metering procedures*				
Strategy		*Encourage electricity customers to install PV systems with guaranteed by-back of surplus electricity*				
Target Market Segment		*All electricity consumers*				
Program Description		*Implement a Net Metering program whereby customers invest in their own generation (PV System) to off-set their electricity consumption from the grid and enabling customers to be paid retail prices for the excess electricity that is put back into the grid.*				
Tasks / Activities		• *Develop a Net-Metering Policy encouraging on-site renewable energy generation.* • *Discussions with financial institutions on financing options of PV Systems* • *Promote program amongst potential customers*				
Expected Outputs		*Higher percentage of Renewable Energy in the generation mix*				
Implementing Agency		*MOI, MOST,MOEP, MOE*				
Other Stakeholders		*Renewable Energy Association Myanmar (REAM), MES, Ministry of Finance, UMFCCI, MIA*				
Monitoring Procedures		*Number of events organized; Market share of PV systems*				
Budget Estimate		*EECD Operating Budget*				
Implementation Time-frame		*Medium Term*				
Roadmap Activity No:		***C.15***	*Commencement*	*Year 3*	*Duration (months)*	*36*

SECTOR		**COMMERCIAL**				
Strategic Objective	**4**	The awareness of EE and capacity building amongst key stakeholders is increased				
Program / Activity	**1**	Increase awareness of technology best practices in the region				
Rationale		*Managers and maintenance staff in the commercial sector have had limited opportunity to engage in seminars in the region relating to EE and hence, are generally unaware of the current technologies practiced in their respective enterprises*				
Strategy		*To promote the establishment of relevant Associations in Myanmar (e.g. Hotels Association) and interaction with similar associations in the region to share EE experiences and seek assistance from donor agencies to support participation in regional energy forums.*				
Target Market Segment		*All commercial enterprises – owners, managers and maintenance staff*				
Program Description		*The aim is to provide access to on information EE technologies applicable for various enterprises and sharing of results of any programs implemented in Myanmar and countries in the region*				
Tasks / Activities		• *Establishment of relevant Associations in various sub-sectors* • *Participation in energy seminars and workshops in the region* • *Site visits to enterprises outside Myanmar where EE technologies are in operation* • *Communication campaigns targeting owners and managers in enterprises through the associations include the issue of e-newsletters on energy efficient best practices in Myanmar and the region.*				
Expected Outputs		*Owners and managers in industrial enterprises are aware of the benefits of application of various EE technologies*				
Implementing Agency		*MOI, MES,MOEP, MOE*				
Other Stakeholders		*MES,REAM, ACE, ECCJ, UNIDO, UMFCCI,MIA,*				
Monitoring Procedures		*Number of seminars conducted*				
Budget Estimate		*EECD Operating Budget*				
Implementation Time-frame		*Medium Term*				
Roadmap Activity No:		***C.16***	*Commencement*	*Year 3*	*Duration (months)*	*24*

8.4 Sector Activities – Residential

SECTOR		**RESIDENTIAL**				
Strategic Objective	1	Household energy costs are reduced through energy standards for appliances				
Program / Activity	1	Introduce EE performance standards and labeling for appliances				
Rationale		*The current market penetration of EE products and appliances (lighting, air conditioning, refrigerators and other home appliances) is very low. There is potential for significant energy savings through the introduction of Minimum Energy Performance Standards (MEPS) and Energy Labelling schemes similar to most countries in the region (Thailand, Malaysia, India, Philippines, Vietnam and Sri Lanka)*				
Strategy		*Promulgation of laws and regulations for minimum energy performance standards (MEPS) for selected appliances and the introduction of a energy labelling scheme*				
Target Market Segment		*All sectors – primarily residential*				
Program Description		*Develop laws and regulations for MEPS for selected appliances (lighting, Refrigerators, ACs, Fans,) and adoption of import regulations for meeting minimum standards.*				
Tasks / Activities		• *Review of similar programs in the region and determine approaches for Myanmar* • *Develop MEPS for selected appliances and the relevant laws and regulations for implementation* • *Consultations with relevant stakeholders and finalize implementation.* • *Develop energy labelling scheme after review of regional programs.* • *Finalize legal arrangements with manufacturers/importers of electrical appliances with regard to mandatory labelling requirements* • *Conduct public awareness campaign of labelling scheme.*				
Expected Outputs		*Higher EE products are gradually introduced into the market with significant energy savings to the consumers*				
Implementing Agency		*MOI, Ministry of Science and Technology*				
Other Stakeholders		*Standards Institute Myanmar Scientific and Technological Research Department (MSTRD) Technical Standard Committee under NEMC, Civil Society , MOEP*				
Monitoring Procedures		*Development and Implementation Schedule for MEPS*				
Budget Estimate		*$300,000 (External Experts, Public Awareness)*				
Implementation Time-frame		*Medium Term*				
Roadmap Activity No:		***C.17***	*Commencement*	*Year 2*	*Duration (months)*	*24*

