# OPPORTUNITIES AND BARRIERS OF POWER DEVELOPMENT IN MYANMAR

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24September 2015

Bangkok , Thailand

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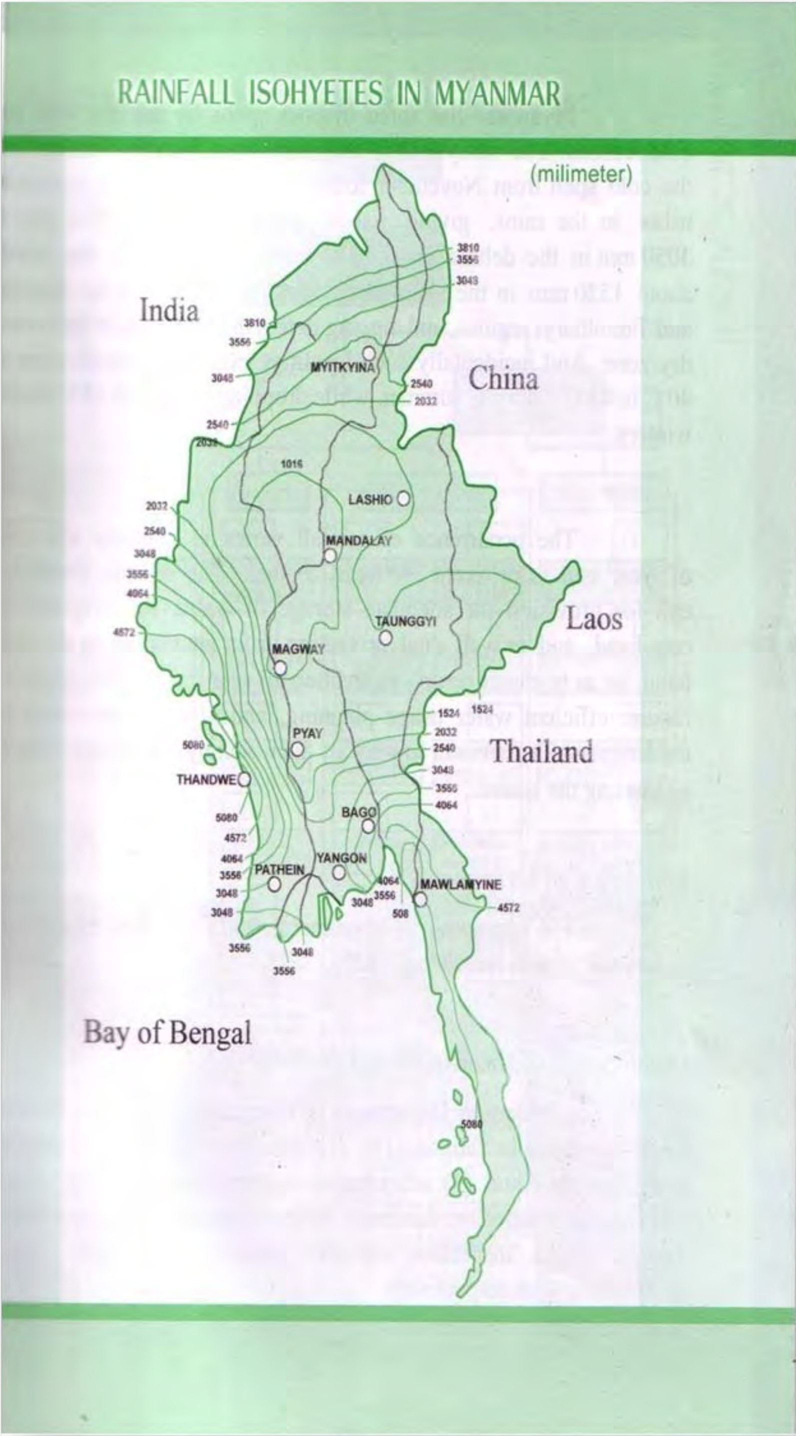
# 1 . Country profile of Myanmar


# 1.1 Myanmar


| | | |
|---|---|---|
| **Location:** | **Latitude** | **9° 32' – 28° 31' N** |
| | **Longitude** | **92° 10' – 101° 11' E** |
| **Land wise** | | |
| **North to South** | | **2060 Km** |
| **East to West** | | **945 Km** |
| **Area:** | | **67.76 million-hectares** |
| | | **(677,577 sq km)** |
| **Population** | | **60.2 million** |
| **Growth rate** | | **1.52%** |
| **Rural population** | | **69%** |
| **North** | | **China** |
| **East** | | **Thailand and Laos PDR** |
| **West** | | **India and Bangladesh** |
| **South** | | **Thailand** |

**Sharing border with 40 % of world population .**




# 1.2 CLIMATE & RAINFALL

| | |
|---|---|
| *Cold Season* | **November - January** |
| *Dry Season* | **February - April** |
| *Wet Season* | **May - October** |

**Rainfall**

| | |
|---|---|
| **South & West** | |
| **Coastal Strip** | **- 5000 mm** |
| **Delta** | **- 2000 - 3000 mm** |
| **North & Eastern** | |
| **Hilly Region** | **- 1250 - 3000 mm** |
| **Central Myanmar** | **- below 750 mm** |

## 4.1 LAND, VEGETATION AND WATER RESOURCES IN MYANMAR

- Total land area of the country -- 676,577 km2 ( 167.186 mio acre )
- Area of closed & degraded forest -- 344,232 km2 ( 85.06 mio acre )
- River basins offers -- 737.8 km2 ( 182.31 mio acre )
- Annual Surface Water -- 1,081.9 km3
- Estimated Ground Water -- 479 km3

# ANNUAL SURFACE AND GROUNDWATER POTENTIAL IN MYANMAR

| Sr. | River Basin Number | Name of Principal River Basin | Catchment area for each stretch (thousand sq.km) | Average estimated annual surface water($km^3$) | Estimated groundwater Potential ($km^3$) |
|---|---|---|---|---|---|
| 1 | I | Chindwin River | 115.30 | 141.293 | 57.578 |
| 2. | II | Upper Ayeyarwady River (up to its confluence with Chindwin) | 193.30 | 227.920 | 92.599 |
| 3. | III | Lower Ayeyarwady River ( From confluence with Chindwin to its mouth) | 95.60 | 85.80 | 153.249 |
| 4. | IV | Sittoung River | 48.10 | 81.148 | 28.402 |
| 5. | V | Rivers in Rakhine State | 58.30 | 139.245 | 41.774 |
| 6. | VI | Rivers in Taninthari Division | 40.60 | 130.927 | 39.278 |
| 7. | VII | Thanlwin River (From Myanmar boundary To its mouth) | 158.00 | 257.918 | 74.779 |
| 8. | VIII | Mekong River (within Myanmar Territory) | 28.60 | 17.634 | 7.054 |
| | | **TOTAL** | **737.80** | **1081.885** | **494.713** |

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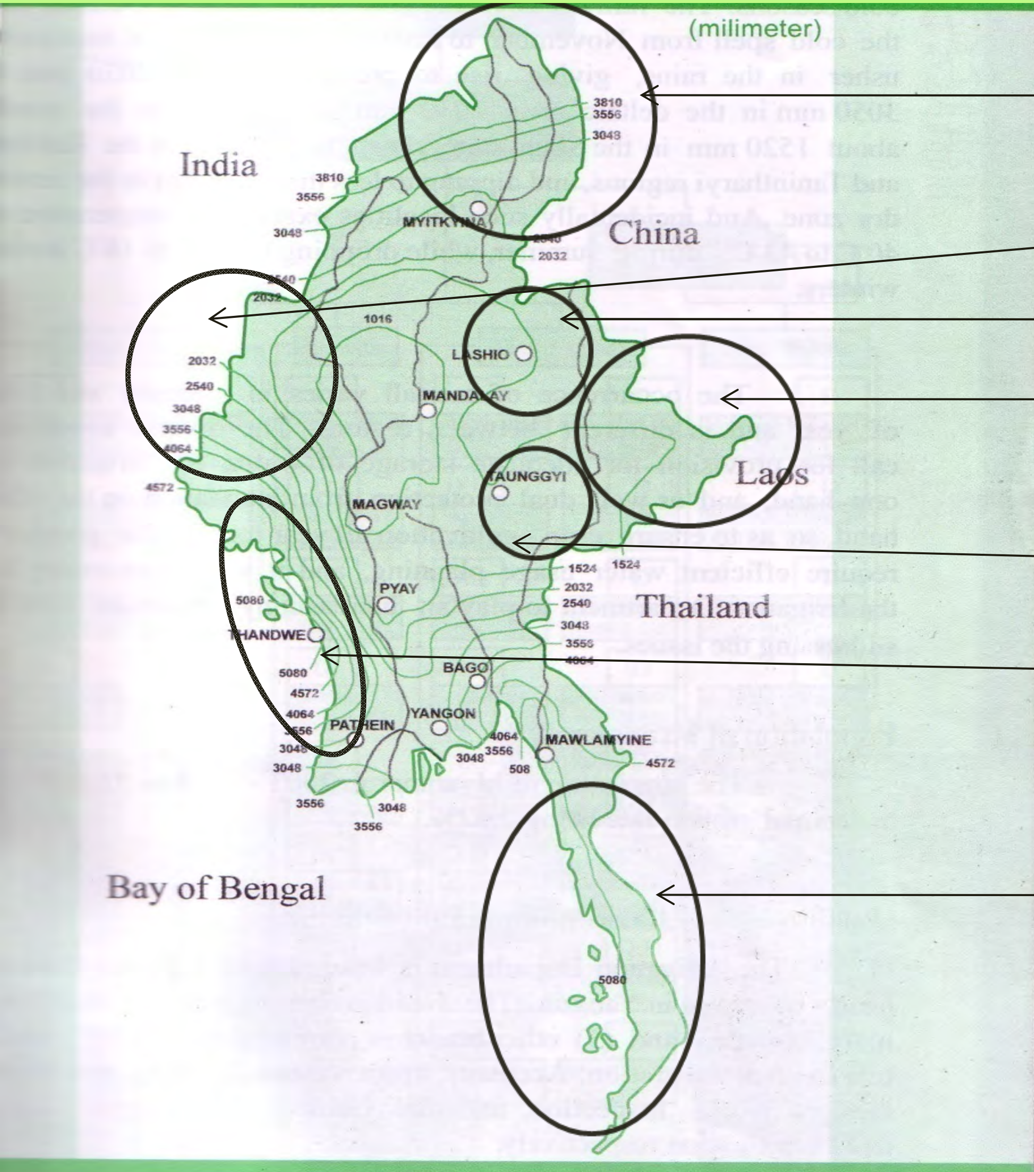
| | | **TOTAL** | **737.80** | **1081.885** | **494.713** |

# land Resources

| Types of land | Million acres | Million hectares |
|---|---|---|
| Net sown area | 28.12 | 11.38 |
| Fallow land | 0.73 | 0.29 |
| Cultural waste land | 14.76 | 5.97 |
| Reserved forests | 40.68 | 16.47 |
| Other forests | 41.97 | 16.99 |
| Other lands | 40.92 | 16.57 |
| Total | 167.18 | 67.68 |
| Source : Myanmar Agriculture in Brief 2008, MOAI, 2008 | | |

# Extendable Land Area for Cultivation




Kachin State- 1,688,660 ha

Chin State - 1,211,340 ha

Shan North - 308,100 ha

Shan East – 1,216,600 ha

Shan South - 516,190 ha

Rakhine State- 112,960 ha

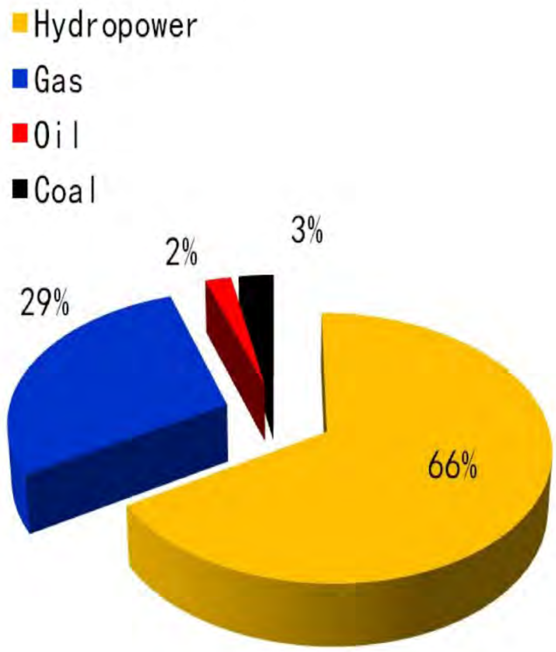
Tanintharyi Division- 254,660 ha

* Other States & Divisions- 446,490 ha

* Total Extendable Land Area - 5,755,000 ha

# Energy resources of Myanmar

## The proportion of conventional energy




The total proven reserves of conventional energy (coal, oil, gas and hydropower) in Myanmar are converted to about 11.9 billion tons of standard coal.

Hydropower is renewable energy with 48.550GW available for economical development, 243 billion kWh annual generation. It is equivalent to about 7.9 billion tons of standard coal for 100-year-use, accounts for 66% of the total exploitable reserve of energy resources.

The proven reserve of gas is 2.54 trillion $m^3$, it is equivalent to about 3.4 billion tons of standard coal, accounts for 29% of the total exploitable reserve of energy resources.

The reserve of coal is 489 million tons, it is equivalent to about 350 million tons of standard coal, accounts for 3% of the total exploitable reserve of energy resources.

The proven reserve of oil is 1.31 billion barrels, it is equivalent to about 260 million tons of standard coal, accounts for 2% of the total exploitable reserve of energy resources.

