Suruhanjaya Tenaga
Energy Commission

Peninsular Malaysia Electricity Supply Industry Outlook 2016

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YEAR IN REVIEW - 2014

It had been a trying and tragic year. Tragic events that befell flights MH370 and MH17, a mudslide which swept away homes, killing five and displacing hundreds in Bertam Valley and Ringlet in Cameron Highlands, and the worst floods in recent memory in Peninsular Malaysia towards the year end, causing loss of lives and properties, as well as forcing thousands of fellow Malaysians to leave their homes, had a heavy toll on the nation.

Two generating units in TNB Janamanjung plant experienced a high chloride level condition at their demineralisation water plant and had to be shut down on 6th May 2014. Another unit was already on an unplanned shutdown due to an Induced Draft (ID) fan breakdown since 1st May 2014. Investigations revealed that the contamination of chloride in the de-mineralised water tank was due to the defective mixed bed outlet pneumatic isolating valve. The valve was not in a fully closed position which caused a leakage of hydrochloric acid to the centralised de-mineralised water tank.

With 2,800MW already out of the system due to outages of TNB Janamanjung and Jimah generation units, the outlook for 7th May 2014 did not look promising. Later, several generating units tripped, which included Block 1 of the Tuanku Jaafar Power Plant steam unit (240MW) due to a faulty de-aerator control valve and Unit 2 (145MW) and Unit 1 (285MW) of the Sultan Salahuddin Abdul Aziz Power Plant (KEV), due to cooling water pumps failures.

Due to the severe shortage in generation capacity, the Grid System Operator (GSO) had initiated several pre-emptive measures to ensure the stability of the grid system, which included the import of power from Singapore and Thailand, the issuance of a red warning at 13:45 hours to the customers informing them of the imminent demand control action and prohibiting steel mills arcing, to reduce demand. Rotational load shedding had to be initiated at 14:11 hours amounting to a total load shedding of 470MW to secure the Grid System due to the deteriorating imbalance between generation and demand. This is in accordance to an approved and agreed load shedding plan which is part of Tenaga Nasional Berhad (TNB) mitigation plan during a crisis. The load shedding was carried out in stages and in blocks of 100MW to balance the generation with the demand, causing pocket of areas in five states in Peninsular Malaysia to experience power outages. This action was undertaken to prevent a total blackout of the Grid System.

Outside our shores, the massive production of shale oil in the United States (US) had changed the oil and gas supply equilibrium. The US, which used to be the world's biggest energy consumer, had become a major oil producer with an ample supply of shale oil, an unconventional fuel. As the geopolitical tensions in oil-producing countries eased, the world's oil production rose, resulting in an oversupply of crude oil, sending its prices on a downward path, as demand grew at a slower pace. As the year drew to an end, the oil prices sunk to five-year lows. The price of international benchmark Brent Crude was at its peak in June 2014 at US$ 115 per barrel, and had fallen to its lowest at US$ 58.50 in December 2014.

Low crude oil prices should come as a welcome relief for the world economy as cheaper energy costs will prevent inflation from rearing its ugly head. Nevertheless, for countries like Malaysia, falling oil prices proved to be detrimental to the Government's revenue as the country is a net oil exporter. In spite of the scrapping of fuel subsidies, the drop in petroleum earnings by PETRONAS could still add pressure to the Government's plan to reduce its fiscal deficit to 3.5% in 2014 and 3% in 2015.

The sharp drop in oil prices in recent months was a red flag for the Malaysian economy. Reflecting the warning sign, the local stock market tumbled while the ringgit fell sharply, putting an end to the good performance during the first three quarters of the year. Due to concerns that the plunge in oil prices will hurt the Government finances and the country's current account, the ringgit depreciated to RM 3.83 from RM 3.52 to the US dollar during the period from the end of November 2014 to the first week of January 2015.

With the ringgit also at its five year's lowest level, the country had to face the ramifications of a prolonged weakness in currency. While short-term ringgit weakness is expected, a repeat of the financial crisis that ravaged Asia was unlikely, as Malaysia's economic fundamentals remained intact. Two key indicators, basically, the current account balance and trade balance were still in surplus, compared with deficits recorded during 1998. Nevertheless, low crude oil prices and continued outflow of foreign capital could have caused the trade and current account surpluses to narrow, albeit not to deficit levels.

In short, the fall of ringgit was due to a combination of several factors i.e. a strong US dollar, lower oil prices and the slowing growth momentum, which implied weak growth. While the depreciating ringgit was likely to boost exports, the potential increase in trade activity between Malaysia and its partners was largely dependent on an uptake in demand from overseas for the nation's goods and services. With its major trading partners, such as China, showing signs of an economic slowdown, Malaysia's track record on reporting trade surpluses may have come under pressure.

Despite the difficulties, the country recorded encouraging Foreign Direct Investment (FDI) value of RM35.3 billion. Apart from that, Malaysia has improved its ranking in the World Bank Ease of Doing Business Report, from 12th to 6th, the IMD World Competitiveness Year Book, from 15th to 12th, and also took the Islamic Finance Leadership Award at the 10th World Islamic Economic Forum in Dubai.

In the power sector, several key measures had been taken to improve sectoral efficiency. Incentive-Based Regulation (IBR) was implemented starting in early 2014 with a mechanism for Imbalance Cost Pass-Through (ICPT) in place. The announcement made by the Government in February 2015 stating that the average tariff would be reduced by 2.25 sen/kWh starting from 1st Mac 2015 until 30th June 2015, was most welcomed by the general population. This decision was made following a review by the Ministry of Energy, Green Technology and Water (KeTTHA) and Suruhanjaya Tenaga based on the actual performance of power plants and the actual cost of fuels such as piped gas, Liquefied Natural Gas (LNG) and coal that are currently used in electricity generation. For this purpose also, the Government deferred the increase in price of piped gas which is supplied by PETRONAS to the power sector. As a result, PETRONAS had to bear an estimated foregone revenue of RM 836 million for the period of July 2014 to June 2015.

With the implementation of IBR, the response of the market was positive, with TNB's shares traded at its highest level at RM 12.50 in August 2014.

In an effort to enhance the governance of the sector, ring fencing framework for Single Buyer (SB) and GSO were implemented on 1st January 2014. The SB and GSO will be reporting to an Oversight Panel chaired by Suruhanjaya Tenaga to oversee the overall planning and operation of the grid system.

On the customer services, several measures were taken to improve the delivery services and enhance consumer protection, which include:

- Introduction of Minimum Service Level (MSL) and Guaranteed Service Level (GSL);
- Implementation of faster connection of supply procedures;
- Implementation of meter testing & verification by Suruhanjaya Tenaga;
- Improvement in power quality incidents response and reporting;
- Revision of standards on power quality; and
- Improvement in the billing system.

YEAR IN REVIEW - 2015

As we stepped into 2015, several new challenges emerged as the country embarked on the last leg of its journey towards achieving high-income nation status by 2020, just five years away. A weak ringgit, low oil revenue, budget deficit, rising cost of living, falling consumer confidence due to the implementation of the Goods and Services Tax (GST) in April 2015, and the high level of household indebtedness - all culminated into a very challenging year.

