Integration – Innovation – Integrity

GLOBAL INTEGRATED SERVICE GROUP OF COMPANIES

GIS

Micro Hydropower

Informational Presentation

Briefing – Nepal November 2014

Global Integrated Service Co. Ltd. (GIS), Yangon, Myanmar is an oil and gas exploration, production and service company. GIS subsidiaries and associated companies also have active and expanding interests in the power and renewable energy sectors, as well as in logistics, agriculture, aquaculture, aviation, tourism, mining and consulting.

Email: info@gisgoc.com

Website: www.gisgoc.com

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MYANMAR- Preface

- Myanmar is resource-rich and strategically located between the People's Republic of China (PRC) and India, at the crossroads between East and South Asia.
- It has the overwhelming potential for rapid economic development
- Yet, today, 74% of its roughly 60 million people lack access to power and endure basic infrastructure.
- Accordingly, Myanmar needs an energy - It needs to deliver comprehensive energy access to its people and fuel the engines of commerce and industry.

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Current Energy Architecture

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MYANMAR- Current Energy Architecture

Myanmar's present energy architecture faces many challenges and opportunities as the country makes its transition to democracy.

- ✓ Only 26% of the population has access to electricity, and **70% of the population lives in rural areas**.
- ✓ Myanmar **relies heavily on traditional biomass** for its energy needs, getting approximately 75% of its total primary energy supply from that source, mainly fuel wood from natural forests.
- ✓ For those who do have access to power, supply is intermittent at best due to the seasonality of hydropower production and inadequate transmission and distribution infrastructure.
- ✓ Even if electricity output doubled every five years, it would take five years just to meet today's needs. In that time, demand would have grown by 12% a year.
- ✓ The energy sector will continue to play a pivotal role in enabling development.

MYANMAR- Current Energy Architecture – Cont'd

- ✓ The economy in rural areas is dominated by the agricultural sector.
- ✓ Myanmar places agricultural sector development at the core of its nationwide poverty alleviation strategy and concomitant efforts to improve food security, increase employment and promote exports.
- ✓ The agriculture sector's development hinges upon rapidly improving productivity and creating post-harvest processing facilities and logistics systems
- ✓ Social opposition to large and medium-scale dams in Myanmar is strong and growing, which will significantly complicate electrification efforts.
- ✓ Small-scale hydropower, mini-grids represent business opportunities - investments in smaller-scale generating assets and distribution/transmission infrastructure will play a critical role during in the next 1- 3 years

MYANMAR- Current Energy Architecture – Cont'd

- ✓ Mini-grids, or autonomous off-grid systems, will therefore play a pivotal role in bringing the benefits of electricity to areas where it is not economically or logistically feasible to expand the national grid in the short to medium term.
- ✓ Myanmar in the process to update the 1984 Electricity Law.
- ✓ In the interim, states and regions can issue permits for small (<10MW) and medium size (<30MW) power plants not connected to the national grid. The new law will effectively encourages state level governments to take the lead in promoting off-grid power infrastructure projects.
- ✓ The move towards state-level decision making structures and policy signals supporting the deployment of mini-grids as an important bridging solution suggest that there are immediate opportunities to invest in Myanmar's power sector.
- ✓ Mini-grids and distributed power generation represent two unique, yet complementary business opportunities for private sector investors eager to establish a foothold in Myanmar's highly lucrative and untapped power sector.

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Barriers & Challenges

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MYANMAR- Barriers & Challenges

- **Barriers to future development of renewable energy resources are:**
  1. Absence of a transparent institutional and legal framework for exploration, development and deployment;
  2. Limited financial capacity to support research and development (R&D), market-based investment and physical infrastructure;
  3. Lack of human resource capacity; and
  4. Subsidized power and petroleum prices.

- **Challenges are:**
  1. A commercially unattractive tariff structure that is perpetuated by strong public opposition to higher tariff rates;
  2. A domestic paucity of qualified personnel to carry out system design, installation, operation as well as maintenance and repairs; and
  3. Insufficient confidence in Myanmar's still nascent political reforms, the staying power of which will either be confirmed or denied following the 2015 election.

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Government Ministries

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MYANMAR- Government Ministries

- Ministry of Electric Power (MOEP), which is responsible for hydropower, thermal power, and transmission and distribution. These areas of responsibility were previously split between two ministries, which merged in 2012.

- Within MOEP, there are three operational entities –
  1. Myanmar Electric Power Enterprise (MEPE), which is responsible for the transmission network and gas-fired power plants;
  2. Yangon City Electricity Supply Board (YESB), which is responsible for the supply of electricity to consumers in Yangon; and
  3. Electric Supply Enterprise (ESE), which is responsible for the supply of electricity to consumers in the rest of Myanmar

- Ministry of Environmental Conservation and Forestry (MOECAF), which is responsible for fuel wood, climate change, and environmental standards and safeguard requirements but not social ones.