# Summary of Potentials & Scenario Ranges

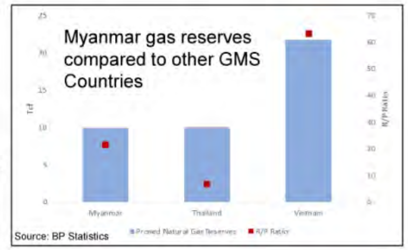
| Resource | Potential | Comments |
|---|---|---|
| Oil (Proven + Probable) | • 610 MM BBL<br>• 102 MM BBL onshore & proven<br>• 43 MM BBL offshore & proven | Backup / reserve capacity |
| Natural Gas (Proven + Probable) | • 166 TSCF (offshore + onshore)<br>• 5.6 TCF proven onshore + 11 TCF proven offshore | • Most of Myanmar's gas is exported<br>• Use in Myanmar contentious |
| Hydro | • 108 GW identified, 45 GW considered<br>• 3 GW installed | • Significant potential<br>• Sustainability, SIA+EIA |
| Coal (Domestic) | Domestic coal, low calorific value<br>540 million tons | • Small scale, if at all<br>• Resource locations not ideal |
| Biomass | 52.5 % of total land area covered with forest potential available annual sustainable yield of woodfuel-19.12 Million Cubic Ton | |
| Wind | • Base: 4000 to 5000 MW (based on limited information), 365-456 TWh/year<br>• High: lack of data (> 5000 MW) | • Resource locations not ideal<br>• 4132 MW of MOU |
| Solar | 51,974 TWh/year (23 GWp) | • Very significant potential |
| Geothermal | • 96 locations have been identified<br>• Commercial potential exists | • Resources identified to date seem feasible to exploit |
| Marine | Not much information | Should be possible |

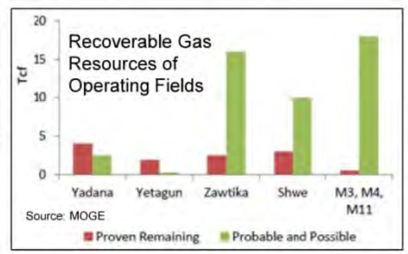
# Natural Gas


- Five gas fields onshore
- Four off-shore gas fields (Yadana, Yetagun,Shwe, Zawtika)
- Export 1300 mmcfd
- Export pipelines to Thailand and China
- Domestic pipelines onshore (4'' and 20'') of 2875 km, plus offshore Yadana to Yangon (24'') of 436 km

- 1092 MW of Gas Turbine capacity
- 236 MW of Gas Engine capacity

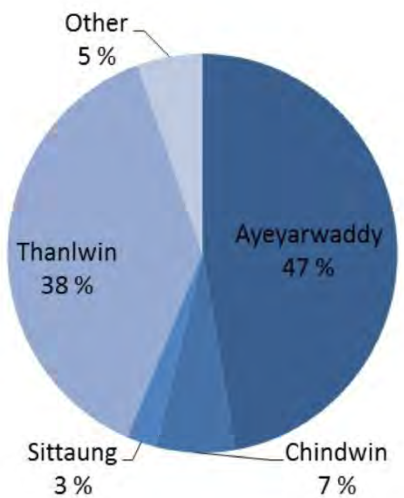
- Most gas exported
- Appropriate allocation of domestic gas (between electricity & non-electricity uses) is a key issue

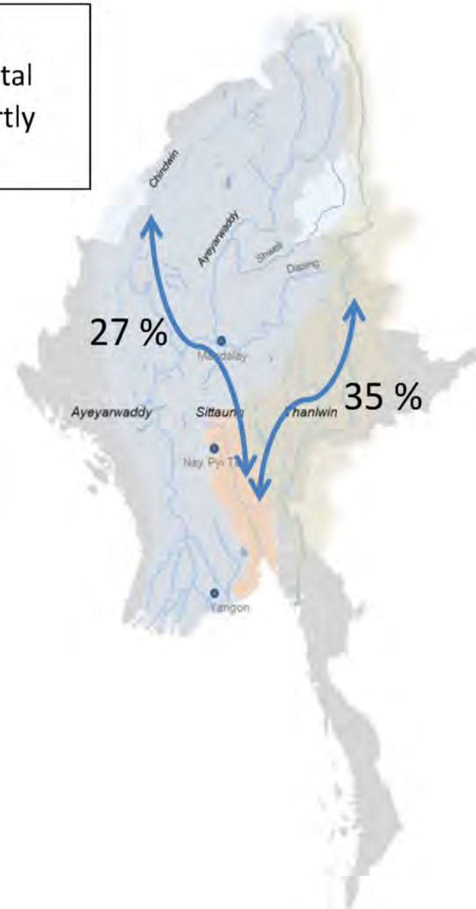


# Hydro Development Potential

Prospects for 108 GW, 3 GW already developed, and 58 projects to the total capacity of 45 GW identified and partly under development




**Annual Variation:**

The likelihood of annual discharge minimum of 60 % seems to be about 10 %.

**Weak Correlation Between River Systems:**

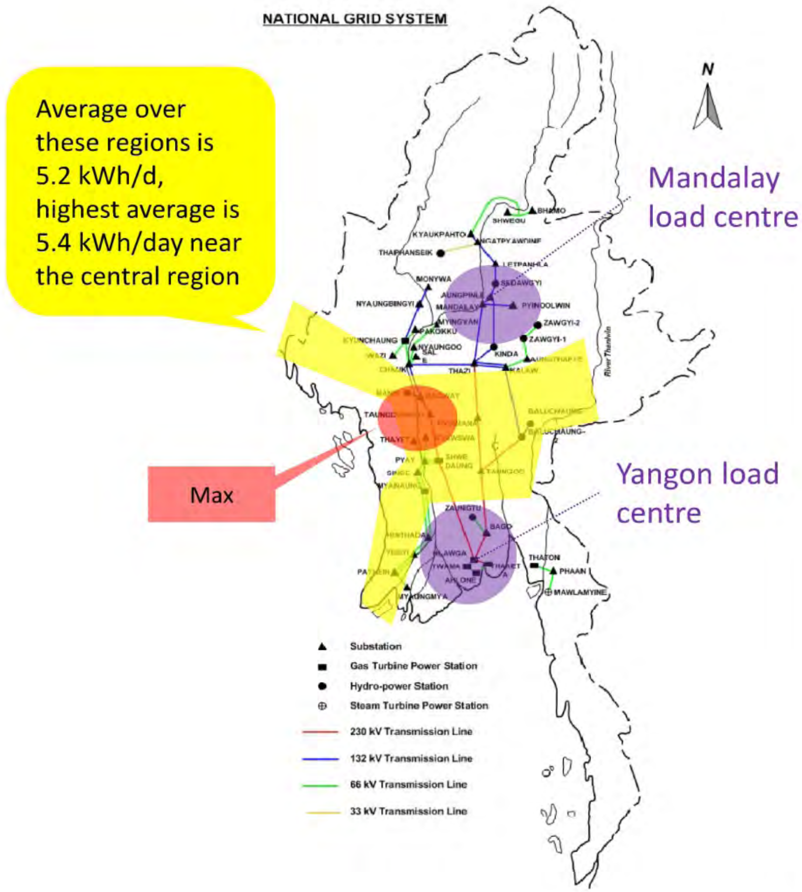
Correlation between annual (12 month moving average) discharges of Chindwin and Sittaung rivers is only 27 %, and correlation of the Sittaung River and Thanlwin River 12-month moving average discharges is 35 %.

*Source: Sakari Oksanen*

# Solar Potential

- Myanmar has very good solar potential especially in the Central Dry Zone Area with potential in the range: 3.3 to 6.6 kWh/m²/day
- Some estimates have placed the potential at 52,000 TWh/year ⇔ 5000 x current annual energy demand
- In August 2014:
  - MOEP signed the first agreement with the US firm ACO Investment for an investment of $480 million in a build-own-transfer (BOT) contract to construct a 300 MW PV (2 x 150 MW) grid-connected solar power plant in two locations in the Mandalay Region that was originally expected to be complete by 2016.
  - Understood to be stalled in PPA negotiation stage
- However, very limited data and detailed studies looking at Myanmar's solar potential

# Myanmar's Solar Potential based on SWERA Toolkit



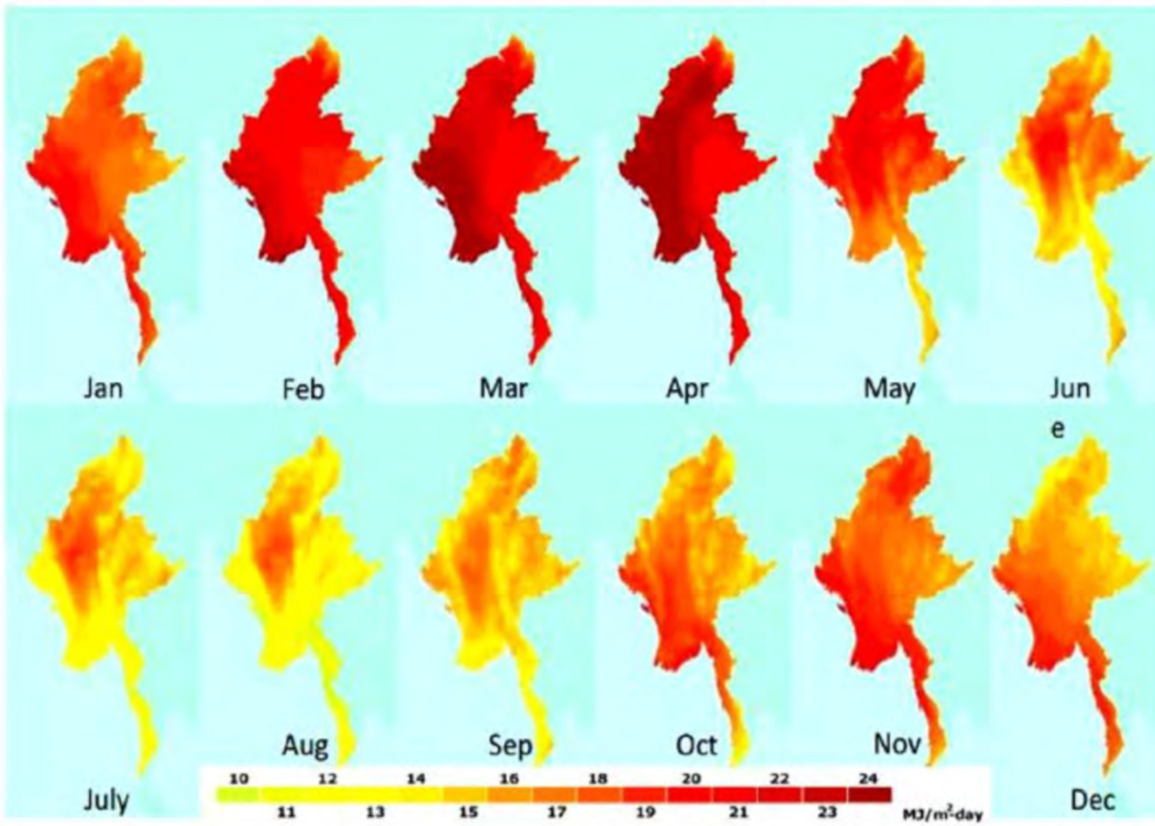

Alternative Source: Annual Monthly Average Radiation Incident on Equator-Pointed Surface (kWh/m²/day)

| Lat \ Long | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 |
|---|---|---|---|---|---|---|---|---|---|
| 28 | 4.95 | 4.46 | 4.31 | 4.32 | 4.6 | 4.78 | [illegible] | 5.46 | 5.28 |
| 27 | 4.21 | 4.23 | 4.49 | 4.42 | 4.21 | 4.31 | 4.79 | 5.29 | 5.26 |
| 26 | 4.97 | 4.86 | 4.61 | 4.37 | 4.5 | 4.57 | 4.82 | 5.2 | 5.24 |
| 25 | 4.92 | 4.91 | 4.62 | 4.63 | 4.8 | 4.76 | 4.94 | 5.11 | 5.17 |
| 24 | 4.96 | 4.75 | 4.75 | 4.76 | 4.93 | 4.87 | 4.92 | 4.86 | 4.87 |
| 23 | 5.11 | 4.74 | 4.92 | 5.05 | 5 | 4.92 | 4.96 | 4.88 | 4.8 |
| 22 | 5.13 | 4.94 | 5.19 | 5.21 | 5.08 | 5.08 | 5.03 | 4.93 | 4.84 |
| 21 | 5.17 | 5.06 | [illegible] | [illegible] | [illegible] | 5.22 | 5.18 | 4.95 | 4.88 |
| 20 | 5.04 | 5.14 | [illegible] | 5.45 | [illegible] | [illegible] | 5.18 | 5.04 | 4.95 |
| 19 | 5.22 | 5.02 | [illegible] | [illegible] | [illegible] | 5.33 | 5.11 | 5.13 | 4.97 |
| 18 | 5.37 | 5.23 | [illegible] | [illegible] | [illegible] | 5.22 | 5.2 | 5.15 | 5.05 |
| 17 | 5.42 | [illegible] | 5.07 | 5.13 | [illegible] | 5.03 | [illegible] | 5.29 | 5.09 |
| 16 | 5.45 | 5.23 | [illegible] | 4.93 | [illegible] | 4.97 | 4.98 | 5.39 | 5.08 |
| 15 | 5.48 | 5.42 | 5.24 | 5.1 | 5.05 | 4.88 | 4.93 | 5.38 | 5.3 |
| 14 | 5.48 | 5.42 | 5.31 | 5.2 | 5.19 | 4.95 | [illegible] | 5.34 | 5.15 |
| 13 | 5.45 | 5.43 | 5.3 | 5.18 | 5.16 | 5.04 | 4.78 | [illegible] | 5.08 |
| 12 | 5.44 | 5.4 | 5.27 | 5.19 | 5.19 | [illegible] | 4.71 | [illegible] | 5.37 |
| 11 | 5.38 | 5.33 | 5.27 | 5.22 | 5.24 | 5.2 | 4.68 | [illegible] | 5.37 |
| 10 | 5.33 | 5.3 | 5.28 | 5.28 | 5.31 | 5.12 | 4.7 | 5.4 | 5.22 |
| | | | | | | | Coding | | |
| | >4 | 4.25 | 4.5 | 4.75 | 5 | 5.25 | Radiation kWh/m²/d | | |

*Source: Sakari Oksanen*

# Regional Variation of Solar Profile over the Year

Average Monthly Radiation on Horizontal Surface (MJ / m2/d) (3.6 MJ/kWh)