At a glance, the big picture did look worrying. However, amidst all this turmoil, how Malaysians had positively responded to this and striven on should not be overlooked. This was quite likely just a temporary phenomenon. Much of the underlying fundamentals that have been driving the markets had not changed. The corporate deals market for 2014 and 2015 also had been relatively quiet with only a handful of major exercises and Initial Public Offerings (IPOs) involving big corporations. In May 2015, Malakoff Corporation Berhad made a debut on Bursa Malaysia with a market capitalisation of RM 9 billion based on an IPO price of RM 1.80 per share.

LNG price trend tends to mimic oil prices, with a lag. While the effect was not immediate, what followed was the expectation of reduced electricity prices for consumers. Under such a scenario, as TNB enjoyed lower fuel prices, particularly coal and LNG, it would not be a surprise if tariffs were to be rebalanced to reflect such changes. Amidst higher foreign exchange costs, such a move would reduce the extent of TNB's fuel cost misalignment with market prices, with minimal impact on electricity tariffs.

In response, the Government in February 2015 announced the outcome of the ICPT review. Cost savings of RM 726.99 million accumulated through a combination of higher output of coal-fired power plants and lower utilisation of alternative fuels, such as medium fuel oil and LNG, has resulted in a tariff rebate of 2.25 sen/kWh. This represented a reduction of 5.8% from the base tariff of 38.53 sen/kWh that was approved in January 2014.

On the power generation development side, a new coal-fired power plant based on ultra-super critical technology built by TNB Janamanjung Sdn. Bhd. with a capacity of 1,010MW was commissioned on 14th April 2015. In addition, Hulu Terengganu Hydroelectric Plant (265MW) was commissioned in stages, with Unit 1 on 3rd December 2015 and Unit 2 on 31st December 2015. Repowering of the old Connaught Bridge CCGT (375MW) is being undertaken and it is to be commissioned by February 2016. Nevertheless, short-term capacity extensions of existing plants were being considered, in view of delays in several committed projects.

As Malaysia took on the ASEAN chair in 2015, the country will also be rolling out the 11th Malaysia Plan (11MP) from 2016 to 2020. The 11MP is expected to propel Malaysia towards high income status by 2020, as most indicators are suggesting that we are on the right track. As mentioned by the Economic Planning Unit (EPU), inclusive growth would be one of the main thrusts of the 11MP. The basic principles of inclusiveness under the 11MP are:

- Being market-friendly, resources will be used optimally to avoid market distortion;
- Being needs-based, the bottom 40% of households and underprivileged people will receive special required assistance;
- Being merit-based, programmes organised by Government will provide equitable opportunities to individuals and businesses;
- Being pro-growth, programmes conducted will promote growth; and
- Being sustainable competitiveness, policies and programmes will be reviewed to ensure that companies will have a fair chance to succeed and be globally competitive.

On the ASEAN front, the Laos–Thailand–Malaysia–Singapore Power Intergration Project which is at an advance negotiation stage, will be a significant milestone in the ASEAN agenda, paving the way for future interconnection between ASEAN countries towards realising an ASEAN power grid.

The electricity supply industry reform continued with the launching of the New Enhanced Despatch Arrangement (NEDA) in October 2015. The first phase of NEDA was commissioned with the participation of generators holding Power Purchase Agreements (PPA) and Service Level Agreements (SLA). As the initiative is still at an infant stage, the existing system for generators' scheduling requires time for adjustment. The second phase of NEDA involving participation of non-PPA/SLA generators is expected to commence in 2016.

Later in the year, a gas supply interruption occurred due to a leak in the Peninsular Gas Utilisation (PGU) pipeline at Ulu Tiram, Johor. The incident happened on October 2015, and directly affected gas supply to three City Gate Stations, namely Pasir Gudang, Plentong and Tanjung Langsat. The interruption lasted for approximately 132 hours (5.5 days), and the gas consumption affected was about 402,000 mmBtu. Re-commissioning work at each City Gate Station was done immediately to assure adequate gas supply to the customers.

As part of the IBR framework to implement efficiency assessment of the utilities, Suruhanjaya Tenaga has appointed Frost & Sullivan Perunding Strategi Sdn. Bhd. to conduct a study entitled 'Benchmarking Study of Generation Cost and TNB's Transmission and Distribution Costs'. The main objective of the study is to compare TNB's capital and operational expenditures incurred in its transmission and distribution business, as well as generation costs in the system with similar benchmarked costs in selected countries. This is to ensure only prudent costs of supply are passed through under the IBR framework.

PROSPECT FOR 2016

As announced by the Prime Minister during the 2016 Federal budget presentation in October 2015, the Gross Domestic Product (GDP) for 2016 is expected to grow at 4% to 5%, driven by investment and private consumption growths at the rates of 6.7% and 6.4% respectively. From the sectoral perspective, construction, services and manufacturing sectors are expected to record a growth of 8.4%, 5.4% and 4.3% respectively while inflation rate is expected to hover at around 2% to 3%.

The World Bank, in the Global Economic Prospects June 2015 had forecasted a moderate world economic growth of 2.8% in 2015, up from 2.4% estimated for 2014. The global economy is expected to pick up with a forecasted growth of 3.3% in 2016 and 3.2% in 2017. For the East Asia and Pacific region, growth is expected to ease further from 6.9% in 2014 to 6.7% in 2015 with similar continuing growth trajectory of 6.7% and 6.6% respectively in 2016 and 2017.

Delayed growth in terms of electricity system peak demand in 2015 was the result of combined changes in primary economic activities (particularly slowdown in the steel mill industry), energy efficiency measures and renewables utilisation at the demand or low voltages side. While electricity generation and sales growths for the financial year 2015 were still positive, the actual rate of increase of 2.2% against forecasted figure of 2.4% for sales and 1.5% against 2.2% for generation were still less than initially projected.

After the successful commissioning of Janamanjung Unit 4 in April 2015, another 1,000MW ultra-supercritical coal-fired generating unit in Tanjung Bin Energy will follow suit in March 2016. Overall system efficiency will be further enhanced with the commercial operation of TNB Prai's 1,071MW state-of-the-art combined cycle gas turbines scheduled in February 2016. The Ulu Jelai Hydroelectric Plant (372MW) is also expected to be commissioned in stages starting from the second quarter of 2016.

The International Energy Agency in the latest World Energy Outlook had stated that almost half of the world's new installed capacity in 2014 was contributed by renewables. A lower-carbon and more efficient energy system seems to be the next order of the day as prices of low-carbon and efficient end-use technologies continue to fall. Since the quota under the Feed-in-Tariff (FiT) will plateau soon, the expansion of renewables-based capacity have to be competitive and in line with conventional market dynamism.

To that, the introduction of Large-scale Solar of 200MW every year from 2017 to 2020 will provide a platform for potential solar-based power producers to compete on their own merit, while doing away with the need of continuous assistance from the Government. Similar to Large-scale Solar, the annual Net Energy Metering (NEM) quota of 100MW for the period of five years will be gradually released in stages to potential applicants. Details of Large-scale Solar and NEM guidelines are now under study for target implementation from 2016 onwards.