SECTOR		**RESIDENTIAL**				
Strategic Objective	**1**	Household energy costs are reduced through energy standards for appliances				
Program / Activity	**2**	Testing and certification facilities for appliances				
Rationale		*All appliances under the Energy Standards and Labeling Program have to be tested and certified for compliance*				
Strategy		*Review the options for testing and certification facilities – could be either establishing testing laboratories in Myanmar or using existing facilities in neighboring countries.*				
Target Market Segment		*All sectors – primarily residential*				
Program Description		*The testing protocols will be specified in the energy performance and labeling regulations and the manufacturers and importers will be required to provide certificates of compliance for the products. Testing laboratories could be established in Myanmar or there is an option of utilising existing facilities in Thailand or India*				
Tasks / Activities		• *Review testing facilities in neighbouring countries and determine the feasibility of using these facilities for equipment imported to Myanmar (or manufactured in Myanmar)* • *Conduct a feasibility study for the establishment of testing facilities in Myanmar including resources, training and budget.*				
Expected Outputs		*Certified testing facilities in compliance with EE Performance Standards and Labeling Program.*				
Implementing Agency		*EECD, Ministry of Science and Technology (MOST)*				
Other Stakeholders		*MOEP, MES, AEMAS, ACE, ECCJ,*				
Monitoring Procedures		*Schedule for the establishment of testing facilities*				
Budget Estimate		*$300,000 (External Experts) – Laboratory equipment excluded*				
Implementation Time-frame		*Medium Term*				
Roadmap Activity No:		***C.18***	*Commencement*	*Year 3*	*Duration (months)*	*6*

SECTOR		**RESIDENTIAL**				
Strategic Objective	**1**	Household energy costs are reduced through energy standards for appliances				
Program / Activity	3	Introduction of incentives for EE equipment				
Rationale		*Initial market research has shown that there a tendency to buy the cheapest appliance irrespective of higher operating costs (due to lower efficiency) due to affordability. Hence, incentives need to be considered to increase the market share of the high EE products.*				
Strategy		*To provide a range of incentives aimed at encouraging consumers to purchase high EE appliances*				
Target Market Segment		*All appliances*				
Program Description		*The program will focus on addressing the incremental cost of a EE unit compared to a low efficiency unit by providing some incentives to address the upfront cost. The incentives may include:* • *Payment in instalments with no-interest or low-interest* • *Rebates to meet incremental cost for exchange of old units with high EE units* • *Import duty concessions on EE appliances*				
Tasks / Activities		• *Review international incentive schemes and determine appropriate models that may be relevant in Myanmar.* • *Meet with stakeholders to finalize incentive scheme.* • *Publish brochures promoting the benefits of EE appliances*				
Expected Outputs		*Increased market share of EE appliances*				
Implementing Agency		*MOI, Ministry of Finance, City Development Committee*				
Other Stakeholders		*Local government Agencies, Civil Society Organizations, UMFCCI*				
Monitoring Procedures		*Approval of EE incentives and promotion activities*				
Budget Estimate		*Included in C.3*				
Implementation Time-frame		*Medium Term*				
Roadmap Activity No:		***C.19***	*Commencement*	*Year 2*	*Duration (months)*	*6*