- Ministry of Agriculture and Irrigation (MOAI), responsible for biofuels and micro-hydropower for irrigation purposes.

MYANMAR- Ministries – Cont'd

- Ministry of Science and Technology (MOST), responsible for research and development related to renewable energy technologies.
- Ministry of Mines (MOM), responsible for coal production.
- Ministry of Industry (MOI), responsible for energy efficiency and off-grid rural energy access (it contains the Rural Energy Supporting Development Committee), as well as approving electrical connections for businesses and industries (this may change with the approval of the new Electricity Law).

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Energy Demands – Key Points

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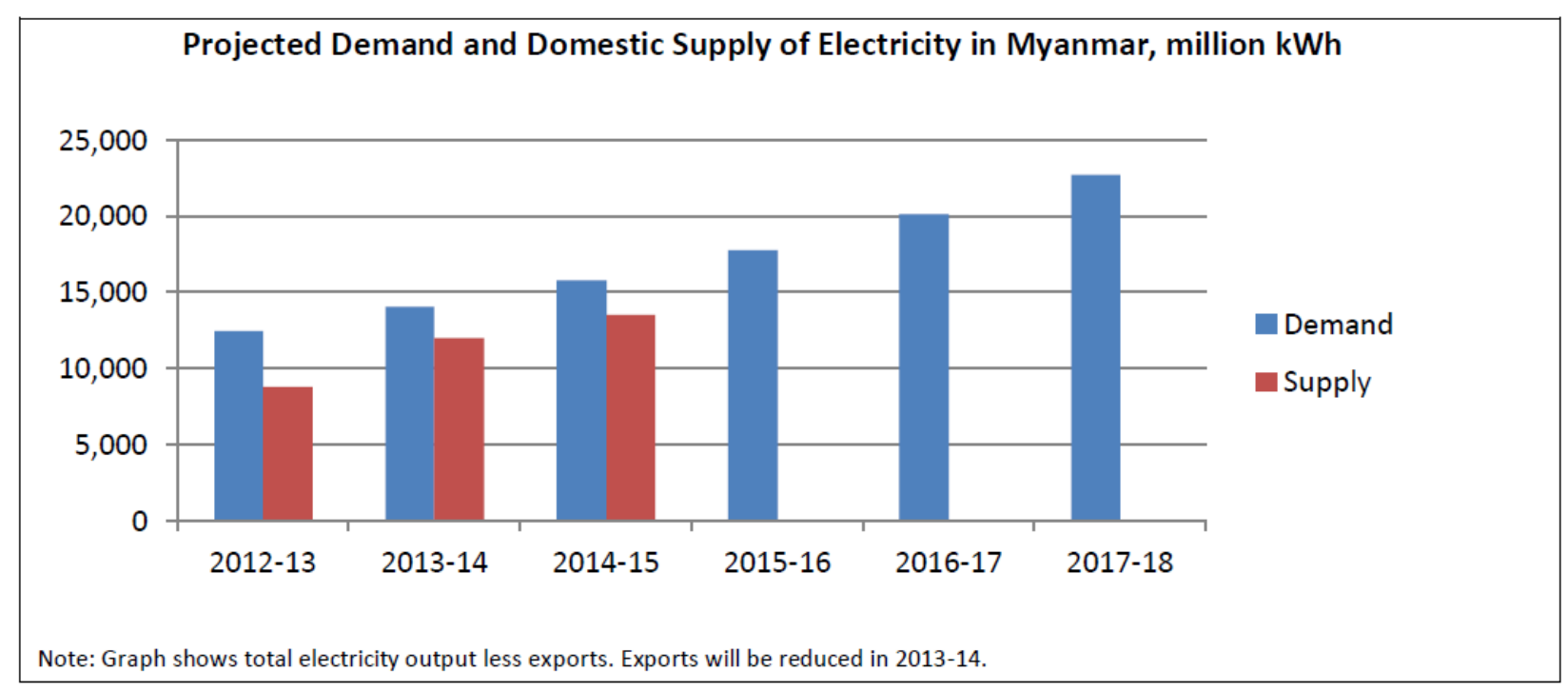
MYANMAR - Energy Demands – Key Points