As fuel prices fell sharply in 2015, the cost of supply to consumers also declined, resulting in a reduction of the overall tariff by 5.8%. The regional stability and declined upstream spending is expected to rebalance the market to a new average. The continuous improvement in the efficient use of energy hopefully will ease some of the supply security and affordability concerns. Provided the short-term energy prices remain low, consumers can expect energy bill savings to continue well into 2016.

The adoption of the latest, most efficient power generation technologies, the introduction of more renewables in the system and continuous transmission and distribution network improvement will call for a thorough review on how best all these assets can be put to optimal use. The introduction of the single largest unit of 1,000MW into the system with another four units to come on stream in years ahead, will pose new challenges in ensuring security at affordable cost.

Short term and long term planning criteria including reliability standards and demand forecast will be re-evaluated to keep up with the imminent changes in the industry.

NEDA will enter the second phase of implementation in 2016 with a broadened pool of potential participants. A detailed study is being carried out by Suruhanjaya Tenaga, the SB, and the GSO to ensure feasible introduction of new participants, particularly co-generators and non PPA/SLA generators. This includes adjustment to current planning and dispatching procedures, system and software adjustments requirement and revision of current rules.

With the Environmental Quality (Clean Air) Regulations gazetted in June 2014, existing and future power plants are now subjected to more stringent limits and technical standards. For new power plants, it is a non-issue as most power plants have been designed to meet this requirement. Even as the grace period of 5 years is applicable to existing plants, conformance to the new limits and standards might require significant capital expenditure and allowance for plant downtime. The impact to the power sector is huge, and measures are being taken by Suruhanjaya Tenaga to study the impact and to have further deliberation with the Department of Environment.

On a smaller scale, NEM of up to 500MW will allow consumers to self-generate most of their electricity requirement. In January 2016, the Government will initiate a plan to introduce NEM to complement the on-going FiT system and subsequently replacing it by 2018. The main objective of NEM is to promote Renewable Energy (RE) in current energy generation mix, hence decreasing the dependency on fossil fuel according to the Renewable Energy Act 2011. Starting from 2016, a 100MW quota per year will be available for bidding. The quota is divided into three sections - Domestic, Commercial and Industrial which make up 10%, 45% and 45% respectively of the total capacity.

Beginning January 2016, Suruhanjaya Tenaga will introduce a new type of tariff category which is, Enhanced Time-of-Use Tariff (EToU) for consumers. The EToU is formed as an alternative to demand side management initiatives. It encourages consumers to use electricity more efficiently by reducing their electricity consumption during peak hours and having more utilisation during off peak hours. Under the new EToU scheme, the peak time zone is reduced to 4 hours from the existing 14 hours and a new mid peak zone of 10 hours is introduced for energy and demand charges at rates lower than the current peak rates. The EToU will be offered to consumers under tariff categories C1, C2, E1, E2, and E3 whereas for consumers under tariff category D, the EToU scheme will be effective from 1st January 2017.

In July 2015, the Parliament approved the Bill to amend the Electricity Supply Act 1990 (Act 447). The purpose of the amendment is to enhance the governance of the electricity supply industry in ensuring better sectoral efficiency, reliability and safety in the industry. Among the key points of the Electricity Supply Act (Amendment) 2015 are the setting up of the Electricity Industry Fund, the ring-fencing of SB and GSO, the separation of licensed activities, and requirements for licensees to submit business plans.

The Gas Framework Agreement (GFA) was proposed and introduced during the Track 1 competitive bidding process to resolve the issues on non-operationalisation of Gas Supply Agreement (GSA) by governing the gas nomination and allocation for the power sector. This mechanism will effectively enhance the governance and instil discipline among the industry players as commercial penalties have been embedded to ensure optimal allocation and utilisation of gas. Provisions in the GFA include Daily Quantity, Take or Pay, Shortfall, Excess Gas, Nominations, Forecasts and Third Party Access.

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BRIEF ECONOMIC REVIEW

At the recorded growth of 6.0% in 2014 (2013: 4.7%), the country's economy had grown at its fastest pace in 4 years driven by the continued strength in private domestic demand and positive growth in the net exports. While the growth in private domestic demand remained strong at 8.0% (2013: 8.6%), public sector expenditure registered a slower growth of 0.2% (2013: 4.4%) which is consistent with the Government's fiscal consolidation efforts. Following these progress, the domestic demand contributed around 5.6% (2013: 6.8%) points to the overall GDP growth.

Like other economies in the Asian region, Malaysia's exports have also benefited from the recovery in the advanced economies and sustained demand from the regional economies. Thus, attributed by higher external demand from these economies, the country's net export had turned around to contribute positively to grow at 19.7% (2013: -12.6%) after several years of negative growth. This, in turn, contributed 1.4% (2013: -1.1%) points to the overall GDP growth.

On the supply side, all economic sectors recorded higher growth in 2014. The services sector which recorded a strong growth of 6.3% (2013: 5.9%) remained the largest contributor to the GDP growth at 3.5% points, supported by domestic-oriented sub-sectors. The manufacturing sector grew at a higher rate of 6.2% (2013: 3.5%), attributable to the stronger performance of the export-oriented industries and expansion in the domestic-oriented industries. The construction sector sustained to grow at a double-digit rate, owing mainly to stronger growth in both residential and non-residential sub-sectors.

The global economy activity, which was forecasted to grow at 3.1%* in 2015, continued to expand at a moderate pace during the first 3 quarters of the year. In Asia, growth was supported by the continued expansion of domestic demand but unlike the previous year, export activity has shown weak performance.

The country's GDP was expected to grow at an average rate of around 4.5% to 5% in 2015, which was at the lower-end of the official forecast of between 5% to 6%, with slower growth in domestic demand and exports. The moderate economic situation globally, coupled with lower commodity prices and ringgit depreciation contributed to this less sanguine forecast.

The Malaysian economy registered a growth of 4.7% in the third quarter of 2015 (1Q 2015: 5.6% and 2Q 2015: 4.9%). Private sector expenditure continued to be the key driver of growth and contributed towards the expansion in domestic demand. In addition, this growth was supported by the improved public sector spending and turnaround in net exports, which recorded a positive growth of 3.3% (Q2 2015: -10.5%) during the quarter. Private investments grew by 5.5% (2Q 2015: 3.9%), driven by capital spending in the manufacturing and services sectors. Private consumption expanded at a more moderate rate of 4.1% (2Q 2015: 6.4%) as households continued to adjust to the implementation of the GST.

On the supply side, all economic sectors continued to expand during the quarter. Growth was led by the construction and manufacturing sectors. The construction sector's growth at 9.9% (Q2 2015: 5.6%), improved mainly due to a faster expansion in the civil engineering and specialised construction activities sub-sectors. Similarly, the manufacturing sector registered a higher growth of 4.8% (Q2 2015: 4.2%), supported in particular by improved export-oriented industries. The services sector registered a lower growth of 4.4% (Q2 2015: 5.0%) due to a moderation in household spending and slower capital market activity. The mining and agriculture sectors expanded at a slower pace due to a moderation in crude oil and palm oil production, respectively.