SECTOR		**RESIDENTIAL**				
Strategic Objective	1	Household energy costs are reduced through energy standards for appliances				
Program / Activity	4	Phasing out of inefficient appliances from the market				
Rationale		*In spite of the introduction of EE standards and Labelling scheme for appliances the enforcement of these standards will be challenging. Countries in the region have experienced counterfeit labels, fake test certificates and smuggling of low efficiency units.*				
Strategy		*Developing a Phase-out policy for low efficiency appliances and enforcement.*				
Target Market Segment		*All appliances in the S&L Scheme.*				
Program Description		*Several countries have introduced phase-out policies for Incandescent Bulbs (IBs) and promoting CFLs as replacements. The program also needs to address the infiltration of inefficient appliances with fake labels that would be hard to detect for average consumers.*				
Tasks / Activities		• *Review international policies relating to phasing out of inefficient electrical products and adopt options suitable for Myanmar* • *Develop laws and regulations for non compliance of S&L program* • *Strengthen enforcement procedures*				
Expected Outputs		*Inefficient electrical products phased out from the market*				
Implementing Agency		*MOI, Ministry of Commerce, Myanmar Customs Department*				
Other Stakeholders		*UMFCCI, MIA, Local Government Agencies*				
Monitoring Procedures		*Schedule for Policy development and implementation*				
Budget Estimate		*EECD Operating Budget*				
Implementation Time-frame		*Long Term (Commencing Year 4)*				
Roadmap Activity No:		***D.6***	*Commencement*	*Year 4*	*Duration (months)*	*12*

SECTOR		**RESIDENTIAL**				
Strategic Objective	1	Household energy costs are reduced through energy standards for appliances				
Program / Activity	5	Promote efficient biomass cook stoves				
Rationale		*Biomass (Fuelwood/Charcoal) is the predominant fuel for cooking in urban and rural households. Hence, the promotion of efficient biomass cook stoves would have significant benefits both economic and social.*				
Strategy		*The strategy is to review the latest designs in cook stoves in other international programs in Asia and Africa; and assist the local manufacturers to improve their cook stove designs*				
Target Market Segment		*Urban and rural households*				
Program Description		*There are several UN agencies (e.g. UN Foundation) that are promoting efficient cook stoves in Asia and Africa.. The program will compare the designs that are currently available in Myanmar and compare the efficiencies of the design in international programs; and assist the local manufacturers in adopting more efficient designs.*				
Tasks / Activities		• *Review results of household surveys recently conducted in Myanmar to determine the penetration of the existing range of cook stoves* • *Discussion with local manufacturers on development activities to improve efficiency and sharing of new designs adopted in other countries.* • *Assist manufacturers in adopting new designs and marketing*				
Expected Outputs		*Transformation to efficient biomass cook stoves*				
Implementing Agency		*Ministry of Environmental Conservation and Forestry, MOI, MOE*				
Other Stakeholders		*Local Government Agencies, UMFCCI, MIA, City Development Committee, REAM, Myanmar Ceramic Association*				
Monitoring Procedures		*Market share of Fuel Efficient Stoves (FES)*				
Budget Estimate		*EECD Operating Budget*				
Implementation Time-frame		*Medium Term*				
Roadmap Activity No:		***C.21***	*Commencement*	*Year 2*	*Duration (months)*	*24*

SECTOR		**RESIDENTIAL**				
Strategic Objective	**2**	Increased used of LPG is adopted by urban households				
Program / Activity	1	Increase consumer awareness of benefits in LPG for cooking				
Rationale		*In spite of LPG being available there is still a high usage of biomass for cooking in urban households. Although LPG is not a EE measure but it is a more efficient use of Myanmar's natural resources and also lower GHG emissions than the use of biomass.*				
Strategy		*Promote the benefits of LPG cooking amongst those households who receive a monthly quota of LPG.*				
Target Market Segment		*Urban households*				
Program Description		*Prepare marketing materials showing the benefits (costs and health) of converting to LPG cooking from the traditional biomass sources; and conduct an awareness campaign for urban households*				
Tasks / Activities		• *Review international programs and case studies* • *Develop marketing materials promoting the use of LPG* • *Conduct awareness campaign via various stakeholders*				
Expected Outputs		*Reduction in the use of biomass for cooking*				
Implementing Agency		*MOE, Ministry of Environmental Conservation and Forestry, MOI*				
Other Stakeholders		*City Development Committee, UMFCCI, MIA, Local Government Agencies*				
Monitoring Procedures		*Market share of LPG stoves*				
Budget Estimate		*$50,000 (Marketing materials and promotion)*				
Implementation Time-frame		*Short Term*				
Roadmap Activity No:		***B.4***	*Commencement*	*Year 1*	*Duration (months)*	*24*