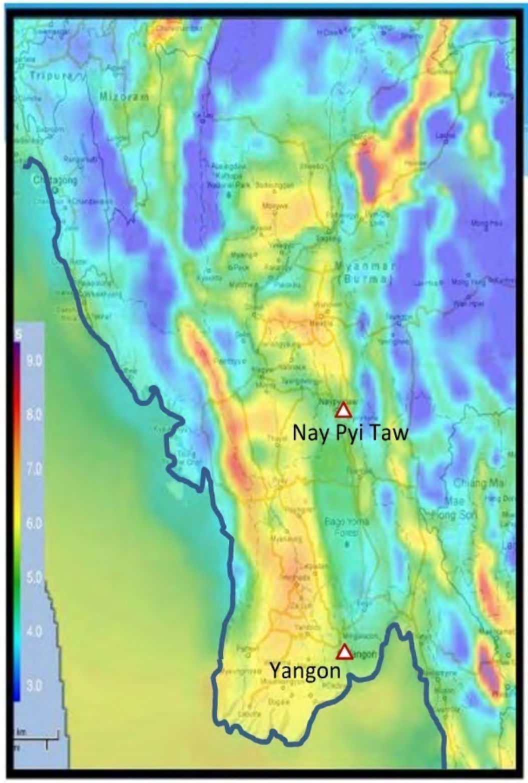


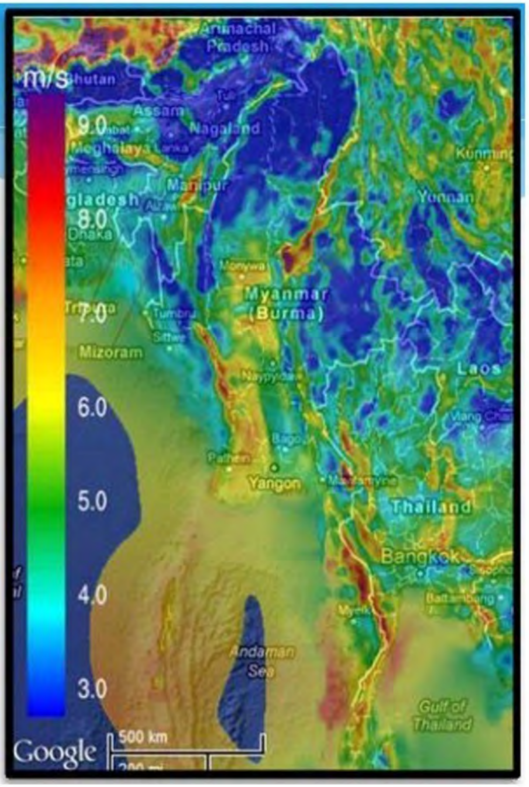

*Source: Serm Janjai, Itsara Masiri, Jarungsaeng Laksanaboonsong, "Derived Solar Resource Maps for Myanmar", Renewable Energy 53 (2013), pp. 132-140.*

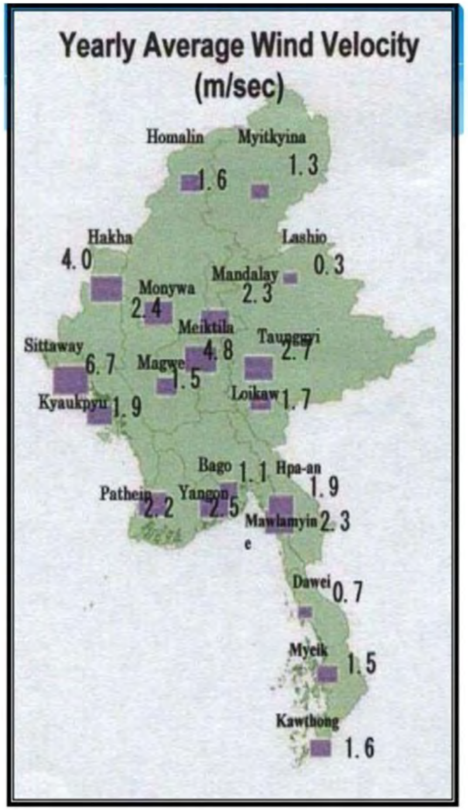
# Myanmar’s Wind Potential

- Early stages of development & very limited information available on Myanmar’s wind potential
- Locations of resource potential based on SWERA Toolkit data (left)
- Other reports suggest technical potential for 4,000 MW from Shan, Chin, Central region (high areas) + Coastal areas
- MOUs reported to have been entered into for 3000 MW+ of wind, but to date not developed
- Consensus seems to suggest that 3000 MW to 5000 MW of wind
- Challenges
  - coincidence of wind resource with existing transmission system & load centres
  - more detailed measurements and assessments of potential
- Small scale pilot projects

# Other Myanmar Wind Resource Maps (MOEP)



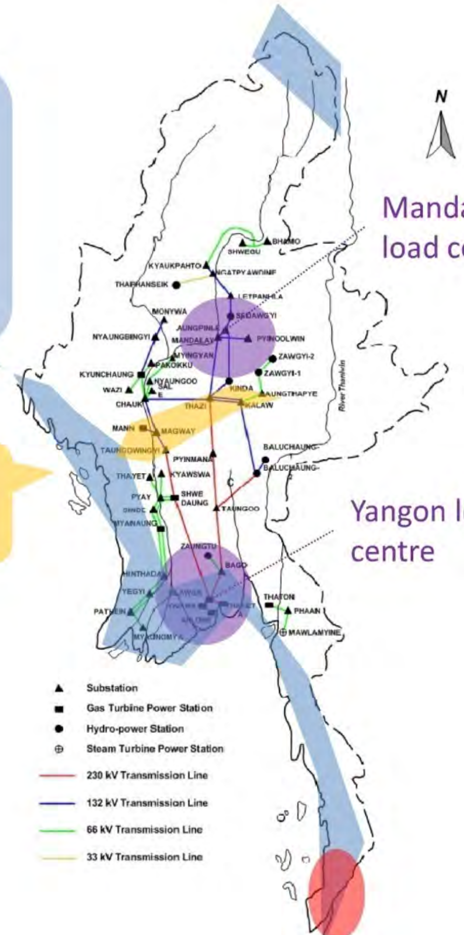



# Myanmar’s Wind Potential based on SWERA Toolkit

Shaded the top 20 regions for wind based on SWERA toolkit. These achieve wind speeds 4-6 m/s for 8 to 9 months / year

Identified potential based on measurements




Mandalay load centre

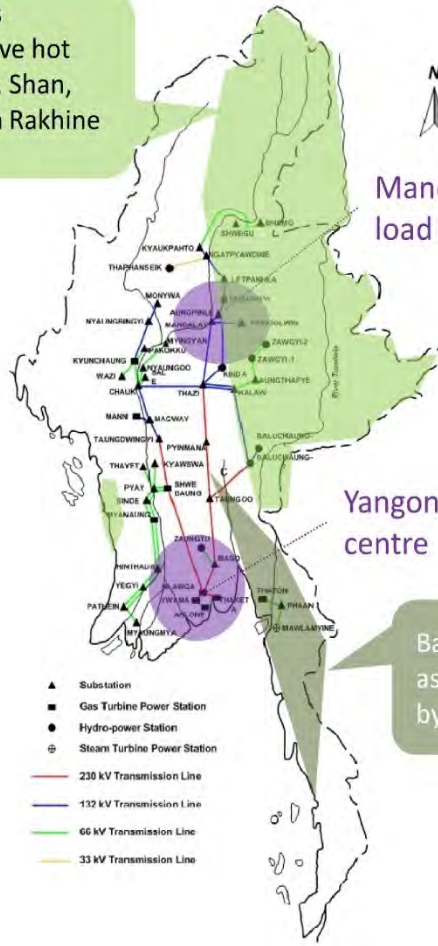
Yangon load centre

Another Wind Resource Map:


*Source: Sakari Oksanen*

# Myanmar's Geothermal Potential

States / regions identified to have hot springs: Kachin, Shan, Kaya. Southern Rakhine (below)




Mandalay load centre

Yangon load centre

Based on resource assessment done by MOGE (1986).

- Considerable potential has been identified
- Kachin, Shan, and Kayah states
- Kayin, Kayah, Mon, Taninthayi
- Also southern part of Rakhine
- 96 sites in total identified
- More information would be appreciated!

# Myanmar Reform Program on Energy Sector

## Introduction

- Mandate of the new government of President U Thein Sein, is to chart a new direction for the country, a major economic, social, and political transformation.
- With abundant natural resources, a strategic location in Southeast Asia, and a large and young population, Myanmar has a unique opportunity to lay the foundation for a brighter, more prosperous future for its people.
- President U Thein Sein, on 11 May, 2012 called for:
- The development of policies and reform strategies that can achieve people-centered development, civic participation and human resource development, effective and transparent use of public financial resources, sustainable regional development, decentralization and greater autonomy for local government, and poverty reduction.

## National Framework of Economic and Social Reforms (FESR)

- FESR designed as a policy linkage between the existing plans of the government to the National Comprehensive Development Plan (NCDP), a long-term plan that GOM is developing through broad consultations and bottom-up processes.
- Under FESR, Ministries are required to prepare their respective Sector Policy Paper for approval by the Parliament
- FESR aims for two broad objectives for the medium-term:

➢ Move the ongoing reform process forward and make it irreversible so that Myanmar can become a modern developed nation that meets the aspirations of its people for a better life; and

➢ Accelerate Myanmar's greater integration with the international community.

## *Energy Sector- Issues, Constraints, and Recommended Actions*

### (1)Energy Resources Development

- **Lack of adequate financing for rehabilitation and maintenance of existing energy infrastructure; and for investment in new assets to undertake development of energy resources, are the major impediments and constraints.**
- **Lack of access by private sector investor to appropriate tariff structure, financing mechanisms, and an appropriate legal and regulatory regime.**
- **Distortion in the pricing structure requiring unsustainable energy subsidy and the resultant macroeconomic imbalances, lack of coordination and decision making regime, and the governance issue.**
- **Subsidies have resulted in the abuse of energy utilization and wastage in consumption by all categories of consumers, provided disincentive for instituting energy conservation and efficiency improvement programs in the industrial sector, and the root cause for the lack of public desire to save energy.**

## (2) Renewable Energy Development

- **Previous Government's policy support, budgetary provision, and regulatory regime favors the development of fossil-fuel based bulk energy supply sources against the development of renewable energy resources.**
- **There is lack of consumer awareness on benefits and opportunities of renewable energy; lack of stakeholder/community participation in energy choices and renewable energy projects.**

## (3) Industrial Energy Efficiency Improvement and Conservation Program

- **While the majority of industrial energy conservation investments are financially viable, most concerned enterprises, with very low energy cost in the overall cost per unit of output, would rather invest in business expansion than energy conservation.**

# *Institution/Organization Responsible for Energy Sector Policy Implementation*

- **Implementation of Energy Sector Policy under guidance and coordination of National Energy Management Committee(NEMC) and support of all organizations/agencies as well as the civil society.**

- **Energy Development Committee (EDC) to support the activities of NEMC**

- **NEMC will assess the appropriateness of institutional structure and organizational set up of various energy sector entities, and formulate capacity building program to fulfill the long term needs of the sector.**

- **Recommendation**

➢ **Establish a team of professional staff to ensure successful Policy Implementation**

# ***Energy Sector Institutional Restructure and Organizational Set Up Reformation***

- A large number of Government departments, agencies and offices are involved in the energy sector.
- Establishment of a new Directorate for Renewable Energy Resources Development.
- Establishment of a new Directorate for Energy Efficiency Improvement and Conservation Program.
- Establishment of an Independent Regulatory body for Energy and Power sector -- Myanmar Energy and Power Regulatory Authority- MEPRA responsible for.

# Energy Sector Policy, Framework and Strategy

## A. Aims and Objective of Energy Sector Policy

- **Ensure energy security for sustainable economic development ;**
- **provide affordable and reliable energy supply to all categories of consumers,**

  **---especially to those without electricity in remote areas**
- **Achieve Government's overarching objective of poverty reduction**
- **Improvement in quality of life of its people**
- **increase foreign exchange earnings through energy exports after meeting the national demand**.
- **expand community-based renewable energy projects, with women participation, that are based on fuel that is free and self-renewing: the sun, the wind, biomass, hydro, and geothermal, and others**

  **-- this will provide income /livelihood opportunities to rural poor.**
- **gradually reduce the energy infrastructure that depends on fossil fuel that continuously rises in price, is dirty, dangerous, causes global warming, and destroys the habitat of this planet**
- **Integrate environmental & social consideration in National Energy Planning**

## *B. Energy Sector Policy Framework and Strategy*

- **Increase electric power and other form of energy supply by developing oil and gas, hydro, renewable energy, etc**
- **Improve energy efficiency particularly in the industrial sector**
- **Expand private sector partnership in energy development**
- **Private sector will be expected to provide new and bold innovative financing instruments, unlike the old traditional lending modalities, that would safeguard interest of the Government and its people.**
- **To attract international private investment funds for energy development,**

➢ **GOM would have in place an appropriate legal and regulatory framework with enforcement mechanism; strong institutional and organizational structures with capacity building program.**

# Policy Framework and Strategy contd.

1. Governance and Transparency ( FESR-2012)
2. Extractive Industries Transparency Initiative (FESR-2012)
3. Expansion of Electrical Power Supply on a Fast Track Basis
4. Energy Pricing and Subsidy (FESR-2012)
5. Optimization of Fuel Mix to Reduce Dependence on Imported Fuel
6. Need for Renewable Energy Development
7. Community–based Renewable Energy Resources Development Program for Poverty Reduction in Remote Areas of Myanmar
8. Key Factors for Sustainability of Community-based Renewable Energy Development
9. Women Participation in Community-based Renewable Energy Development
10. Industrial Energy Efficiency Improvement and Conservation
11. Market- Based Policies for Private Sector Financing in Energy Sector
12. New Foreign Investment Law
13. Financing Sources of Energy Sector Development

## *Nine National Energy Sector Policies*

- 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 bioenergy for the sustainable energy development in Myanmar .

- 6. To promote Energy Efficiency and Energy Conservation .