- Estimates of future demand growth by the Ministry of Electric Power for electricity show demand doubling from 12,459 million kWh in 2012-13 to 25,683 million kWh and in 2018-19, a compound rate of growth of 13% a year. However, the actual production in 2013 appears to be only 10,500 million kWh, and it is unlikely that moving beyond 2013 will raise the total much beyond 10,500 million kWh. **("Myanmar: Energy Sector Initial Assessment," Asian Development Bank, October 2012)**



MYANMAR - Energy Demands – Key Points

- 70% of Myanmar's 60 million population live in rural areas and 74% lack access to energy. Yangon is by far the largest city, with 4.6 million inhabitants; of these, only 67% are connected to the grid.
- Industrial activity constitutes 26% of GDP, double the level in 1965. The contribution of services has dropped from 52% in 1965 to 38% in 2010. These rates are very low and will need to be increased to create economic growth.
- Agriculture constitutes 36% of GDP, and is the source of 25-30% of export value.
- Per capita electricity consumption was about 105 kWh per year
- Electricity consumption increased by 7% annually
- The largest end-use of electricity in the country is for "general purpose," representing households, accounting for approximately 42% of total end-use in 2011, followed by industry at 36% and commerce at 20%.

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Energy Supply - Key Points

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MYANMAR- Energy Supply - Key Points

- Traditional biomass meets 75% of Myanmar's primary energy supply, followed by gas (10%) and crude oil (6%).
- Fuel wood harvested from natural forests makes up 90% of traditional biomass and this poses a threat to environmental sustainability.
- Myanmar holds natural gas reserves of 7.8 trillion cubic feet, and current gas production is centred on the Yadana and Yetagun fields.
- Foreign companies are increasingly taking an interest in oil operations, with 75 expressions of interest received for tenders released in January and April 2013.
- Coal production has risen significantly, with 0.065 million metric tons (approximately) being produced in 1998 and 1.4 million tons in 2011.
- Wind, solar and biomass energy hold great potential, but only hydropower is being commercially exploited at present. The Ministry of Electric Power has identified 300 potential hydropower projects with a combined capacity of 46,331 megawatts.

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Current Tariff Structure

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MYANMAR- Current Tariff Structure

- Under Myanmar's recently updated and highly subsidized electricity tariff structure, households are charged between 35 to 50 kyat per kWh (USD .03 -.05), and business and industry are charged 100 to 130 kyats per kWh (USD .10 - .13)
- Diesel-based mini-grids in Mandalay region, for example, found that the average cost of electricity was 833 kyat (USD .86) per kilowatt-hour (kWh), with the average household consuming <6 kWh per month.
- Myanmar has a population of 60 million, of which 70% live in rural areas where average electrification rates are 16%. The two largest cities, Yangon and Mandalay, have a combined population of 5.6 million, of which 4.6 million reside in Yangon. Average electrification rates are 67% in Yangon and 31% in Mandalay. Population figures, however, are estimates, and there has been no official census for the last two decades.
- Now Government is planning to reform Tariff Structure for retail Household & Industry in coming this budget year

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Potential - The Way Forward

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MYANMAR- Potential - *The Way Forward*

- **The challenge of supplying electricity is huge. People in rural areas rely on off-grid sources such as fuel wood and kerosene. In such areas, off-grid mini and micro hydropower, wind and solar energy systems could help meet basic energy needs while reducing traditional biomass usage, thereby enabling access to new forms of services and technologies to enhance people's well-being.**
- **Renewable energy – Investing in renewable energy is vital to ensure Myanmar develops a sustainable and environmentally clean energy system.**
- **Myanmar has significant potential for the development of hydropower, biofuels, solar and wind power, but these are currently at an early stage of development.**
- **Low-head hydropower technologies and cascades of smaller-scale (<10MW) dams have fewer environmental and social impacts, and are therefore likely to generate less public opposition, particularly when the electricity generated benefits local communities**

MYANMAR- Potential - *The Way Forward* – Cont'd

- **Although Myanmar's relative low electricity tariffs makes investment in on-grid hydro projects less attractive commercially, there are a multitude of opportunities to develop hydrological assets in rural areas as off-grid, autonomous systems, where tariffs can be structured to make a project more commercially attractive.**
- **Mini-grids will need to be designed with certain technical standards in mind to:**
  1. **Allow for the mini-grid's seamless integration into the national grid once it reaches the project area;**
  2. **Ensure electricity generated by the asset(s) can be up-sold into the national grid under Small Power Producer (SPP) or Very Small Power Producer (VSPP) frameworks to generate long-term returns; and**
  3. **Remotely monitor and manage mini-grids at centralized facilities to reduce operations costs and increase reliability.**