SECTOR		**RESIDENTIAL**				
Strategic Objective	**2**	Increased used of LPG is adopted by urban households				
Program / Activity	2	Introduce EE labeling scheme for LPG cook stoves				
Rationale		*There is a wide range of LPG cook stoves in the market but the consumers are not aware of the efficiencies of the different products to make purchase decisions.*				
Strategy		*To include LPG cook stoves in the program for energy Standards & Labelling (S&L) proposed for electrical appliances*				
Target Market Segment		*Mainly urban households*				
Program Description		*The Bureau of Energy Efficiency (BEE) and Petroleum Conservation Research Association (PCRA) in India are developing "star ratings" for LPG cook stoves based on thermal efficiency. It is proposed to adopt a similar rating scheme for LPG cook stoves imported to Myanmar.*				
Tasks / Activities		• *Obtain information on the rating program in India and determine the feasibility of adopting the same standards/labelling for Myanmar* • *Include LPG stoves in the S&L Program*				
Expected Outputs		*Higher efficiency LPG cook stoves are introduced in to the market*				
Implementing Agency		*MOI, MSTRD, MOST*				
Other Stakeholders		*MOE, Ministry of Environmental Conservation and Forestry, Technical Standard Committee under NEMC*				
Monitoring Procedures		*Schedule for MEPS and Labelling Program*				
Budget Estimate		*Included in C.17*				
Implementation Time-frame		*Medium Term*				
Roadmap Activity No:		***C.22***	*Commencement*	*Year 3*	*Duration (months)*	*24*

SECTOR		**RESIDENTIAL**				
Strategic Objective	**3**	Awareness of EE technologies are increased in the residential sector				
Program / Activity	**1**	Conduct of regular EE awareness campaigns in national media				
Rationale		*Most households are not aware of EE appliances and their benefits*				
Strategy		*To adopt a regular awareness campaign utilizing different communication channels*				
Target Market Segment		*Residential and small commercial*				
Program Description		*Prepare a series of promotional materials; develop and implement an awareness program using various media outlets.*				
Tasks / Activities		• *Design and produce various publications (e.g. Home Energy Guide) for use in awareness campaign* • *Prepare video clips and radio spots for advertising* • *Conduct regular media briefings on EE* • *Conduct awareness programs via housing associations*				
Expected Outputs		*Higher penetration of EE appliances in the market and cost savings*				
Implementing Agency		*MOI, Ministry of Information*				
Other Stakeholders		*MOEP, MOE, MOST, Local Government Agencies, Civil Society Organizations*				
Monitoring Procedures		*Schedule for the preparation of materials and awareness programs conducted*				
Budget Estimate		*$50,000 (advertising)*				
Implementation Time-frame		*Short Term*				
Roadmap Activity No:		***B.5***	*Commencement*	*Year 1*	*Duration (months)*	*24*

SECTOR		**RESIDENTIAL**				
Strategic Objective	**3**	Awareness of EE technologies are increased in the residential sector				
Program / Activity	2	Training programs targeting educational institutions				
Rationale		*Introduction of energy efficiency concepts to schools curricula will result in students applying these in their home environment.*				
Strategy		*Develop curriculum materials for primary and secondary students in coordination with the Ministry of Education*				
Target Market Segment		*Primary and Secondary schools*				
Program Description		*There are several schools programs conducted in other countries that have impacted of household energy consumption. These include energy audit workbooks for students, curriculum material in both primary and secondary grades, conduct of schools energy audits with teachers and students, EE poster campaigns etc.*				
Tasks / Activities		• *Discussions with the Ministry of Education on the key aspects for a EE Schools Program* • *Develop curriculum material with assistance from the Ministry* • *Prepare resource material for the conduct of program* • *Provide training to teaching staff on energy efficiency and conduct of energy audits*				
Expected Outputs		*Increased participation of students in reducing household energy consumption*				
Implementing Agency		*EECD, Ministry of Education, MOST*				
Other Stakeholders		*MOEP, MOE, Local Government Agencies, Schools teachers, Technological Institues*				
Monitoring Procedures		*Schedule for curriculum development and introduction*				
Budget Estimate		*EECD Operating budget*				
Implementation Time-frame		*Long Term*				
Roadmap Activity No:		***D.5***	*Commencement*	*Year 4*	*Duration (months)*	*24*