Note: Percentages are expressed from real GDP at constant 2005 and 2010 prices respectively
Sources: *2016 Budget by Ministry of Finance
Bank Negara Malaysia (BNM)Quarterly Bulletin
BNM Annual Report 2014

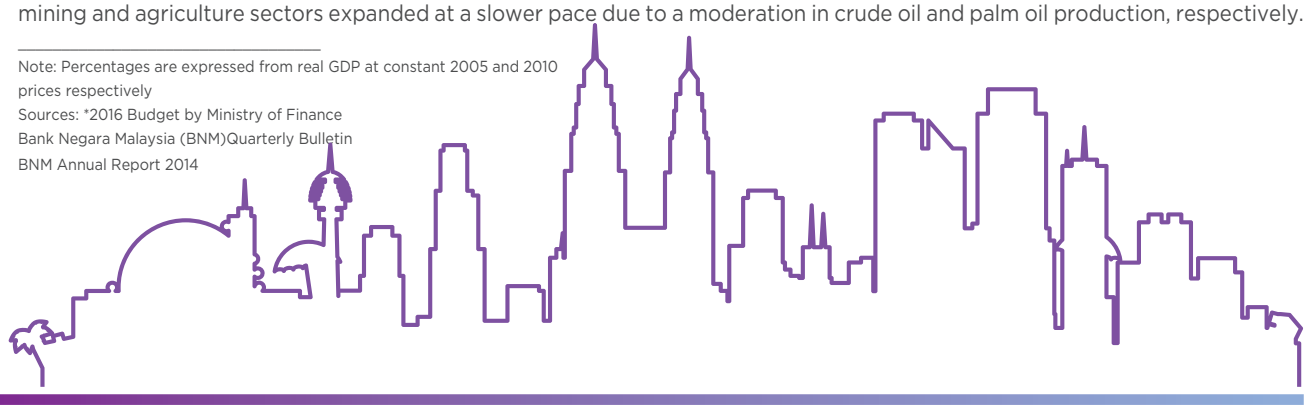
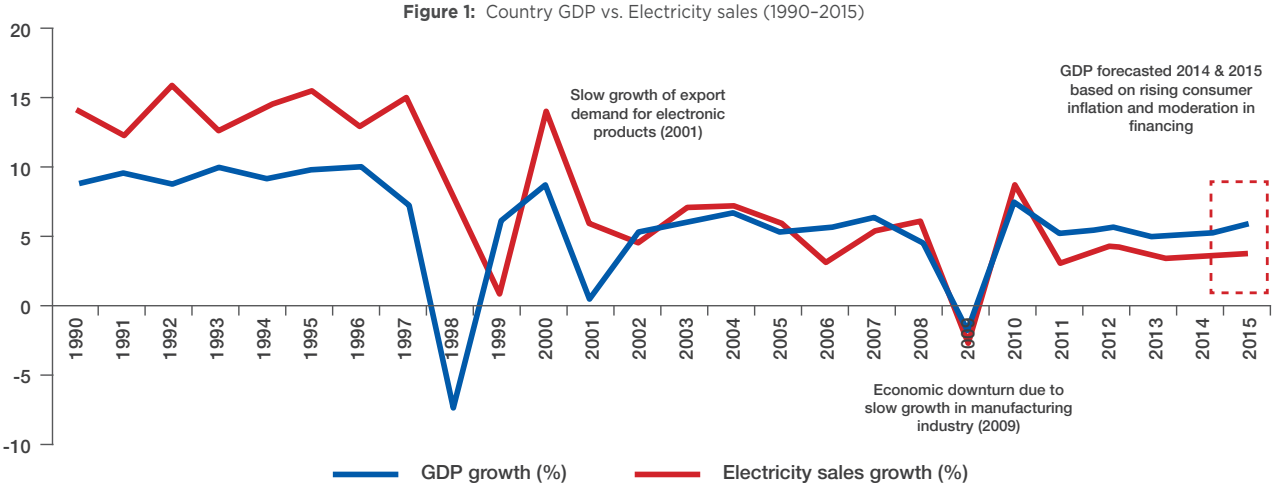


Figure 1: Country GDP vs. Electricity sales (1990–2015)



There has always been a strong correlation between the country's GDP and its electricity consumption where the predominance of certain types of economic activities affected the electricity demand at the sectoral basis. However, during these recent years, the encouraging economy growth did not reflect the Peninsular Malaysia electricity growth trend and this could be contributed by the energy efficiency and renewable energy initiatives aggressively implemented in the country. Nevertheless, the electricity intensity stood at 0.16 GWh/GDP for the year 2013 and recently achieved 0.123 GWh/GDP during the first half of 2015.

Table 1: Historical data for energy intensity, demand and elasticity

PENINSULAR MALAYSIA	2005	2006	2007	2008	2009	2010	2011	2012	2013
GDP at Current Prices (RM million)*	451,305	493,491	546,624	623,052	583,652	653,772	718,666	770,225	810,569
GDP at 2005 Prices (RM million)*	451,305	476,899	506,808	532,612	522,240	564,959	595,224	632,369	663,458
Population ('000 people)**	20,785	21,280	21,577	21,970	22,363	22,754	23,099	23,417	23,726
Final Energy Consumption (ktoe)	32,195	34,390	37,921	38,530	34,521	35,593	36,968	36,683	41,859
Electricity Consumption (ktoe)	6,336	6,669	7,030	7,307	7,567	8,145	8,427	8,791	9,108
Electricity Consumption (GWh)	73,987	77,504	81,710	84,924	87,950	94,566	97,939	102,174	105,861
PER CAPITA									
GDP at Current Prices (RM)*	21,713	23,298	25,334	28,360	26,099	28,733	31,112	32,822	34,164
Final Energy Consumption (toe)	1,549	1,624	1,757	1,754	1,544	1,564	1,557	1,567	1,764
Final Energy Consumption (kWh)	3,560	3,659	3,787	3,866	3,933	4,161	4,240	4,363	4,462
ENERGY INTENSITY									
Final Energy Consumption (toe/GDP at 2005 prices (RM million))	71.3	72.1	74.8	72.3	66.1	63.0	60.4	58.0	63.1
Electricity Consumption (toe/GDP at 2005 prices (RM million))	14.1	14.0	13.9	13.7	14.5	14.4	14.2	13.9	13.7
Electricity Consumption (GWh/GDP at 2005 prices (RM million))	0.164	0.163	0.161	0.159	0.168	0.168	0.165	0,162	0.160

*: GDP data by states from Department of Statistics Malaysia

**: Mid-Year population from Department of Statistics Malaysia

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EXISTING GENERATION CAPACITY

As of 31st December 2014, the installed capacity in the Peninsula stood at 20,944MW after the retirement of Unit GT4 in S.J. Jambatan Connaught with a capacity of 116MW. However, with the successful commissioning of TNB Janamanjung Unit U4 with a capacity of 1,010MW in April 2015, the installed capacity rose to 21,954MW, but came down to 20,460MW due to ceased operation of YTL Power (1,170MW) and S.J. Putrajaya Unit 1, Unit 2 and Unit 3 (324MW). By the end of December 2015, installed capacity increased to 20,710MW with the commissioning of HEP Hulu Terengganu with capacity of 250MW. Details of the installed capacity and the list of power plants in operation as of December 2015 are described in the following tables:

Table 2: Installed capacity by type

Type	Fuel	Capacity (MW)
Conventional Thermal	Coal	8,066
Combined Cycle Gas Turbine (CCGT)	Gas	8,030
Conventional Thermal	Gas	564
Open Cycle Gas Turbine (OCGT)	Gas	1,900.4
Hydroelectric	Hydro	2,149.1
	Total Capacity (MW)	**20,710**