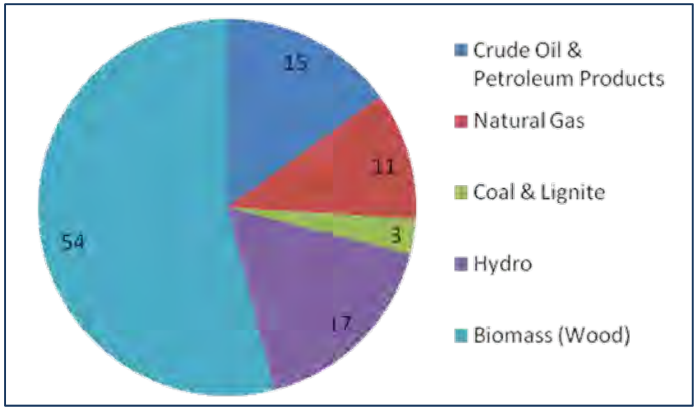
- 7. To establish R,D,D&D (Research, Development, Design, and Dissemination) Institution in order to keep abreast with international practices in energy resources exploration and development works and to produce international quality products in order to manufacture quality products and in order to conduct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

# Energy situation in Myanmar

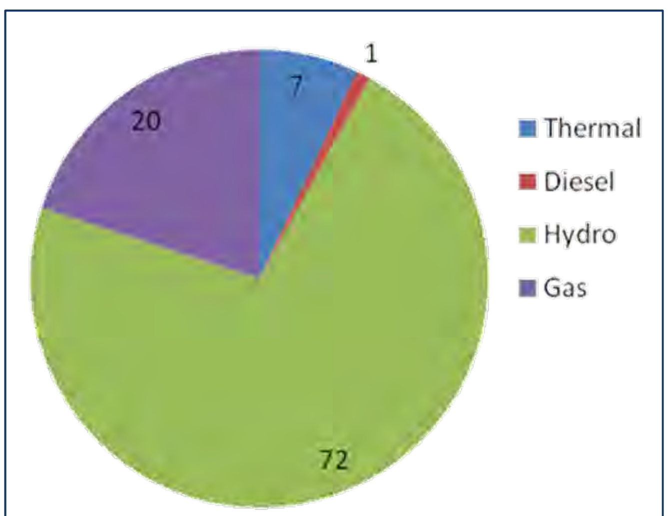
Composition of Primary Energy Supply



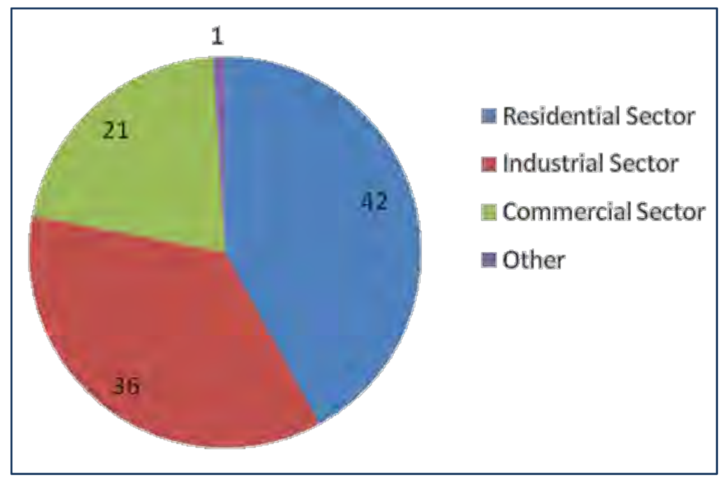

Self Sufficiency Rate of Energy Supply

50% meets domestic demand for Oil & Natural Gas

Electric Power Supply by sources




Final electricity Consumption by sectors




Coverage ratio of electrification = 28%

# Resources Exploited & Development Options

### Resources In Use for Power Generation

| | Fossil Fuel Options | | | Renewable Energy & Energy Efficiency | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coal | Gas | Oil | Hydro | Wind | Solar | Geo | Biomass | Marine | EE* | DR** |
| Cambodia | | | | | | | | | | Yes | |
| Laos | | | | | | | | | | | |
| Myanmar | | | | | | | | | | Yes | |
| Thailand | | | | | | | | | | Yes | Pilot |
| Vietnam | | | | | | | | | | Yes | Pilot |

* Energy Efficiency targets in place, ** Demand Response

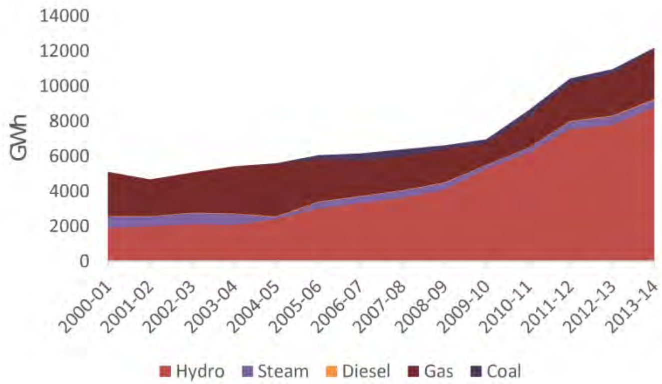
High % of Fuel Mix
Medium % of Fuel Mix
Low % of Fuel Mix

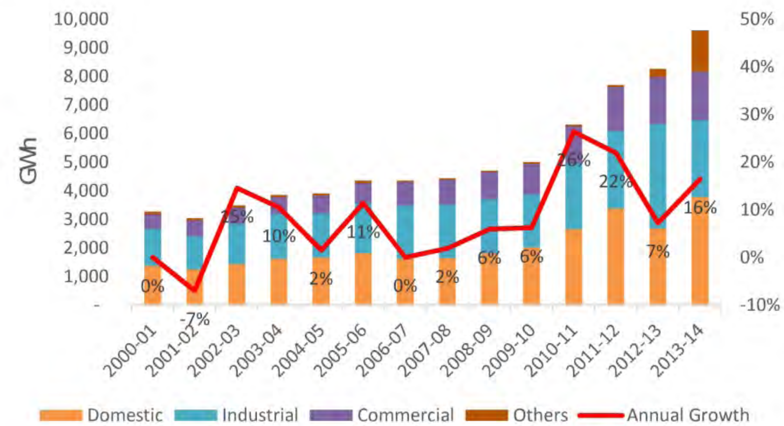
### Development Potential for Power Sector

| | Fossil Fuel Options | | | Renewable Energy & Energy Energy Efficiency | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coal | Gas | Oil | Hydro | Wind | Solar | Geo | Biomass | Marine | EE | DR |
| Cambodia | | | | | | | ? | | | | |
| Laos | | | | | | | ? | | | | |
| Myanmar | | | | | | | | | | | |
| Thailand | | | | | | | ? | | | | |
| Vietnam | | | | | | | | | | | |

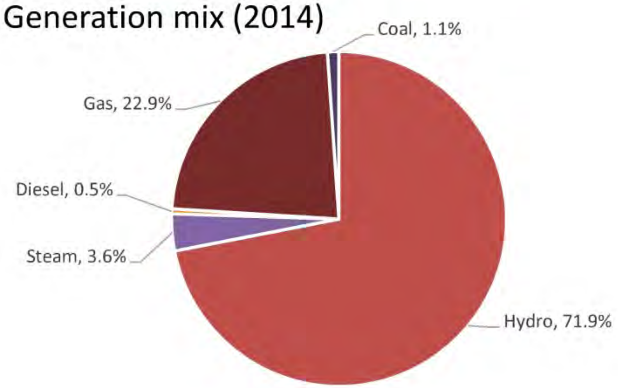
Significant potential
Reasonable potential
Potential exists but limited

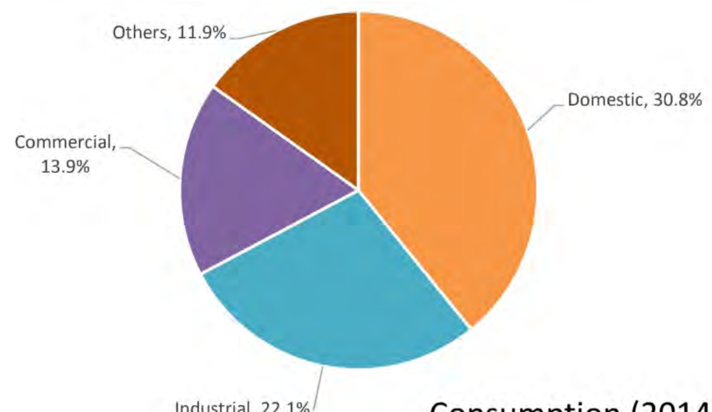
# Supply and Demand




Generation mix (2014)



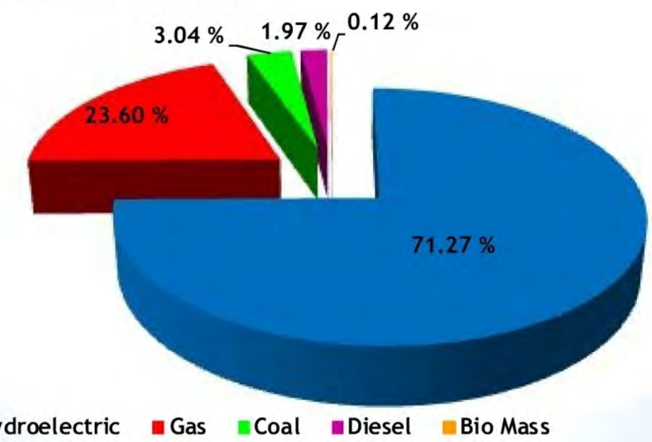




Consumption (2014)

# Installed Capacity in Year 2013

| | Grid System (MW) | Isolated (MW) | Total (MW) | (%) |
|---|---|---|---|---|
| Installed Capacity | 3,896 | 116 | 4,012 | 100.00% |
| Hydroelectric | 2,780 | 33 | 2,813 | 70.13% |
| Gas | 996 | - | 996 | 24.83% |
| Coal | 120 | - | 120 | 2.99% |
| Diesel | - | 78 | 78 | 1.93% |
| Bio Mass | - | 5 | 5 | 0.12% |

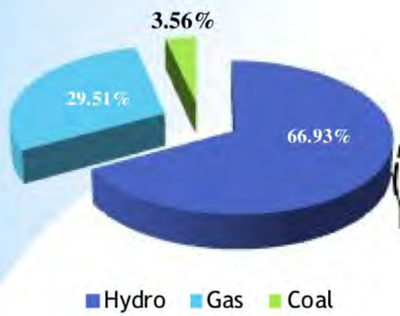
(Remark - 521 MW export to China)

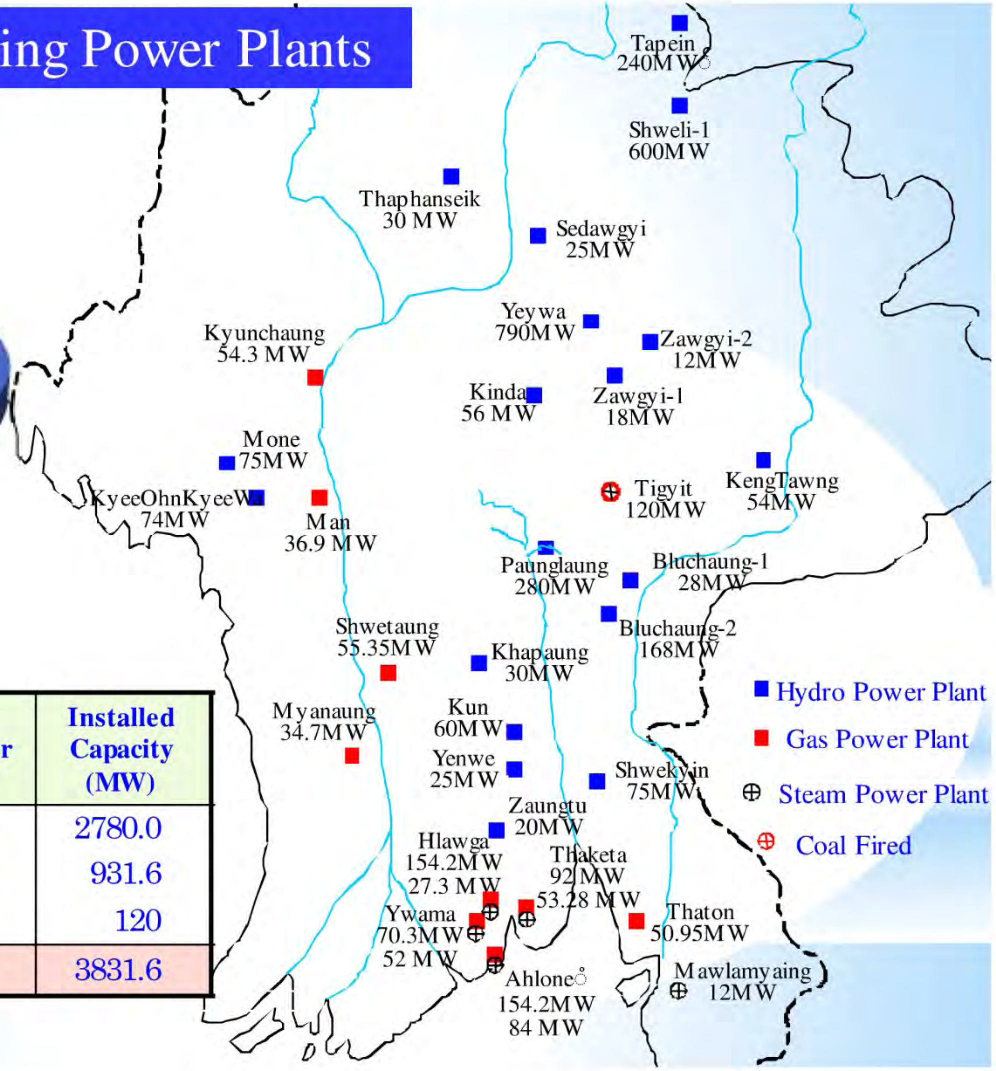


# Organizational Profile

| Generation Facilities | | | | | | |
|---|---|---|---|---|---|---|
| (1) | Ministry's own | - | Hydro | (17) nos | 1820 | MW |
| | | | Coal Fired | (1) nos | 120 | MW |
| | | | Gas Turbine | (10) nos | 715 | MW |
| | | | Diesel sets | (635) nos | 77.61 | MW |
| | Ministry Total | | | (663) nos | 2732.61 | MW |
| (2) | JV Scheme | - | Hydro | (2) nos | 840 | MW |
| (3) | Local government | - | Mini hydro | (32) nos | 33.33 | MW |
| | | - | Biomass | (43) nos | 4.7 | MW |
| (4) | Private sector | - | Hydro | (1) nos | 120 | MW |
| | | - | Gas Turbine | (4) nos | 281.15 | MW |
| | | | National Total | (745) nos | 4012 | MW |

# Location of Existing Power Plants




| Sr No. | Type of Power Plant | Number | Installed Capacity (MW) |
|---|---|---|---|
| 1. | Hydro Power | 20 | 2780.0 |
| 2. | Gas | 14 | 931.6 |
| 3. | Coal | 1 | 120 |
| Total | | 35 | 3831.6 |

# Organizational Profile

## Transmission Facilities

| Voltage (kV) | Nos. of Line | Length | | Substations | |
|---|---|---|---|---|---|
| | | miles | km | nos | Capacity MVA |
| 230 | 43 | 1,894 | 3,047 | 30 | 3,760 |
| 132 | 35 | 1,311 | 2,109 | 25 | 1,323 |
| 66 | 138 | 2,248 | 3,616 | 130 | 1,975 |
| Total | 216 | 5,453 | 8,773 | 185 | 7,058 |

## Distribution Facilities

| Voltage (kV) | Length | | Transformer Capacity (MVA) |
|---|---|---|---|
| | miles | km | |
| 33 | 4516 | 7269 | 4279 |
| 11 | 8683 | 13974 | 4399 |
| 6.6 | 825 | 1327 | 1475 |
| 0.4 | 11453 | 18428 | - |
| Total | 25477 | 40998 | 10153 |

# Energy Sector Development Plan

A. **Strategy**

1. Increase National Electrification Rate
2. Provision of Community-based Renewable Energy/Rural Electrification
3. Generate Electric Power
   - Establish properly the power demand
   - Prepare least-cost generation plan.
4. Rehabilitate/ Expand Transmission System
5. Rehabilitate/ Expand Refining Capacity
6. Industrial Energy Efficiency