8.5 Sector Activities – Public Buildings

SECTOR		**PUBLIC BUILDINGS**				
Strategic Objective	**1**	Use of EE technologies in public buildings are increased and energy costs reduced				
Program / Activity	1	Implementation of energy audit program for public buildings				
Rationale		*Currently maintenance personnel and building managers do not have any formal training in the conduct of energy audits in their own buildings*				
Strategy		*Conduct focused energy audit training program to managers and maintenance personnel*				
Target Market Segment		*Public Buildings*				
Program Description		*The energy audit program will include a 3 phase program – conduct of walk through audits, conduct of detailed energy audits and conduct of Investment Grade audits. The program will include classroom type training and on-site measurements.*				
Tasks / Activities		*The scope of training for each subsector will include:* • *Phase 1: Historical data collection and analysis; equipment inventory, initial survey of end-use equipment and preliminary estimation of EE opportunities* • *Phase 2: EE end-use technologies (lighting, ACs, water heating etc), cost-benefit analysis and reporting* • *Phase 3: Conduct of Investment grade audit including budget quotations for equipment/installation, monitoring & verification plan, sensitivity analysis and project cash-flow statements; and report preparation for submission to the respective Ministry for funding*				
Expected Outputs		*In-house capacity within each Ministry to conduct energy audits and implement EE measures*				
Implementing Agency		*MOI , MOEP*				
Other Stakeholders		*Union Ministries MES, Local Government Agencies, City Development Committee, AMA*				
Monitoring Procedures		*Number of training programs conducted; number of trainees*				
Budget Estimate		*Included in C.1*				
Implementation Time-frame		*Medium Term (Commencing Year 3)*				
Roadmap Activity No:		***C.23***	*Commencement*	*Year 3*	*Duration (months)*	*24*

SECTOR		**PUBLIC BUILDINGS**				
Strategic Objective	**1**	Use of EE technologies in public buildings are increased and overall energy costs are reduced				
Program / Activity	2	Adoption of standard procurement guidelines for equipment				
Rationale		*At present there are no standard procurement guidelines for the public sector for office equipment and appliances. As a result. Procurement is based on the preferences of each Ministry*				
Strategy		*To develop Procurement Guidelines for the Public Sector which includes all energy consuming equipment and ensure specifications for EE equipment is included.*				
Target Market Segment		*All public sector procurement*				
Program Description		*It is proposed to develop technical specifications for a range of energy consuming equipment (lighting, ACs, Fans, Computers, Printers, Copiers etc) that would include energy performance standards in compliance with the energy Standards & Labeling program. The Procurement Guidelines would be applicable to all Ministries.*				
Tasks / Activities		• *Prepare technical specifications for all major office equipment and appliances incorporating minimum energy performance standards* • *Prepare templates for evaluation of proposals and selection* • *Prepare comprehensive Procurement Guidelines detailing the entire process and submit to the respective Ministry for approval and adoption.*				
Expected Outputs		*Overall energy consumption in the public sector is reduced.*				
Implementing Agency		*MOI, Group of Procurement inter-ministries*				
Other Stakeholders		*Union Ministries,*				
Monitoring Procedures		*Schedule for the development and adoption of procurement guidelines*				
Budget Estimate		*EECD Operating Budget*				
Implementation Time-frame		*Medium Term*				
Roadmap Activity No:		***C.24***	*Commencement*	*Year 2*	*Duration (months)*	*24*