As of December 2015, installed capacity in Peninsula stood at 20,710MW

TNB Janamanjung

Table 3: Operational thermal and hydroelectric power plants

PPA / SLA Expiry Year	Power Plant	Fuel	Type	Capacity (MW)
Jan 2016	Powertek Bhd.	Gas	OCGT	434
Jan 2016	Port Dickson Power Bhd.	Gas	OCGT	436.4
Mac 2016	S.J. Jambatan Connaught	Gas	OCGT	362
Aug 2016	S.J. Sultan Iskandar, Pasir Gudang	Gas	OCGT	210
Aug 2017	S.J. Sultan Ismail, Paka	Gas	CCGT	1,029
Dec 2018	S.J. Jambatan Connaught	Gas	CCGT	300
July 2019	Kapar Energy Ventures Sdn. Bhd.	Gas	OCGT (GT8 & GT9)	205
Aug 2020	Pahlawan Power Sdn. Bhd.	Gas	CCGT	322
Aug 2022	S.J. Sultan Iskandar, Pasir Gudang	Gas	CCGT	275
Aug 2022	S.J. Sungai Perak Scheme	Water	Hydro	649.1
Dec 2022	GB3 Sdn. Bhd.	Gas	CCGT	640
Feb 2023	Panglima Power Sdn. Bhd.	Gas	CCGT	720
March 2024	Teknologi Tenaga Perlis Consortium Sdn. Bhd.	Gas	CCGT	650
June 2024	Prai Power Sdn. Bhd.	Gas	CCGT	350
Aug 2024	S.J. Gelugor	Gas	CCGT	310
Aug 2025	S.J. Putrajaya	Gas	OCGT	253
Aug 2025	S.J. Sultan Mahmud Kenyir	Water	Hydro	400
Feb 2026	Genting Sanyen Power Sdn. Bhd.	Gas	CCGT	720
June 2027	Segari Energy Ventures Sdn. Bhd.	Gas	CCGT	1,303
Aug 2027	S.J. Cameron Highlands	Water	Hydro	250
Aug 2028	S.J. Tuanku Jaafar, Port Dickson	Gas	CCGT PD1	703
July 2029	Kapar Energy Ventures Sdn. Bhd.	Gas	Conventional Thermal	564
		Coal	Thermal (U3 – U6)	1,486
Jan 2030	S.J. Tuanku Jaafar, Port Dickson	Gas	CCGT PD2	708
Aug 2030	TNB Janamanjung Sdn. Bhd.	Coal	Thermal	2,070
Sept 2031	Tanjung Bin Power Sdn. Bhd.	Coal	Thermal	2,100
Dec 2033	Jimah Energy Ventures Sdn. Bhd.	Coal	Thermal	1,400
Aug 2037	S.J. Pergau	Water	Hydro	600
Mac 2040	TNB Janamanjung Sdn. Bhd.	Coal	Thermal	1,010
Dec 2065	S.J. Hulu Terengganu	Water	Hydro	250
			Total Capacity (MW)	**20,710**

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Malaysia is blessed with vast renewable sources of energy such as biomass, solar, biogas and mini hydro. In line with the Five-Fuel Strategy, the policy has a target of RE being the source of 11% of electricity generation, which amounts to 2,080MW of installed capacity by 2020. As of the second quarter of 2015, the Peninsula has a total licensed capacity of 358.23MW, mostly fuelled by solar (187.17MW), followed by biomass (114.93MW), mini hydro (29.88MW) and biogas (26.25MW) with the Central area being the largest RE contributor. The high capacity of solar energy installation is triggered by the attractive rates offered under the FiT scheme as well as the readily available resource factor as Malaysia is geographically located at the equator.