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Conclusions

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MYANMAR- Conclusions

- Energy is a pre-requisite to development, and seeking to leverage international investor's renewed interest in the country.
- Electric demand in Myanmar has been rising rapidly against the background of economic reforms such as attract foreign investment and industrialization.
- Funneling large-scale private investment into the power sector and centralized generating assets will initially be difficult due to the absence of mature legal and regulatory vehicles to govern investments in, and the operation of, modern power infrastructure.
- Due to the challenges associated with large-scale projects, investments in **smaller-scale** generating assets and distribution/transmission infrastructure will play a critical role during the next 1 – 3 years.
- Small-scale hydropower, mini-grids and value-added agricultural facilities represent three complementary business opportunities that can be jointly developed to reduce risk and guarantee fair returns for investors while simultaneously delivering higher-quality, lower-cost electricity to end users.

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Myanmar Background

Brief Introduction of the Republic of the Union of Myanmar

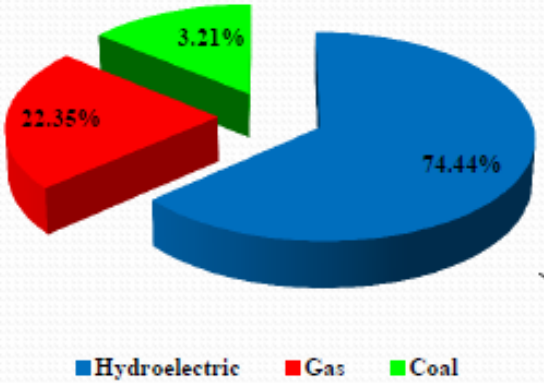
- Located in South East Asia
- Population – 59.78 millions
  (Average growth rate-1.75% per annum)
- Total Area – 676,552 sq.km
  (Total international boundary - 5860 km)
  (Coastal strip - 2833 km)
- Neighboring Countries
  - China on North and North - East
  - Laos on East
  - Thailand on South - East
  - Bangladesh and India on North - West
- Four Major Rivers
  - Ayeyawady (2,063 km)
  - Chindwin (1,151 km)
  - Sittaung (310 km)
  - Thanlwin (1,660 km)

Map of Myanmar

MYANMAR- Background

- The electrification rate of Myanmar is 26%, which is among the lowest of ASEAN countries alongside Cambodia (approx. 24%). The household electrification rate is 63% in Yangon, the center of the country's economy, followed by the capital city of Nay Pyi Taw (52%), Kayah (37%) and Mandalay (29%). The remaining rural areas are electrified averaging at approximately 16%.
- Myanmar is prone to power shortages in dry season (from December to around April) because its electrical power generation relies heavily on hydropower that accounts for more than 70% of total power generation. Therefore, in spite of the increasing share of gas-fired thermal power plants in total power generation in Yangon area during the dry season when the water level is low, the electricity generation capacity of thermal power plants has been confined to about 70% of rated output due to their aged deterioration. Also, there are growing concerns about the emergence of system failures, frequent occurrence of accidents, and increase in technical/non-technical loss, because some of the existing transmission as well as substation facilities are decades-old.