B. **Proposed Development Plan**

1. Additional Power Generation
   - Gas-based 17.0 %
   - Coal-based 29.0 %
   - Hydropower 43.5 %
   - Renewable Energy (Solar, Mini-Hydro, Biomass, Wind, Etc.) 10.5 %
2. Rehabilitation/ Expansion of Transmission System
   - The transmission system should be installed before the power generation is ready
3. Rehabilitation/ Expansion of Refining Capacity
   - To improve operations of the refineries, the government is consider a joint venture with a foreign company for the Thanlyin refinery.
4. Industrial Energy Efficiency

# Power Development Plan

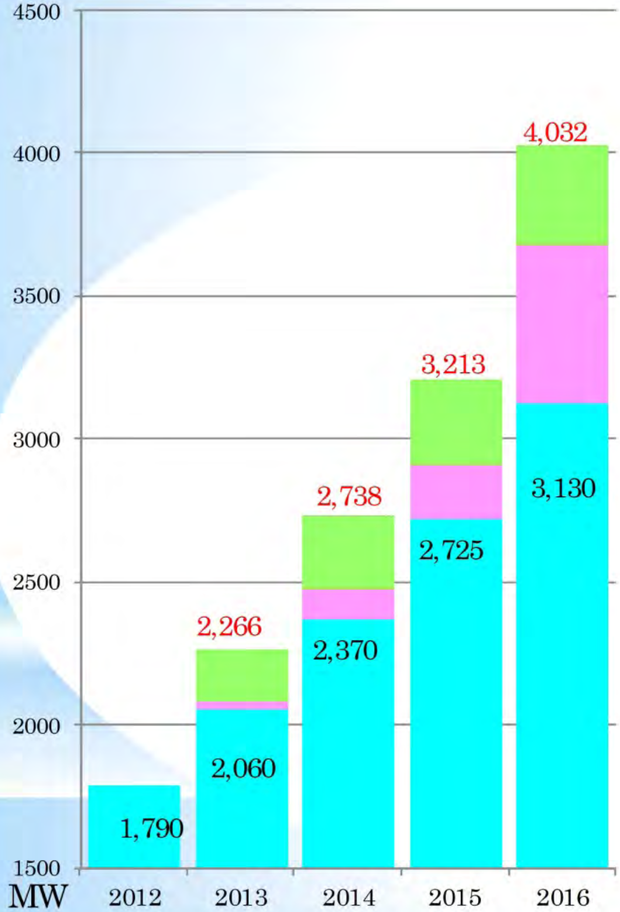
# Projects to be completed during 2013-14 to 2015-16

# Demand Forecasting for Short Term Period

| Sr. No. | Year | Demand (MW) | Increased Rate(%) |
|---|---|---|---|
| 1 | 2013 | 2060 | 15 % |
| 2 | 2014 | 2370 | 15 % |
| 3 | 2015 | 2725 | 15 % |
| 4 | 2016 | 3130 | 15 % |

- Applied the trend of demand increase in past 3 years which was nearly15%.
- Based on the system peak load in year 2012 which was 1790 MW.
- Excluded for industrial zones and special economic zones.

# Short Term Demand Forecasting for Industrial and Commercial Zones during 2013 to 2016




| Year | Regular Demand Growth Rate (15 %) (MW) | Dawei SEZ | Thilewa SEZ | Yangon Industrial Zones | Total (MW) |
|---|---|---|---|---|---|
| 2012 | 1,790 | - | - | - | 1,790 |
| 2013 | 2,060 | 28 | - | 178 | 2,266 |
| 2014 | 2,370 | 111 | 2 | 255 | 2,738 |
| 2015 | 2,725 | 187 | 6 | 295 | 3,213 |
| 2016 | 3,130 | 548 | 12 | 342 | 4,032 |

# Power Plant Projects to be Completed During 2013 to 2016 (MW)

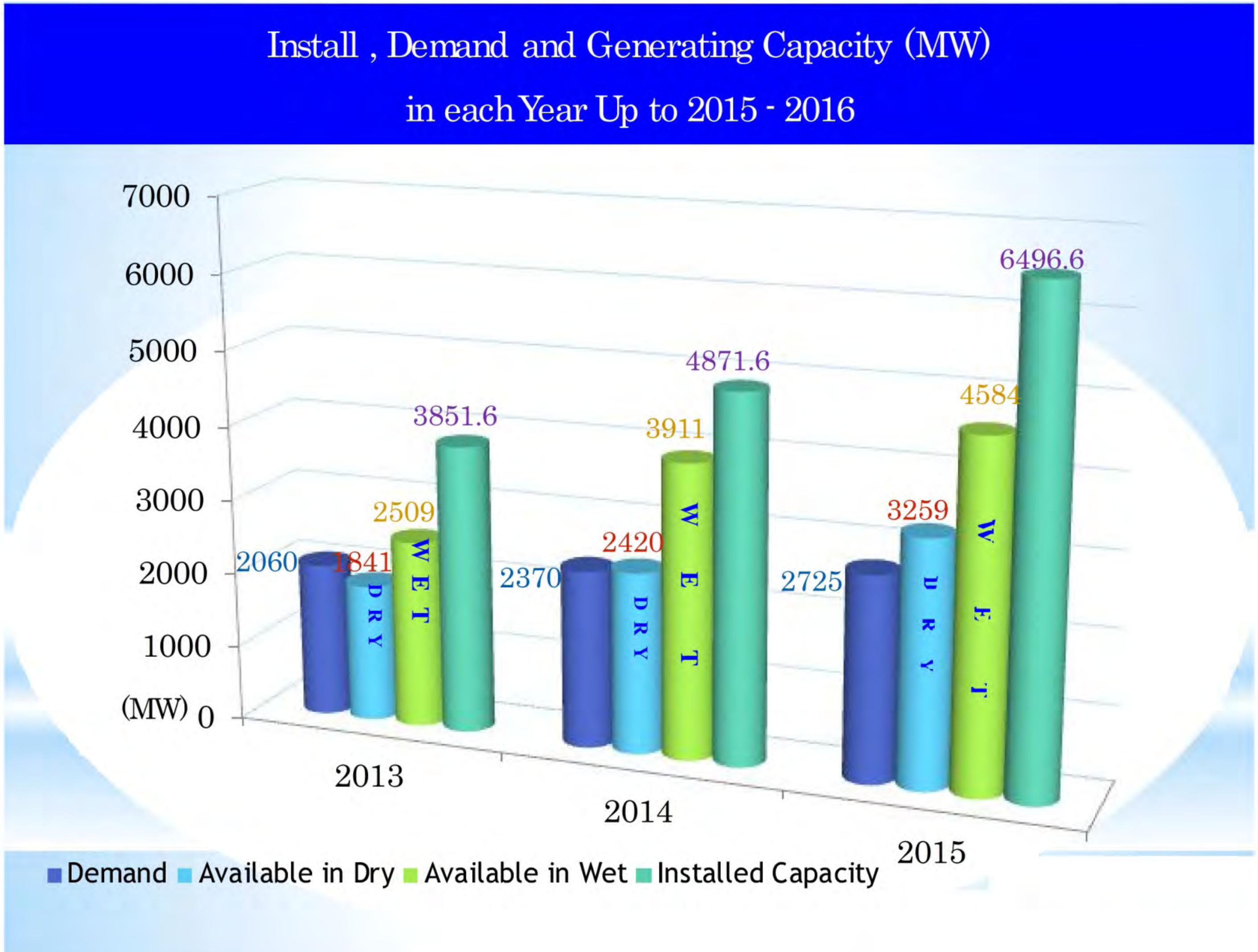
| Sr. | Project Name | Investor Type | Type | Installed Capacity | 2013-14 | 2014-15 | 2015-16 | Remark |
|---|---|---|---|---|---|---|---|---|
| 1 | Phyu | MOEP | Hydro | 40 | 40 | - | - | |
| 2 | Namcho | MOEP | Hydro | 40 | 40 | - | - | |
| 3 | Upper Paunglaung | MOEP | Hydro | 140 | - | 140 | - | |
| 4 | Baluchaung No.(3) | MOEP | Hydro | 52 | 52 | - | - | |
| 5 | Upper Baluchaung | MOEP | Hydro | 29 | - | 29 | - | |
| 6 | Chibwengae | CPI (China) | Hydro | 99 | 99 | - | - | |
| 7 | Tapain | China Datang | Hydro | 101 | - | - | 101 | |
| | | | | | | | | |
| Hydro Total | | | | 501 | 231 | 169 | 101 | - |
| | | | | | | | | |
| 8 | Minbuu | Green Earth (Thai) | Solar | 50 | 50 | - | - | MOU |
| Solar Total | | | | 50 | 50 | - | - | |

# Power Plant Projects to be Completed During 2013 to 2016 (MW)

| Sr. | Project Name | Investor Type | Type | Installed Capacity | 2013-14 | 2014-15 | 2015-16 | Remark |
|---|---|---|---|---|---|---|---|---|
| 9 | Hlawga | Zeya Co. | Gas | 54.55 | 54.55 | - | - | MOU |
| 10 | Hlawga | (Hydrolancang Co., China) | Gas | 486 | - | 243 | 243 | MOU |
| 11 | Ywama | UPP (S' pore) | Gas | 52 | 52 | - | - | MOU |
| 12 | Ywama | MOPE(EGAT Thai) | Gas | 240 | 240 | - | - | |
| 13 | Thaketa | Myanmar Power Pte (S'pore) | Gas | 53.6 | 53.6 | - | - | MOU |
| 14 | Thaketa | BKB (Korea) | Gas | 503 | - | 167 | 336 | MOA |
| 15 | Thaketa | UREC (China) | Gas | 513 | - | 127 | 386 | MOU |
| 16 | Ahlone | Toyo Thai (Thai) | Gas | 121 | 82 | 39 | - | MOA |
| 17 | Mawlamyaing | Myanmar Lighting | Gas | 230 | - | 100 | 130 | MOU |
| 18 | Kyaukphyu | MOEP | Gas | 100 | - | 100 | - | |
| 19 | Kanbauk | (Dawei Power Utilities) | Gas | 525 | - | 175 | 350 | MOU |
| Gas Total | | | | 2,878.15 | 482.15 | 951 | 1,445 | |

# Power Plant Projects to be Completed During 2013 to 2016 (MW)

| Sr. | Project Name | Investor Type | Type | Installed Capacity | 2013-14 | 2014-15 | 2015-16 | Remark |
|---|---|---|---|---|---|---|---|---|
| 20 | Yangon (Kunchangon) | Virtue Land | Coal | 300 | - | - | 300 | MOU |
| | | | | | | | | |
| Coal Total | | | | 300 | - | - | 300 | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| GRAND TOTAL | | | | 3,729.15 | 763.15 | 1,120 | 1,846 | |


Install , Demand and Generating Capacity (MW)
in each Year Up to 2015 - 2016
7000
6000
5000
4000
3000
2000
1000
(MW) 0
2060
1841
2509
3851.6
2370
2420
3911
4871.6
2725
3259
4584
6496.6
DRY
WET
2013
2014
2015
Demand
Available in Dry
Available in Wet
Installed Capacity

# Power Transmission Projects to be completed during 2013-14 to 2015-2016

| Sr. No | State/ Region | Transmission Lines | | | | Substations | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 500 kV (mile) | 230 kV (mile) | 132 kV (mile) | 66 kV (mile) | 500 kV | | 230 kV | | 132 kV | | 66 kV | |
| | | | | | | No. | MVA | No. | MVA | No. | MVA | No. | MVA |
| 1. | Kachin State | | 285 | 60 | 89 | | | 3 | 300 | 1 | 60 | 5 | 34 |
| 2 | Kayar State | | | | 145 | | | | | 2 | 150 | 3 | 65 |
| 3 | Kayin State | | 80 | | 39 | | | 2 | 200 | | | 2 | 10 |
| 4 | Chin State | | | | 85 | | | | | | | 3 | 15 |
| 5 | Mon State | | | | 91 | | | | | | | 6 | 100 |
| 6 | Rakhine State | | 65 | | 374 | | | | | | | 11 | 87 |
| 7 | Shan State | | 60 | | 213 | | | 2 | 200 | 1 | 100 | 5 | 50 |
| 8 | Sagaing Region | | 80 | | 30 | | | 1 | 100 | 1 | 100 | 3 | 20 |
| 9 | Tanintharyi Region | | 142 | | | | | 2 | 200 | | | 2 | 20 |
| 10 | Bago Region | 167 | 366 | | | 2 | 1000 | | | | | | |
| 11 | Magway Region | | 385 | | 65 | | | 4 | 400 | 3 | 180 | 2 | 20 |
| 12 | Mandalay Region | | | | 38 | 1 | 500 | 2 | 200 | 4 | 400 | 3 | 60 |
| 13 | Ayeyarwaddy Region | | 240 | | 202 | | | 2 | 200 | | | 11 | 160 |
| 14 | Yangon Region | | 135 | | | | | 5 | 900 | | | | |
| Total | | 167 | 1838 | 60 | 1371 | 3 | 1500 | 23 | 2700 | 12 | 990 | 56 | 641 |

# Distribution Lines and Substations to be completed during 2013-14 to 2015-2016

| Sr No | State/ Region | Distribution Lines | | | | Substations | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 66kV mile | 33 kV mile | 11 kV mile | 0.4 kV mile | 66 kV | | 33 kV | | 11 kV | |
| | | | | | | No. | MVA | No. | MVA | No. | MVA |
| 1. | Kachin State | - | 50 | 51 | 19 | - | - | 2 | 20 | 21 | 4.2 |
| 2 | Kayar State | - | 38 | 40 | 66 | - | - | 4 | 40 | 31 | 6.2 |
| 3 | Kayin State | - | 107 | 60 | 48 | - | - | 4 | 40 | 59 | 11.8 |
| 4 | Chin State | - | 10 | 77 | 39 | - | - | 1 | 10 | 36 | 7.2 |
| 5 | Mon State | - | 80 | 405 | 287 | - | - | 7 | 70 | 163 | 32.6 |
| 6 | Rakhine State | - | 67 | 73 | 75 | - | - | 2 | 20 | 92 | 18.4 |
| 7 | Shan State | - | 130 | 283 | 262 | - | - | 11 | 110 | 230 | 46.0 |
| 8 | Sagaing Region | - | 98 | 76 | 89 | - | - | 6 | 60 | 144 | 28.8 |
| 9 | Tanintharyi Region | - | - | 81 | 69 | - | - | - | - | 92 | 18.4 |
| 10 | Bago Region | - | 123 | 143 | 145 | - | - | 10 | 100 | 258 | 51.6 |
| 11 | Magway Region | - | 50 | 92 | 109 | - | - | 6 | 60 | 126 | 25.2 |
| 12 | Mandalay Region | - | 212 | 360 | 472 | - | - | 23 | 230 | 816 | 163.2 |
| 13 | Ayeyarwaddy Region | - | 47 | 69 | 89 | - | - | 4 | 40 | 160 | 32.0 |
| 14 | Yangon Region | 119 | 67 | 311 | 270 | 25 | 750 | 26 | 260 | - | - |
| Total | | 119 | 1079 | 2121 | 2039 | 25 | 750 | 106 | 1060 | 2228 | 446 |