Figure 2 (a): Peninsular Malaysia RE projects

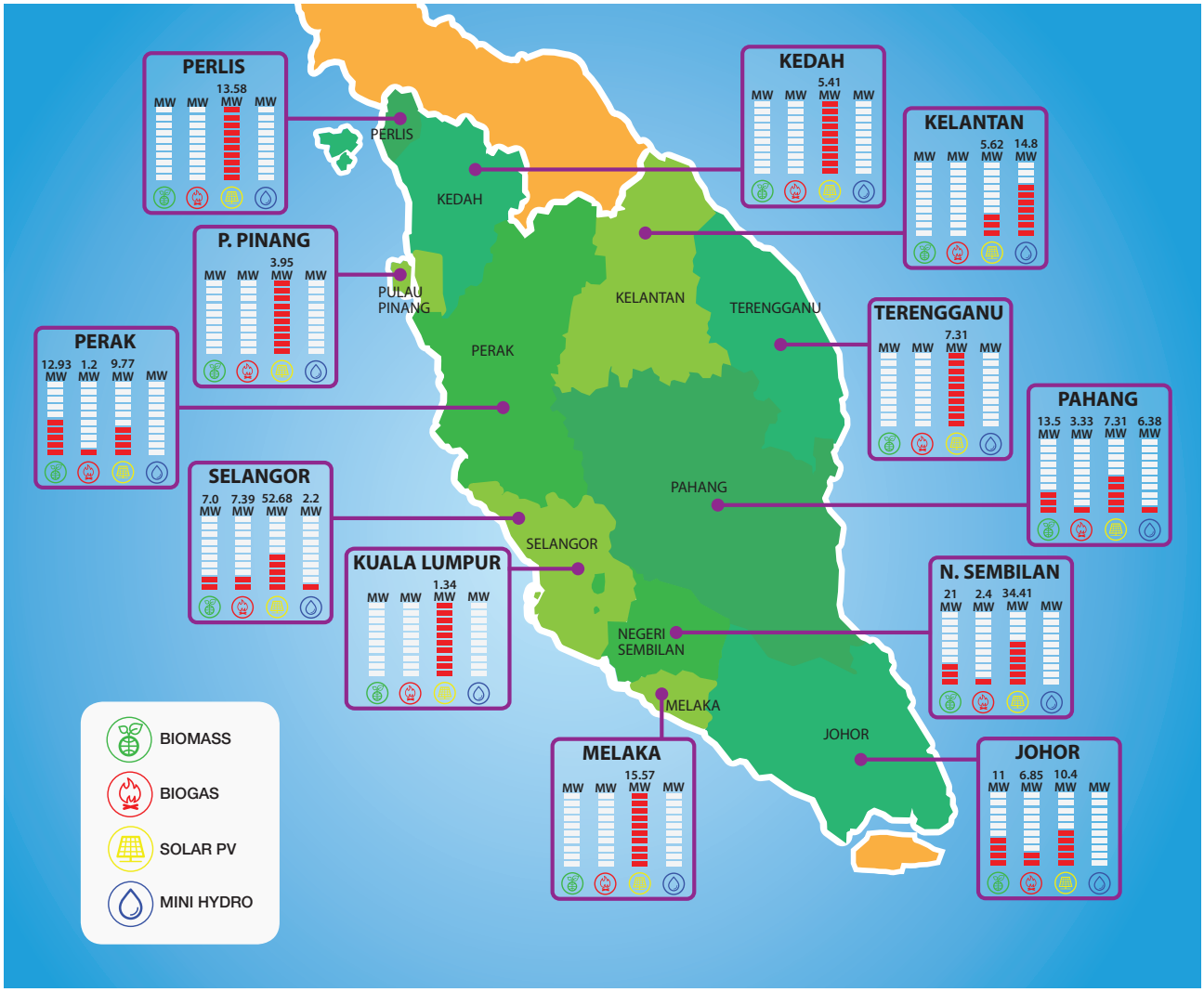
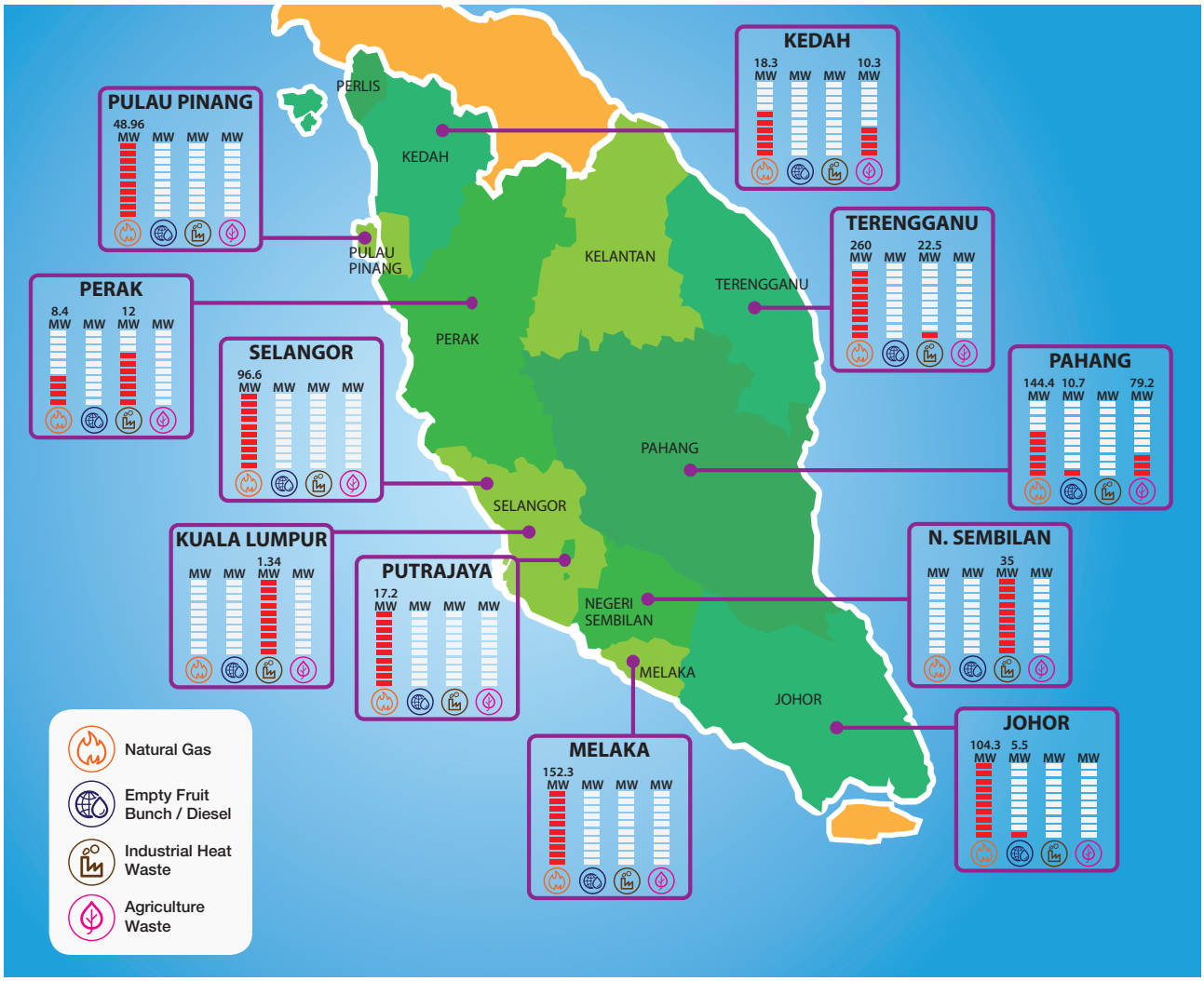


Figure 2 (b): Peninsular Malaysia co-generation projects



Co-generation, or combined heat and power (CHP) generation, popularly known in many developed countries is the simultaneous production of two different forms of useful energy, typically electricity and thermal energy, from a single primary energy source.

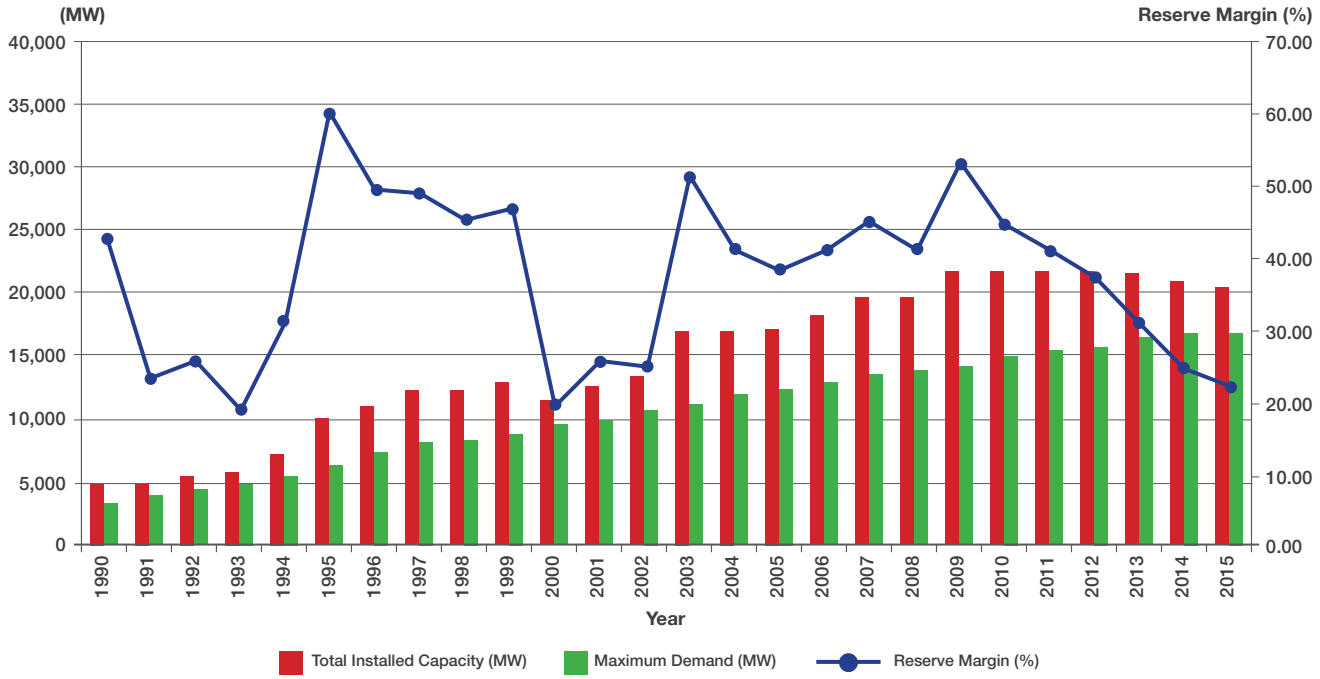
In Malaysia, co-generation technologies have captured the interest of local industries for decades. As at 2015, Suruhanjaya Tenaga has issued 32 co-generation licences which had an overall capacity of 1,065.7MW, mainly fuelled by natural gas (890.5MW), agriculture waste (89.5MW), industrial heat waste (69.5MW) and empty fruit bunch/diesel (16.2MW).