Location of Existing Power Plants



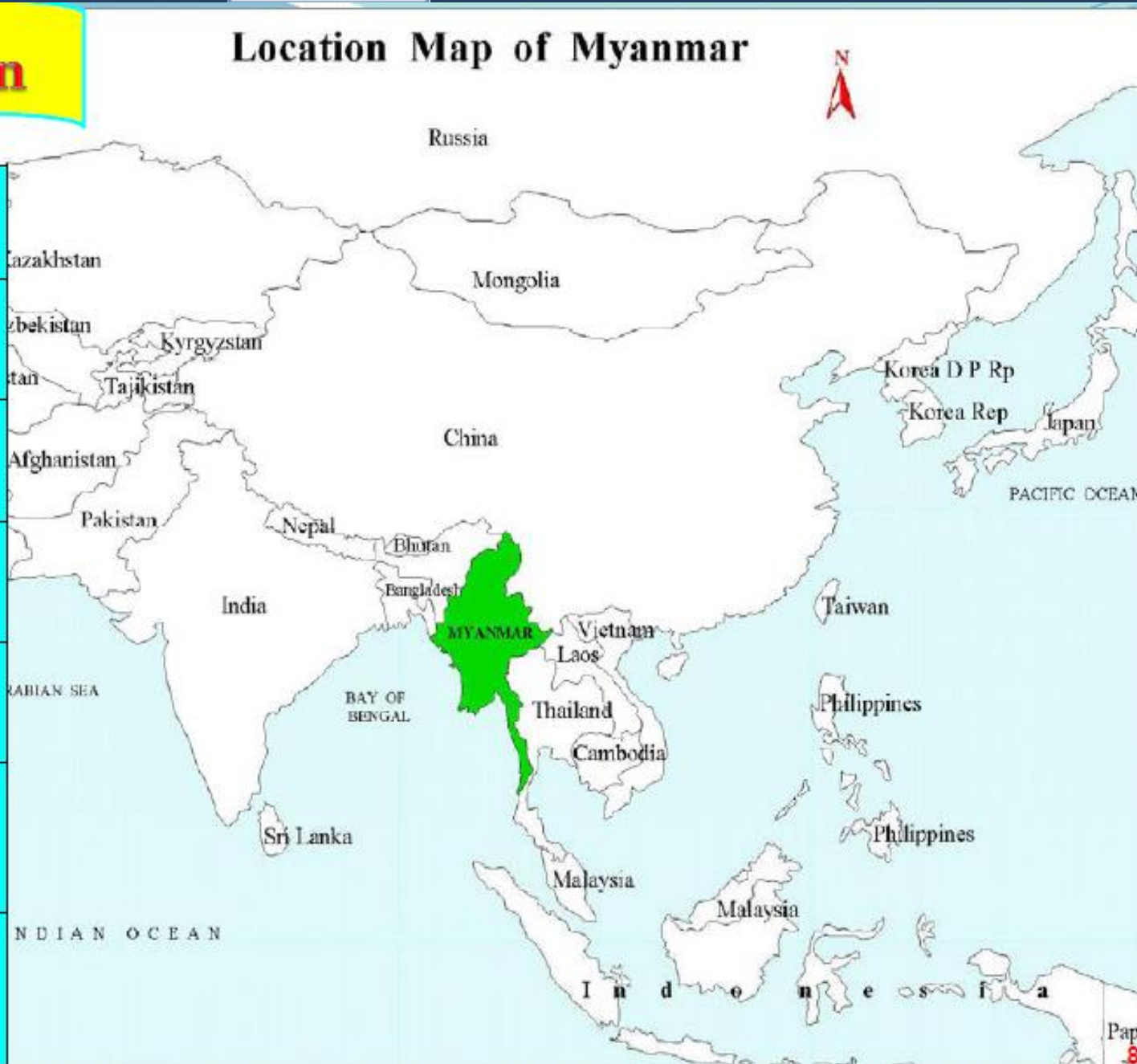
Sr. No.	Type of Power Plant	Number	Installed Capacity (MW)
1.	Hydro Power	20	2780.0
2.	Gas	10	834.9
3.	Coal	1	120
Total		**31**	**3734.9**

Tapein 240MW
Shweli-1 600MW
Thaphanseik 30 MW
Sedawgyi 25MW
Yeywa 790MW
Zawgyi-2 12MW
Kyunchaung 54.3 MW
Kinda 56 MW
Zawgyi-1 18MW
Mone 75MW
KyeeOhnKyeeWa 74MW
Man 36.9 MW
Tigyit 120MW
KengTawng 54MW
Paunglaung 280MW
Bluchaung-1 28MW
Shwetaung 55.35MW
Khapaung 30MW
Bluchaung-2 168MW
Thauk-Ye-Khat 120MW
Myanaung 34.7MW
Kun 60MW
Yenwe 25MW
Shwekyin 75MW
Zaungtu 20MW
Hlawga 180.2MW
Thaketa 92 MW
Thaton 50.95MW
Ywama 70.3MW
Ahlone 248.2MW
Mawlamyaing 12MW

Hydro Power Plant
Gas Power Plant
Steam Power Plant
Coal Fired

Electrification

Population	59.78 million
Numbers of Household	8.92 million
Electrified Household	2.58 million
Electrification Ratio (%)	29 %
Total Nos. of Village	64308
Nos. of Electrified Village	16425
Rural Electrification Ratio (%)	25.54%



Power Sector in Myanmar: Summary of Strengths and Weaknesses

STRENGTHS	WEAKNESSES
❖ Huge hydropower resources (estimated at more than 100 GW)	❑ Heavy reliance on seasonal hydropower generation and lack of domestic gas supply and capacity in gas-fired power generation
❖ Large gas reserves (11.8 tcf) and production (430 bcf in 2011) with potential for big discoveries	❑ Underinvestment in power sector resulting in load shedding of about 20% of demand and T&D losses of 19.43%
❖ Well developed power transmission system	❑ Electrification ratio of about 29%
❖ Strategic location in the regional energy market	❑ Fragmented institutional and regulatory framework in the energy sector
	❑ Electricity tariffs below the economic cost
	❑ No legal requirements for social and environmental safeguards for infrastructure projects

MYANMAR- Sources

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