# Long Term Demand Forecasting and Planned Projects during 2016-17 to 2030-31

## Demand Forecasting

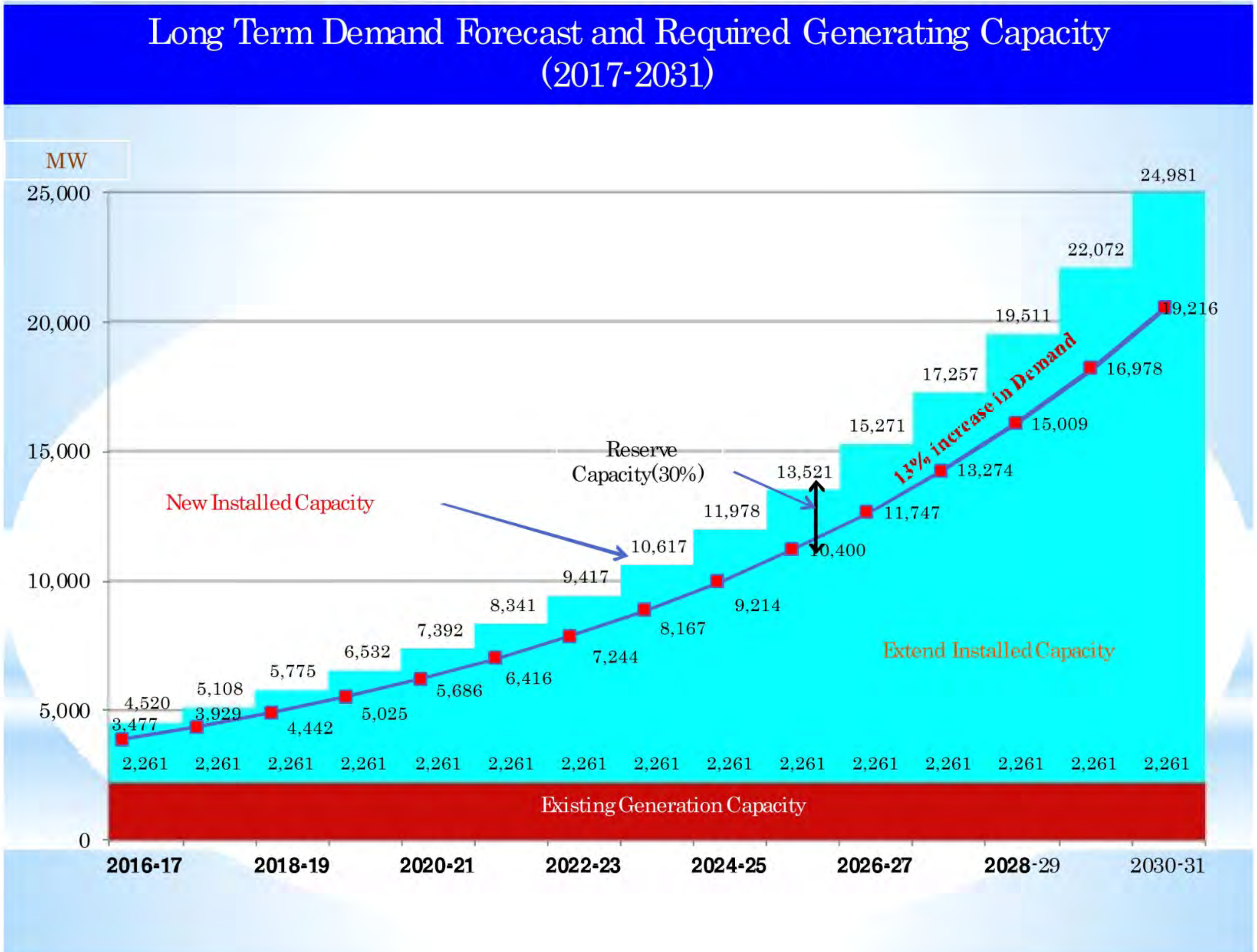
- From 2001-2002 to 2011-2012 decade, the economic growth of the state increased and the average GDP growth rate was about 11%, the elasticity factor, the ratio of GDP growth rate and power consumption was about 1.4%.
- At that moment, the power consumption increased from 2001-2002 to 2011-2012 was 2.5 times.
- The power demand forecasting from 2012-2013 to 2030-2031 is based on the GDP growth rate 8.7 %, population growth rate 1.1% and also based on the yearly growth rate of GDP and population of the regions and states, 13%.

# Status of Area-wide Demand Growth in States (From 2011-12 to 2030-31)Year (MW)

| Year / State | 2011-12 | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 2018-19 | 2019-20 | 2020-21 |
|---|---|---|---|---|---|---|---|---|---|---|
| Kachin | 18.56 | 24.13 | 25.82 | 27.63 | 29.56 | 31.63 | 33.85 | 36.22 | 38.75 | 41.46 |
| | | 30 % | 7% | 7% | 7% | 7% | 7% | 7% | 7% | 7% |
| Kayar | 6.99 | 7.70 | 8.01 | 8.33 | 8.67 | 9.01 | 9.37 | 9.75 | 10.14 | 7.70 |
| | | 10% | 4% | 4% | 4% | 4% | 4% | 4% | 4% | 10% |
| Kayin | 11.62 | 32.56 | 36.14 | 40.12 | 44.53 | 49.43 | 54.87 | 60.90 | 67.60 | 75.04 |
| | | 180% | 11% | 11% | 11% | 11% | 11% | 11% | 11% | 11% |
| Chin | 2.86 | 3.15 | 3.31 | 3.47 | 3.79 | 4.13 | 4.50 | 4.90 | 5.34 | 5.82 |
| | | 10% | 5% | 5% | 9% | 9% | 9% | 9% | 9% | 9% |
| Mon | 40.15 | 84.84 | 94.17 | 104.53 | 116.03 | 128.79 | 142.96 | 158.69 | 176.14 | 195.52 |
| | | 111% | 11% | 11% | 11% | 11% | 11% | 11% | 11% | 11% |
| Rakhaing | 8.81 | 9.69 | 10.76 | 11.94 | 13.25 | 14.71 | 16.33 | 17.80 | 19.40 | 21.15 |
| | | 10% | 11% | 11% | 11% | 11% | 11% | 9% | 9% | 9% |
| Shan | 90.94 | 103.45 | 112.76 | 122.91 | 133.97 | 146.03 | 159.17 | 173.49 | 189.11 | 206.13 |
| | | 14% | 9% | 9% | 9% | 9% | 9% | 9% | 9% | 9% |
| **Total** | **180** | **266** | **291** | **319** | **350** | **384** | **421** | **462** | **506** | **556** |
| **State+Region** | **1,806** | **2,155** | **2,426** | **2,732** | **3,078** | **3,477** | **3,929** | **4,442** | **5,025** | **5,686** |
| **(%)** | | **19%** | **13%** | **13%** | **13%** | **13%** | **13%** | **13%** | **13%** | **13%** |

# Status of Area-wide Demand Growth in States
# (From 2011-12 to 2030-31)Year (MW)

| Year / State | 2021-22 | 2022-23 | 2023-24 | 2024-25 | 2025-26 | 2026-27 | 2027-28 | 2028-29 | 2029-30 | 2030-31 |
|---|---|---|---|---|---|---|---|---|---|---|
| Kachin | 44.37 | 47.47 | 50.80 | 54.35 | 58.16 | 62.23 | 66.58 | 71.24 | 76.23 | 81.57 |
| | 7% | 7% | 7% | 7% | 7% | 7% | 7% | 7% | 7% | 7% |
| Kayar | 10.97 | 11.40 | 11.86 | 12.33 | 12.83 | 13.34 | 13.87 | 14.43 | 15.01 | 15.61 |
| | 4% | 4% | 4% | 4% | 4% | 4% | 4% | 4% | 4% | 4% |
| Kayin | 80.29 | 85.91 | 91.92 | 98.36 | 105.24 | 112.61 | 120.49 | 128.93 | 137.95 | 147.61 |
| | 7% | 7% | 7% | 7% | 7% | 7% | 7% | 7% | 7% | 7% |
| Chin | 6.17 | 6.54 | 6.94 | 7.35 | 7.79 | 8.26 | 8.76 | 9.28 | 9.84 | 10.43 |
| | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% |
| Mon | 217.02 | 240.90 | 267.40 | 296.81 | 329.46 | 365.70 | 405.92 | 450.58 | 500.14 | 555.16 |
| | 11% | 11% | 11% | 11% | 11% | 11% | 11% | 11% | 11% | 11% |
| Rakhaing | 23.05 | 25.12 | 27.38 | 29.85 | 32.53 | 35.46 | 38.65 | 42.13 | 45.93 | 50.06 |
| | 9% | 9% | 9% | 9% | 9% | 9% | 9% | 9% | 9% | 9% |
| Shan | 224.68 | 244.90 | 266.94 | 290.97 | 317.15 | 345.70 | 376.81 | 410.72 | 447.69 | 487.98 |
| | 9% | 9% | 9% | 9% | 9% | 9% | 9% | 9% | 9% | 9% |
| **Total** | **607** | **662** | **723** | **790** | **863** | **943** | **1,031** | **1,127** | **1,233** | **1,348** |
| **State+Region** | **6,416** | **7,244** | **8,167** | **9,214** | **10,400** | **11,747** | **13,274** | **15,009** | **16,978** | **19,216** |
| **(%)** | **13%** | **13%** | **13%** | **13%** | **13%** | **13%** | **13%** | **13%** | **13%** | **13%** |


Long Term Demand Forecast and Required Generating Capacity
(2017-2031)
MW
25,000
20,000
15,000
10,000
5,000
0
24,981
22,072
19,511
19,216
17,257
16,978
15,271
15,009
13,521
13,274
11,978
11,747
10,617
10,400
9,417
9,214
8,341
8,167
7,392
7,244
6,532
6,416
5,775
5,686
5,108
5,025
4,520
4,442
3,929
3,477
2,261
Reserve
Capacity(30%)
New Installed Capacity
13% increase in Demand
Extend Installed Capacity
Existing Generation Capacity
2016-17
2018-19
2020-21
2022-23
2024-25
2026-27
2028-29
2030-31

## Long Term Planned Target for Electricity Supply Up to Year 2030-31

| Term | Expected Population (million) | Demand Forecast (MW) | Required Generation (GWh) | Target for Power Consumed per person (kWh) | Target for Electrified Household (%) |
|---|---|---|---|---|---|
| Yr. 2011-12 | 60.44 | 1,806 | 10,444 | 173 | 27% |
| From Yr.(2012-13) to Yr.(2015-16) | 63.14 | 3,078 | 17,797 | 282 | 34% |
| From Yr.(2016-17) to Yr.(2020-21) | 66.69 | 5,686 | 32,874 | 493 | 45% |
| From Yr.(2021-22) to Yr.(2025-26) | 70.45 | 10,400 | 60,132 | 854 | 60% |
| From Yr.(2026-27) to Yr.(2030-31) | 74.42 | 19,216 | 111,100 | 1,493 | 80% |

- To meet the Electricity demand growth during both of short and long term period, we need to implement a lot of projects for Generation, Transmission, and Distribution. We would like to invite the investor to participate in Electric Power Business, not only the capital investment but also in terms of technical assistance.

# Summary of Generation Expansion Plan (From 2013 to 2031)

| No | Type | 2013-2016 | | 2017-2021 | | 2022-2026 | | 2027-2031 | |
|---|---|---|---|---|---|---|---|---|---|
| | | No | MW | No | MW | No | MW | No | MW |
| (1) | Hydro | 7 | 501.00 | 22 | 7,328.35 | 18 | 7,311.00 | 6 | 3,847.5 |
| (2) | Gas | 11 | 2,878.15 | 1 | 500.00 | - | - | - | - |
| (3) | Coal | 1 | 300.00 | 4 | 1,670.00 | 1 | 300.00 | - | - |
| (4) | Solar | 1 | 50.00 | - | - | - | - | - | - |
| (5) | Wind | - | - | 3 | 1,209.00 | - | - | - | - |
| (6) | Geothermal | - | - | 1 | 200.00 | - | - | - | - |
| Total | | 20 | 3,719.25 | 31 | 10,907.35 | 19 | 7,611.00 | 6 | 3,847.5 |

## Estimated Installed Capacity to be realized at the end of Respective target year (for Domestic Use) (MW)

| No | Type | End of 2016 | End of 2021 | End of 2026 | End of 2031 |
|---|---|---|---|---|---|
| (1) | **Hydro** | 2,760.00 | 10,088.35 | 17,399.35 | 21,246.85 |
| (2) | **Gas** | 3,593.05 | 4,093.05 | 4,093.05 | 4,093.05 |
| (3) | **Coal** | 420.00 | 2,090.00 | 2,390.00 | 2,390.00 |
| (4) | **Solar** | 50.00 | 50.00 | 50.00 | 50.00 |
| (5) | **Wind** | - | 1,209.00 | 1,209.00 | 1,209.00 |
| (6) | **Geothermal** | - | 200.00 | 200.00 | 200.00 |
| | **TOTAL** | **6,823.05** | **17,730.04** | **25,341.40** | **29,188.90** |

# Summary of Transmission Expansion Plan (From 2013 to 2031)

| Type | 2013-2016 | | 2017-2021 | | 2022-2026 | | 2027-2031 | |
|---|---|---|---|---|---|---|---|---|
| | Line Length mile (km) | MVA | Line Length mile(km) | MVA | Line Length mile(km) | MVA | Line Length mile(km) | MVA |
| 500 kV | 167 (269) | 1500 | 637 (1025) | 500 | 299 (481) | 1000 | 250 (402) | - |
| 230 kV | 1838 (2957) | 2700 | 1841 (2962) | 1180 | 366 (589) | 1150 | - | 700 |
| 132 kV | 60 (96) | 990 | 140 (225) | 160 | 44 (71) | 260 | 50 (81) | 300 |
| 66 kV | 1371 (2206) | 641 | 670 (1078) | 242 | 93 (150) | 150 | - | 75 |
| Total | 3436 (5528) | 5831 | 3288 (5290) | 2082 | 802 (1291) | 2560 | 300 (483) | 1075 |