PERFORMANCE REVIEW

Based on the plants' retirement schedule, the total installed capacity stood at 21,954MW and this is reduced to 20,909MW by the end of 2015 with a reserve margin hovering above 25%, at least through the first half of the year. In the following half of 2015, several plants retired from the system, hence slightly reducing the reserve margin in October and November to 20% and 22% respectively. Nevertheless, the minimum requirement for operating reserve of 2,600MW was met 94% through the year of which the generation capacity was sufficient with a Loss of Load Expectation (LOLE) of 0.8 day/year.

The main reason for the prevalent use of reserve margin as a reliability criteria is its ease of calculation and understanding. Reserve margin is a deterministic measure and represents the relative amount of the installed generating resources being greater than the annual peak loads. If the calculated reserve margin is above the criterion, then the system would be considered to be within the criteria for the period evaluated. The percentage of reserve margin criteria must be at a minimum of 20% which relates to the provision of sufficient generation capacity to meet the demand.

Figure 3: Peninsular Malaysia reserve margin



OPERATING RESERVE

Operating reserve is the generation capacity that is available to the system operator within a short interval of time to meet demand in case a generator experiences an unexpected outage or there is another disruption in supply. The operating reserve is made up of both spinning reserve and non-spinning reserve.

Spinning Reserve → Spinning reserve is any back-up energy production capacity that can be made available to a transmission system with a 10 minutes notice and can operate continuously for at least two hours once it is brought online.

Non-Spinning Reserve → Non-spinning reserve is generation capacity which is capable of being brought online within 10 minutes if it is offline, (or interrupted within 10 minutes if it is online), and which is capable of either being operated or interrupted for at least two hours.

Figure 4: Operating reserve requirement

Year	Spinning Reserve		Largest Coal unit (next N-1)	Largest CCGT block (next N-1)	Target Operating Reserve
	Lost of largest unit in the system	Regulating reserve			
2015	1,000MW (M4)	200MW	700MW	700MW	2,600MW
2016-2019	1,000MW (M4)	200MW	1,000MW (T4)	700MW	2,900MW

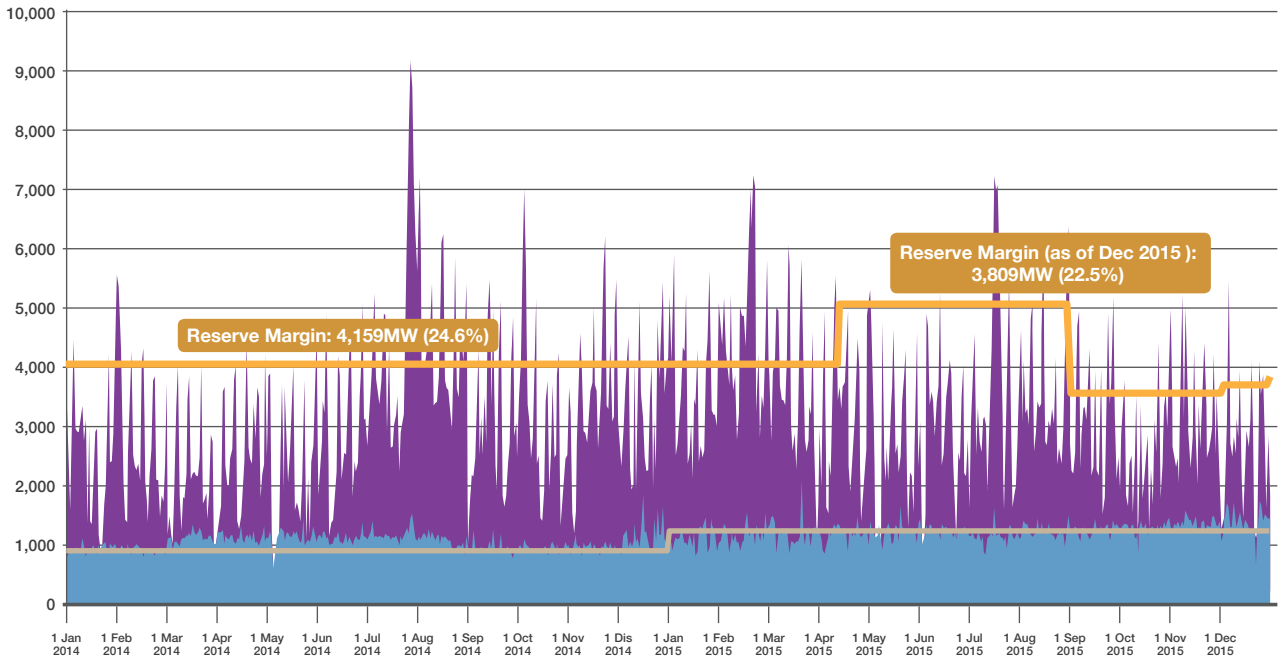
STATUS OF SYSTEM RESERVE

Operating reserve for the system in 2014 was initially set at 2,300MW and revised downward by the GSO to 1,800MW due to unreliable generation units. In 2015, the operating reserve for the system had increased to 2,600MW, taking into account the criteria of loss of largest unit in the system (1,000MW of TNB Janamanjung U4) and regulating reserve of 200MW set by the GSO. Forecast operating reserve for 2016-2019 is 2,900MW taking into consideration the commissioning of Tanjung Bin Energy with the capacity of 1,000MW.

Before Janamanjung Unit 4 was commissioned, the total installed capacity in 2015 was 20,944MW. A total of more than 1,821MW of capacity was added to balance the capacity retirements. The reserve margin increased from 25% in 2014 to 26% in 2015 (peak day of the year). The system reliability criteria of LOLE of not more than 1 day per year is observed to be met in 2015.