SECTOR		**PUBLIC BUILDINGS**				
Strategic Objective	**2**	The awareness of EE is increased amongst public sector employees				
Program / Activity	1	Introduction of a Public Sector Energy Management Program				
Rationale		*Currently there is no government policy, program or targets relation to the reduction of public sector energy consumption*				
Strategy		*Introduce a Public Sector Energy Management Program (EMP) outlining the government's target in relation to energy costs and programs to achieve these targets.*				
Target Market Segment		*Public Sector*				
Program Description		*An EMP is designed to reduce the total annual cost of energy at each site (or Ministry) and will include technical options for reducing energy and employee participation. The EMP has four basic steps – Set EM Policy, conduct detailed energy audit, formulate plan of action; and monitor and evaluate progress.*				
Tasks / Activities		• *Develop EM Policy outlining energy consumption savings targets and implementation plan.* • *Assist each Ministry in developing an action plan – conduct of audits, appointment of Energy Manager, implementation of EE measures, Staff Awareness plan and monitoring and evaluation of results*				
Expected Outputs		*Reduction on public sector energy consumption*				
Implementing Agency		*MOI, MOC,MOEP*				
Other Stakeholders		*Union Ministries, AMA*				
Monitoring Procedures		*Schedule for the development of policy; Number of Government Ministries adopting an EMP*				
Budget Estimate		*EECD Operating budget*				
Implementation Time-frame		*Medium Term*				
Roadmap Activity No:		***C.25***	*Commencement*	*Year 3*	*Duration (months)*	*24*

SECTOR		**PUBLIC BUILDINGS**				
Strategic Objective	**2**	The awareness of EE is increased amongst public sector employees				
Program / Activity	2	Prepare Energy Efficiency Guidelines for public buildings				
Rationale		*At present there are no guidelines for energy efficiency in public buildings. This would be required if a Public Sector Energy Management Program is to be implemented.*				
Strategy		*To develop EE Best Practices Guidelines for Public Buildings including international case studies*				
Target Market Segment		*Public Buildings*				
Program Description		*The program covers research on EE best practices internationally, especially in the region and preparation of EE Guidelines. Dissemination is achieved through the conduct of workshops.*				
Tasks / Activities		• *Market research on EE Best Practices and case studies in Commercial Buildings* • *Publication of Energy Efficiency Guidelines including staff awareness program* • *Conduct workshops for dissemination of information*				
Expected Outputs		*The knowledge of EE best practices are increased in the Public sector.*				
Implementing Agency		*MOI, MOEP, MOE*				
Other Stakeholders		*Union Ministries, Local Government Agencies, Ministry of Information*				
Monitoring Procedures		*Schedule for the development of the guideline; Number of workshops conducted*				
Budget Estimate						
Implementation Time-frame		*Medium Term Included in C.5*				
Roadmap Activity No:		***C.26***	*Commencement*	*Year 3*	*Duration (months)*	*6*

SECTOR		**PUBLIC BUILDINGS**				
Strategic Objective	**3**	Capacity building of maintenance staff in EE&C in increased				
Program / Activity	1	Conduct organized training for maintenance staff				
Rationale		*The maintenance staff in Public Sector Building do not have adequate training in EE*				
Strategy		*Conduct customized training programs covering building maintenance that include energy saving options.*				
Target Market Segment		*Public sector maintenance staff*				
Program Description		*The training program will cover all aspects of building maintenance including servicing of various energy consuming equipment, servicing, preventative maintenance etc.*				
Tasks / Activities		• *Develop training materials with assistance from maintenance staff* • *Conduct regular training programs for each Ministry*				
Expected Outputs		*Well maintained buildings with reduced energy losses*				
Implementing Agency		*MOI, MOEP, MOC*				
Other Stakeholders		*AMA, Union Ministries, Local Government Agencies*				
Monitoring Procedures		*Schedule for the development of training materials; Number of training programs conducted and number of staff trained.*				
Budget Estimate		*EECD Operating Budget*				
Implementation Time-frame		*Long Term (Commencing Year 4)*				
Roadmap Activity No:		***D.7***	*Commencement*	*Year 4*	*Duration (months)*	*24*

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