# Summary of Distribution Expansion Plan (From 2013 to 2031)

| Type | 2013-2016 | | 2017-2021 | | 2022-2026 | | 2027-2031 | |
|---|---|---|---|---|---|---|---|---|
| | Line Length mile(km) | MVA | Line Length mile (km) | MVA | Line Length mile (km) | MVA | Line Length mile (km) | MVA |
| 66 kV | 119 (192) | 750 | 182 (293) | 1110 | 152 (245) | 1050 | 152 (245) | 1050 |
| 33 kV | 1079 (1736) | 1060 | 1108 (1783) | 1210 | 1506 (2423) | 1880 | 1695 (2727) | 2450 |
| 11 kV | 2121 (3413) | 446 | 2876 (4627) | 1405 | 3400 (5471) | 2043 | 5192 (8354) | 3322 |
| 0.4 kV | 2039 (3281) | - | 5692 (9158) | - | 7783 (12523) | - | 8239 (13257) | - |
| Total | 5358 (8622) | 2256 | 9858 (15861) | 3725 | 12841 (20661) | 4973 | 15278 (24583) | 6822 |

# Projects to be completed during 2016-17 to 2020-21

# Power Plant Projects to be completed during 2017 to 2021 (MW)

| Sr. No. | Project Name | Investor Type | Type | Installed Capacity | Myanmar self-use capacity |
|---|---|---|---|---|---|
| 1 | Upper Yeywa (MOEP) | MOEP | Hydro | 280 | 280 |
| 2 | Shweli-3 (MOEP) | MOEP | Hydro | 1050 | 1050 |
| 3 | Bawgata (MOEP) | MOEP | Hydro | 160 | 160 |
| 4 | Upper Bu (MOEP) | MOEP | Hydro | 150 | 150 |
| 5 | Middle Paunglaung (MOEP) | MOEP | Hydro | 100 | 100 |
| 6 | Thahtay (MOEP) | MOEP | Hydro | 111 | 111 |
| 7 | Upper Keng Teng (MOEP) | MOEP | Hydro | 51 | 51 |
| 8 | Chibwe (CPI) | FDI | Hydro | 3400 | 1700 |
| 9 | Laza (CPI) | FDI | Hydro | 1900 | 950 |
| 10 | Upper Thanlwin (Konlong) (Hangery-China+ Virgin-Island+AWC) | FDI | Hydro | 1400 | 700 |
| 11 | Gawlan (YPIC) | FDI | Hydro | 100 | 50 |
| 12 | Wxhonhgze (YPIC) | FDI | Hydro | 60 | 30 |
| 13 | Lawngdin (YPIC) | FDI | Hydro | 435 | 217.5 |
| 14 | Hkankwang (YPIC) | FDI | Hydro | 140 | 70 |
| 15 | Tongxinqiao (YPIC) | FDI | Hydro | 320 | 160 |
| 16 | Hutgyi (Sinohydro+EGAT) | FDI | Hydro | 1360 | 680 |
| 17 | Shweli-2 (Hueneng Lancang) | FDI | Hydro | 520 | 260 |
| 18 | Saidin (CDOI+ SHT) | FDI | Hydro | 76.5 | 38.25 |

# Power Plant Projects to be completed during 2017 to 2021 (MW)

| Sr. No. | Project Name | Investor Type | Type | Installed Capacity | Myanmar self-use capacity |
|---|---|---|---|---|---|
| 19 | Tapein-2 (DUHD) | FDI | Hydro | 168 | 84 |
| 20 | Manipur(Henshin+Mega) | FDI | Hydro | 380 | 190 |
| 21 | Belin (Asia World Co., Ltd) | FDI | Hydro | 280 | 280 |
| 22 | Ngot Chaung (Neo Energy Oasis Co.,) | FDI | Hydro | 16.6 | 16.6 |
| 23 | Yangon – Htantapin (Hueneng Langcang) | FDI | Coal | 270 | 270 |
| 24 | Yangon- Thilawar (Toyo-Thai ) | FDI | Coal | 650 | 650 |
| 25 | Boakpyin (C-wave) | FDI | Coal | 500 | 250 |
| 26 | Ngayutkong (TATA) | FDI | Coal | 500 | 500 |
| 27 | Ayeyarwaddy/Yangon | FDI | Gas | 500 | 500 |
| 28 | Tanintharyi, Mon , Kayin (Gunkul) | FDI | Wind | 1000 | 300 |
| 29 | Shan, Kayah (Gunkul) | FDI | Wind | 1930 | 579 |
| 30 | Chin, Rakhine, Ayeyarwaddy, Yangon | FDI | Wind | 1102 | 330 |
| 31 | Sagaing, Magwe, Mandalay, Shan, Taninthari (Emerging Market Energy Pte., Ltd) | FDI | Geothermal | 200 | 200 |
| Total | | | | 19,110 | 10,907 |

# Power Transmission Projects to be completed during 2016-17 to 2020-2021

| Sr. No | State/ Region | Transmission Lines | | | | Substations | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 500 kV (mile) | 230 kV (mile) | 132 kV (mile) | 66 kV (mile) | 500 kV | | 230 kV | | 132 kV | | 66 kV | |
| | | | | | | No. | MVA | No. | MVA | No. | MVA | No. | MVA |
| 1. | Kachin State | 377 | 240 | 5 | - | 1 | 500 | 1 | 100 | - | - | 2 | 15 |
| 2 | Kayar State | - | - | - | - | - | - | - | - | - | - | - | - |
| 3 | Kayin State | - | 60 | - | 25 | - | - | - | - | - | - | 1 | 45 |
| 4 | Chin State | - | - | - | 95 | - | - | - | - | - | - | 2 | 4 |
| 5 | Mon State | - | 8 | - | - | - | - | 2 | 200 | - | - | - | - |
| 6 | Rakhine State | - | 7 | - | - | - | - | - | - | - | - | - | - |
| 7 | Shan State | 260 | 409 | 50 | 393 | - | - | 5 | 500 | - | - | 14 | 100 |
| 8 | Sagaing Region | - | 20 | - | 70 | - | - | - | - | - | - | 1 | 5 |
| 9 | Taninthari Region | - | 330 | - | 70 | - | - | 3 | 300 | - | - | 3 | 18 |
| 10 | Bago Region | - | 20 | - | - | - | - | - | - | - | - | 1 | 10 |
| 11 | Magway Region | - | 64 | 85 | - | - | - | - | - | - | - | 2 | 20 |
| 12 | Mandalay Region | - | 125 | - | - | - | - | 1 | 80 | 2 | 160 | 1 | 5 |
| 13 | Ayeyarwaddy Region | - | 140 | - | 17 | - | - | - | - | - | - | 1 | 20 |
| 14 | Yangon Region | - | 58 | - | - | - | - | - | - | - | - | - | - |
| Total | | 637 | 1481 | 140 | 670 | 1 | 500 | 12 | 1180 | 2 | 160 | 28 | 242 |

# Distribution Line and Substations to be completed during 2016-17 to 2020-21

| Sr No | State/ Region | Distribution Lines | | | | Substations | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 66kV mile | 33 kV mile | 11 kV mile | 0.4 kV mile | 66 kV | | 33 kV | | 11 kV | |
| | | | | | | No. | MVA | No. | MVA | No. | MVA |
| 1. | Kachin State | - | 30 | 73 | 43 | - | - | 3 | 30 | 50 | 10.0 |
| 2 | Kayar State | - | 33 | 171 | 149 | - | - | 3 | 30 | 88 | 17.6 |
| 3 | Kayin State | - | 50 | 59 | 147 | - | - | 5 | 50 | 194 | 38.8 |
| 4 | Chin State | - | 30 | 5 | 13 | - | - | 3 | 30 | 25 | 5.0 |
| 5 | Mon State | - | 16 | 84 | 210 | - | - | 3 | 30 | 280 | 56.0 |
| 6 | Rakhine State | - | 40 | 25 | 28 | - | - | 4 | 40 | 56 | 11.2 |
| 7 | Shan State | - | 120 | 175 | 436 | - | - | 13 | 130 | 581 | 116.2 |
| 8 | Sagaing Region | - | 127 | 148 | 368 | - | - | 10 | 100 | 495 | 99.0 |
| 9 | Tanintharyi Region | - | 50 | 173 | 315 | - | - | 5 | 50 | 508 | 101.6 |
| 10 | Bago Region | - | 130 | 152 | 379 | - | - | 14 | 140 | 505 | 101.0 |
| 11 | Magway Region | - | 90 | 151 | 380 | - | - | 5 | 50 | 505 | 101.0 |
| 12 | Mandalay Region | - | 300 | 932 | 2306 | - | - | 45 | 450 | 3074 | 614.8 |
| 13 | Ayeyarwaddy Region | - | 80 | 202 | 444 | - | - | 8 | 80 | 662 | 132.4 |
| 14 | Yangon Region | 182 | 12 | 526 | 474 | 37 | 1110 | - | - | - | - |
| Total | | 182 | 1108 | 2876 | 5692 | 37 | 1110 | 121 | 1210 | 7023 | 1404 |

# Projects to be completed during 2021-22 to 2025-26

# Power Transmission Projects to be completed during 2021– 22 to 2025 - 26

| Sr. No | State/ Region | Transmission Lines | | | | Substations | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 500 kV (mile) | 230 kV (mile) | 132 kV (mile) | 66 kV (mile) | 500 kV | | 230 kV | | 132 kV | | 66 kV | |
| | | | | | | No. | MVA | No. | MVA | No. | MVA | No. | MVA |
| 1. | Kachin State | 99 | 106 | - | - | 1 | 1000 | - | - | - | - | - | - |
| 2 | Kayar State | 200 | - | 44 | - | - | - | - | - | 1 | 60 | - | - |
| 3 | Kayin State | - | 25 | - | - | - | - | 1 | 50 | - | - | - | - |
| 4 | Chin State | - | - | - | - | - | - | - | - | - | - | - | - |
| 5 | Mon State | - | - | - | 30 | - | - | - | - | - | - | 2 | 35 |
| 6 | Rakhine State | - | 80 | - | - | - | - | 1 | 100 | - | - | - | - |
| 7 | Shan State | - | 130 | - | 40 | - | - | - | - | - | - | 6 | 55 |
| 8 | Sagaing Region | - | 10 | - | - | - | - | - | - | - | - | - | - |
| 9 | Tanintharyi Region | - | 15 | - | - | - | - | 1 | 200 | - | - | - | - |
| 10 | Bago Region | - | - | - | - | - | - | 1 | 100 | - | - | - | - |
| 11 | Magway Region | - | - | - | - | - | - | - | - | - | - | 1 | 10 |
| 12 | Mandalay Region | - | - | - | 23 | - | - | 5 | 700 | 1 | 200 | 3 | 20 |
| 13 | Ayeyarwaddy Region | - | - | - | - | - | - | - | - | - | - | 3 | 30 |
| 14 | Yangon Region | - | - | - | - | - | - | - | - | - | - | - | - |
| Total | | 299 | 366 | 44 | 93 | 1 | 1000 | 9 | 1150 | 2 | 260 | 15 | 150 |

# Power Transmission Projects to be completed during 2021– 22 to 2025 - 26

| Sr. No | State/ Region | Transmission Lines | | | | Substations | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 500 kV (mile) | 230 kV (mile) | 132 kV (mile) | 66 kV (mile) | 500 kV | | 230 kV | | 132 kV | | 66 kV | |
| | | | | | | No. | MVA | No. | MVA | No. | MVA | No. | MVA |
| 1. | Kachin State | 99 | 106 | - | - | 1 | 1000 | - | - | - | - | - | - |
| 2 | Kayar State | 200 | - | 44 | - | - | - | - | - | 1 | 60 | - | - |
| 3 | Kayin State | - | 25 | - | - | - | - | 1 | 50 | - | - | - | - |
| 4 | Chin State | - | - | - | - | - | - | - | - | - | - | - | - |
| 5 | Mon State | - | - | - | 30 | - | - | - | - | - | - | 2 | 35 |
| 6 | Rakhine State | - | 80 | - | - | - | - | 1 | 100 | - | - | - | - |
| 7 | Shan State | - | 130 | - | 40 | - | - | - | - | - | - | 6 | 55 |
| 8 | Sagaing Region | - | 10 | - | - | - | - | - | - | - | - | - | - |
| 9 | Tanintharyi Region | - | 15 | - | - | - | - | 1 | 200 | - | - | - | - |
| 10 | Bago Region | - | - | - | - | - | - | 1 | 100 | - | - | - | - |
| 11 | Magway Region | - | - | - | - | - | - | - | - | - | - | 1 | 10 |
| 12 | Mandalay Region | - | - | - | 23 | - | - | 5 | 700 | 1 | 200 | 3 | 20 |
| 13 | Ayeyarwaddy Region | - | - | - | - | - | - | - | - | - | - | 3 | 30 |
| 14 | Yangon Region | - | - | - | - | - | - | - | - | - | - | - | - |
| Total | | 299 | 366 | 44 | 93 | 1 | 1000 | 9 | 1150 | 2 | 260 | 15 | 150 |

# Distribution Lines and Substations to be completed during 2021-22 to 2025-26

| Sr No | State/ Region | Distribution Lines | | | | Substations | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 66kV mile | 33 kV mile | 11 kV mile | 0.4 kV mile | 66 kV | | 33 kV | | 11 kV | |
| | | | | | | No. | MVA | No. | MVA | No. | MVA |
| 1. | Kachin State | - | 50 | 37 | 25 | - | - | 5 | 50 | 12 | 2.4 |
| 2 | Kayar State | - | 50 | 52 | 80 | - | - | 5 | 50 | 54 | 10.8 |
| 3 | Kayin State | - | 50 | 57 | 143 | - | - | 5 | 50 | 189 | 37.8 |
| 4 | Chin State | - | 30 | 5 | 11 | - | - | 3 | 30 | 27 | 5.4 |
| 5 | Mon State | - | 90 | 138 | 344 | - | - | 10 | 100 | 459 | 91.8 |
| 6 | Rakhine State | - | 80 | 25 | 63 | - | - | 8 | 80 | 82 | 16.4 |
| 7 | Shan State | - | 160 | 242 | 605 | - | - | 18 | 180 | 807 | 161.4 |
| 8 | Sagaing Region | - | 162 | 225 | 533 | - | - | 17 | 170 | 711 | 142.2 |
| 9 | Tanintharyi Region | - | 70 | 127 | 314 | - | - | 7 | 70 | 433 | 86.6 |
| 10 | Bago Region | - | 220 | 256 | 643 | - | - | 23 | 230 | 855 | 171 |
| 11 | Magway Region | - | 100 | 194 | 411 | - | - | 10 | 100 | 548 | 109.6 |
| 12 | Mandalay Region | - | 340 | 1609 | 3999 | - | - | 67 | 670 | 5332 | 1066.4 |
| 13 | Ayeyarwaddy Region | - | 100 | 201 | 438 | - | - | 10 | 100 | 708 | 141.6 |
| 14 | Yangon Region | 152 | 4 | 232 | 174 | 35 | 1050 | - | - | - | - |
| Total | | 152 | 1506 | 3400 | 7783 | 35 | 1050 | 188 | 1880 | 10217 | 2043 |

# Projects to be completed during 2026-27 to 2030-31

## Power Plant Projects to be completed during 2027 to 2031 (MW)

| Sr. No. | Project Name | Investor Type | Type | Installed Capacity | Myanmar self-used capacity |
|---|---|---|---|---|---|
| 1 | Htukyan (CDOI+STH) | FDI | Hydro | 105 | 52.5 |
| 2 | Hanna (CDOI+STH) | FDI | Hydro | 45 | 22.5 |
| 3 | Thakya (CDOI+STH) | FDI | Hydro | 150 | 75 |
| 4 | Palaung (CDOI+STH) | FDI | Hydro | 105 | 52.5 |
| 5 | Bawlake (CDOI+STH) | FDI | Hydro | 180 | 90 |
| 6 | Upper Thanlwinr Mong Tong (China Threegorges+ EGAT) | FDI | Hydro | 7,110 | 3,555 |
| Total | | | | 7,695 | 3,847 |

## Power Transmission Projects to be completed during 2026 – 27 to 2030 - 31

| Sr. No | State/ Region | Transmission Lines | | | | Substations | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 500 kV (mile) | 230 kV (mile) | 132 kV (mile) | 66 kV (mile) | 500 kV | | 230 kV | | 132 kV | | 66 kV | |
| | | | | | | No. | MVA | No. | MVA | No. | MVA | No. | MVA |
| 1. | Kachin State | - | - | - | - | - | - | - | - | - | - | 1 | 10 |
| 2 | Kayar State | 250 | - | 50 | - | - | - | - | - | - | - | - | - |
| 3 | Kayin State | - | - | - | - | - | - | | - | - | - | - | - |
| 4 | Chin State | - | - | - | - | - | - | - | - | - | - | - | - |
| 5 | Mon State | - | - | - | - | - | - | - | - | - | - | 2 | 15 |
| 6 | Rakhine State | - | - | - | - | - | - | - | - | - | - | - | |
| 7 | Shan State | - | - | - | - | - | - | - | - | - | - | 2 | 10 |
| 8 | Sagaing Region | - | - | - | - | - | - | - | - | 1 | 100 | - | - |
| 9 | Taninthary i Region | - | - | - | - | - | - | - | - | - | - | - | - |
| 10 | Bago Region | - | - | - | - | - | - | - | - | - | - | - | - |
| 11 | Magway Region | - | - | - | - | - | - | - | - | - | - | - | - |
| 12 | Mandalay Region | - | - | - | - | - | - | 3 | 600 | 1 | 200 | 1 | 10 |
| 13 | Ayeyarwaddy Region | - | - | - | - | - | - | 1 | 100 | - | - | 3 | 30 |
| 14 | Yangon Region | - | - | - | - | - | - | - | - | - | - | - | - |
| Total | | 250 | - | 50 | - | - | - | 4 | 700 | 2 | 300 | 9 | 75 |

# Distribution Lines and Substations to be completed during 2026-27 to 2030-31

| Sr No | State/ Region | Distribution Lines | | | | Substations | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 66kV mile | 33 kV mile | 11 kV mile | 0.4 kV mile | 66 kV | | 33 kV | | 11 kV | |
| | | | | | | No. | MVA | No. | MVA | No. | MVA |
| 1. | Kachin State | - | 50 | 10.5 | 11.55 | - | - | 5 | 50 | 25 | 5 |
| 2 | Kayar State | - | 50 | 65 | 50 | - | - | 5 | 50 | 25 | 5 |
| 3 | Kayin State | - | 40 | 80 | 197 | - | - | 5 | 50 | 263 | 52.6 |
| 4 | Chin State | - | 30 | 6 | 15 | - | - | 3 | 30 | 39 | 7.8 |
| 5 | Mon State | - | 130 | 234 | 584 | - | - | 15 | 150 | 780 | 156 |
| 6 | Rakhine State | - | 70 | 41 | 80 | - | - | 7 | 70 | 107 | 21.4 |
| 7 | Shan State | - | 150 | 345 | 864 | - | - | 16 | 160 | 1153 | 230.6 |
| 8 | Sagaing Region | - | 205 | 339 | 785 | - | - | 18 | 180 | 1046 | 209.2 |
| 9 | Tanintharyi Region | - | 80 | 232 | 544 | - | - | 8 | 80 | 702 | 140.4 |
| 10 | Bago Region | - | 290 | 434 | 1083 | - | - | 36 | 360 | 1442 | 288.4 |
| 11 | Magway Region | - | 100 | 153 | 383 | - | - | 10 | 100 | 511 | 102.2 |
| 12 | Mandalay Region | - | 400 | 2776 | 2718 | - | - | 108 | 1080 | 9263 | 1862.6 |
| 13 | Ayeyarwaddy Region | - | 100 | 379 | 904 | - | - | 9 | 90 | 1203 | 240.6 |
| 14 | Yangon Region | 152 | - | 98 | 20 | 35 | 1050 | - | - | - | - |
| Total | | 152 | 1695 | 5192 | 8239 | 35 | 1050 | 245 | 2450 | 16559 | 3321 |

## Current Issues emphasized in First priority

1. **Introduction of 500 kV transmission system and SCADA EMS system**
2. Solving the supply and demand unbalance problem within short term, especially in dry season
3. Reduction of high power loss and upgrading the distribution system
4. Enhancing private sector participation to be involved more and more in generation and distribution activities
5. Formulating Electricity laws and regulations, taking the idea assistance from Local and international experts
6. Capacity building and human resources development program for engineers to be in line with the advanced technology

# 500 KV Power Transmission Plan In Myanmar


- ❑ 500kV ShweLi(3)~ Tha-pya-wa
  Double Circuit Line (250)miles
- ❑ 500kV Tha-pya-wa ~ Taungoo
  Double Circuit Line (153.3)miles
- ❑ 500kV MongTon~Taungoo
  Double Circuit Line (230)miles
- ❑ 500kV Taungoo~KamarNat
  Double Circuit Line (117 )miles
- ❑ 500kV KamarNat-MyaungTagar
  Double Circuit Line (50)miles

Proposal Stage Contracted Stage

## The Future Power Planning and Power & Energy Balance of Myanmar

**Potential power market**

China、Thailand、India

Bangladesh

### China

China has large energy demand, its demand for electricity is steadily increasing. On the basis of the existing capacity of 1.05 billion kW, 734 million kW and 628 million kW increase are needed from 2011~2020 and from 2021~2030 respectively.

### Thailand

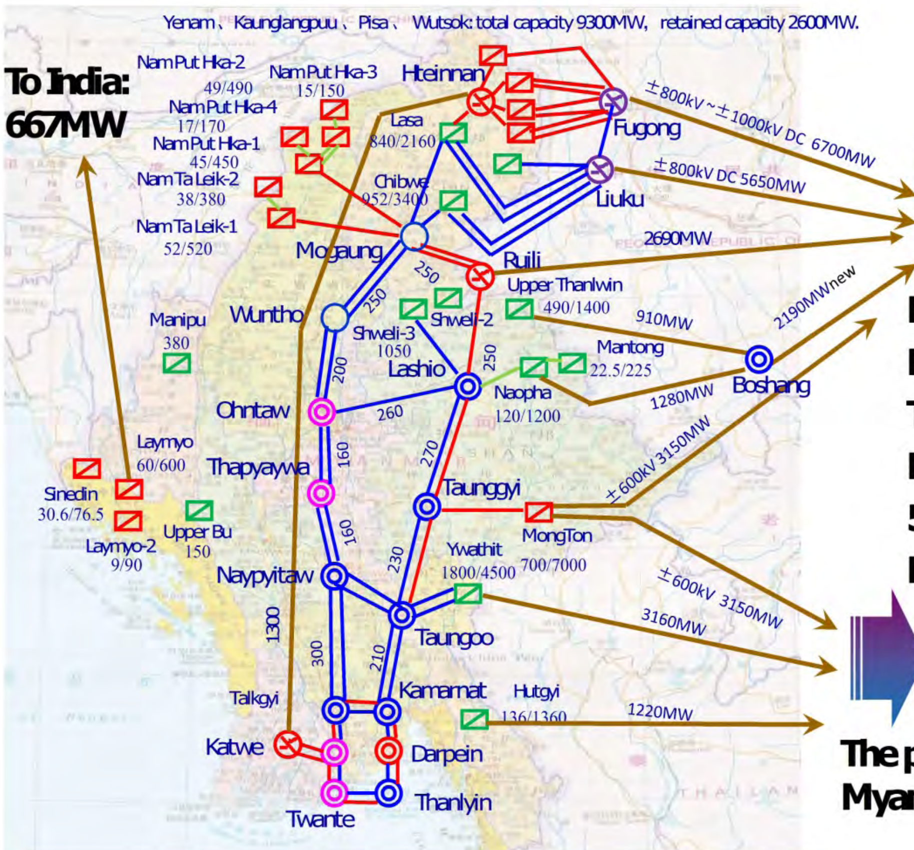
The domestic electric power supply is short in Thailand. In addition to the imported electric power from Laos and Malaysia, there are still 1.9 million kW and 6.3 million kW of electric power potential market in 2020 and 2030 respectively.

### India

Indian power supply is seriously deficient with about 10% (20,000 MW) power shortage. On the basis of the existing capacity of 200 million kW, 101 million kW and 139 million kW increase are needed from 2011~2020 and from 2021~2030 respectively.

### Bangladesh

At present, Bangladesh power supply is seriously deficient with about 2 million kW power shortage. However, considering the uncertain factors, Bangladesh is not considered as the potential market.




## Hydropower export to China: 20,379MW～23,790MW

New 500kV substation: 1

Extended 500kV substation: 4

Total substation capacity: 14,000MVA

DC transmission line: 1 with 1,300km

500kV transmission line: 17

New added length: 2,365km

## Hydropower export to Thailand: 7,533MW～8,883MW

The peak load of Myanmar: 11,520MW

Myanmar self-use capacity: 20,220MW

hydropower: 13,500MW

gas-turbine: 6,720MW

The investment :

±800kV DC project: 2 billion $

500kV project: 1 billion $

230kV project: 624 million $

In 2030, total investment of new project: 3.63 billion $

## The Perspective of Myanmar power grid diagram in 2030

Note: The red for new project

The pink for extended project

***Hydro China Kunming Engineering Corporation***

# Opportunities

## Investment by Foreigners

- Allowed foreign investors to participate in the from of JV
- Foreign partners can form up a consortium
- Minimum share of foreign party is 30%
- Foreign investors must contribute 15% (or) 10% of Free Share to MOEP as royalty payment
- Foreign investors must contribute 10% (or) 15% of Free Power to MOEP as royalty payment
- Royalty payments will not exceed 25% on the whole
- Royalty payments is depending on financial model

## POWER PURCHASE AGREEMENT (PPA)

- Between Myanma Electric Power Enterprise (MEPE) and JV Company.
- Effectiveness and term of contract is one year.
- Six months before the expiration of the term of this agreement, the parties shall negotiate the renewal of this agreement.

# Performances to Reduce Losses

- To replace old electromagnetic energy meter with Digital Meter (Offsite meter reading system) .
- To replace 400 V bare conductor over head distribution line with aerial bundle Conductor (ABC).
- To reduce long distance 400 V distribution line losses by using Multi transformer System .
- To upgrade 6.6 kV distribution voltage to 11 kV.
- To upgrade 33 kV distribution voltage to 66 kV .

## Towards Privatization

- To invite Independent Power Producer (IPP) for sufficient electricity power supply
- To start franchise township wise utility task to Private sector .

## Conclusion & Discussions

### Invitation for Cooperation with YESB

- Capacity building of YESB employee.
- Research and development co-workmanship in Energy Planning, environmental engineering and renewable energy
- Human Resources Development
- Control, Operation and maintenance training for distribution system (SCADA/EMS)
- Effective on-job trainings especially for distribution system
- Capital Investment through PPP scheme
- To replace 6.6 kV, 11 kV and 33 kV Medium voltage overhead line with spacer cable system

# Barriers and Challenges

1. Policy Framework
2. Laws, Rules and Regulations
3. Planning and Road Map
4. Coordination and Cooperation among Government Agencies
5. Cooperation and Cooperation among International Donating and Supporting Agencies
6. Financial Support (Local and International)
7. Foreign and Local Investment (Public, Private and PPP)
8. Regional and International Cooperation
9. Privatization and Reforming of Government Enterprises
10. Human Resources Development, Capacity Building and Transfer of Technology

# Conclusion

- The electric power sector plays a vital role for the development of the state and social affairs.
- Due to the geographic conditions, most of the hydropower resources are in the northern part of Myanmar, however, the areas where great electricity consumers reside, including Yangon region are in the south. Therefore high power kVA transmission lines should be constructed so as to maintain the transmission of electric power by reducing unnecessary losses.
- Coal-fired Thermal Power Plant and Gas Turbine Power Plant Projects assisted by high technologies causing low impact on environmental, social and health as well as short term construction periods, are to be established in the highest power demand areas to fulfill the present power demands.
- For practicing the power generation-mixed, hydropower projects should also be implemented by exploiting the existing hydropower resources throughout the country. Then only, low tariff rate can be enjoyed and excess power, other than domestic use, generated from the hydropower projects can also be sold the neighboring countries and somehow increase the earning of the state.

- Energy sector is critical for a sustainable economic development. Myanmar has a challenging task of transforming the energy sector so it is responsive, grows rapidly and becomes financially sustainable.
- Country has adequate energy resources that is mostly clean (hydropower, gas, and renewable energy) .
- Private sector is already investing in energy sector, and willing to invest more .
- Development partners are keen to extend assistance for reducing poverty, which includes extension of energy supply to about 71% of the population, and
- Government is strongly committed to the reform process (market-based economy etc) .
- With continued macroeconomic stability, Myanmar has a comparative advantage for foreign direct investments (in manufacturing, mining, oil and gas, renewable) that can help the economy grow at a rapid pace and large poverty reduction is possible with proper governance.

- **By timely transforming the energy sector, Myanmar will ensure that energy supply does not become a binding constraint for economic growth, something faced by several developing countries.**
- **This is the overview of the Myanmar National Energy Policy in brief. As you have been informed there are a lot of opportunities for investment and cooperation in Myanmar Energy Sector development. The government of Myanmar is welcoming you. I sincerely believe that your interest and investment in the energy development of Myanmar is truly essential for the Win – Win cooperation for both of Myanmar and it's friends.**

# Thank You for Your Kind Attention

U Thoung Win
Member , Energy Development Committee
( National Energy Management Committee )
and
Chairman , Energy and Renewable Energy Committee
( Myanmar Engineering Society )
24 September 2015 Bangkok Thailand