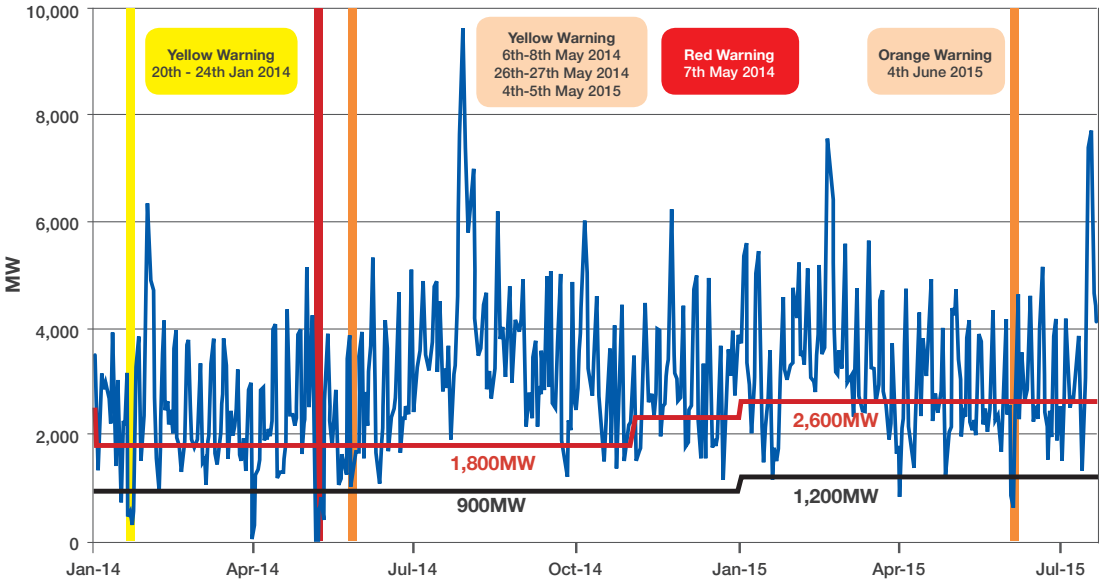
In the first quarter of 2015, the minimum operating reserve was 2,300MW which consisted of 11% of the installed capacity. For the second quarter of 2015, the operating reserve had increased to 2,600MW, which was 12% of the installed capacity. The spinning reserve increased from 900MW to 1,200MW after the entry of Janamanjung Unit 4. Frequent unscheduled downtime of the power plants had affected the operating reserve. Although the actual operating reserve was below the target, however, the spinning reserve was maintained at the 1,200MW level. A Committee was formed under the Grid Code Committee to conduct a study on the response of a 1,000MW power plant to the system to ensure secure and reliable operation in the future.

Figure 5: System status throughout 2014 and 2015



The figures stated above are contributed by spinning reserve and non-spinning reserve capacities that are put on stand-by for unplanned outages of 1 unit of the largest coal, 1 unit of the next largest coal, 1 unit of the largest CCGT unit in the system and the variations in demand. Based on the maintenance schedule prepared by the GSO, the operating reserve requirement of 2,600MW must be available at least 80% of the time throughout the year.

Figure 6: System status throughout year 2015

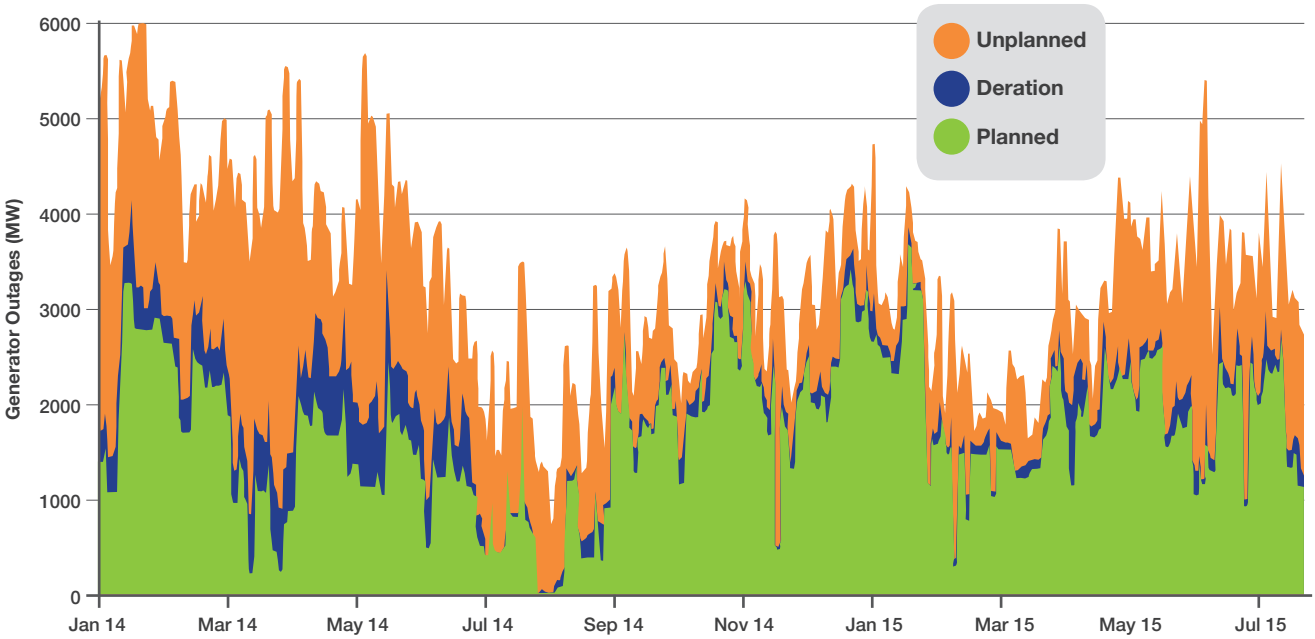


An orange warning was issued on 4th June 2015 (in accordance to the Malaysian Grid Code (MGC) OC 4.4.5) due to a sudden additional shortfall of 2,060MW as a result of forced outages of several generating plants involving Janamanjung U4 (1,010MW), Jimah Unit 1 (700MW) and Tuanku Jaafar Power Plant GT2A (350MW). The situation had put the grid system in a possibility of insufficient generation to meet demand during that time.

Table 4: Type of warning issued by GSO

Type	Description
YELLOW WARNING	System operating conditions when there may be a **Probable Risk of Demand Reduction**.
ORANGE WARNING	System operating conditions when there may be a **High Risk of Demand Reduction**.
RED WARNING	System operating conditions when there may be an **Extremely High Risk of Demand Reduction or Demand Control Imminent**.

Figure 7: Generator outages in 2015



In 2015, the average forced outage rate was 2.11% per year, a lower rate as compared to that in 2014 which was at the average of 5.37% per year. The higher forced outage rate recorded in 2014 was due to boiler related problems particularly tube failures in most coal-fired power plants. In 2015, the outage rate was lower after several improvement measures were conducted in coal-fired power plants such as modifications of the boiler tubes and the introduction of preferred coal list. Table 5 shows the average force outage rates from 2012 to 2015.

Table 5: Average force outage rate from 2012 to 2015

Year	Average/Yr	Max/Yr
2012	3.34%	8.84%
2013	6.6%	17.78%
2014	5.37%	17.85%
2015	2.11%	10.56%

The operating reserve for the system in 2014 was initially set at 2,300MW and was revised downward by the GSO to 1,800MW due to unreliable generation units. In 2015, the operating reserve for the system was 2,600MW, taking into account the criteria of the loss of the largest unit in the system (1,000MW from the new TNB Janamanjung U4) and regulating reserve of 200MW set by the GSO. The forecast operating reserve for 2016-2019 is 2,900MW taking into the account of Tanjung Bin Energy as the next largest coal unit with the capacity of 1,000MW in the system.

FUEL SUPPLY SITUATION

Malaysia still has considerable hydrocarbon resources in relation to the size of its economy. Its discovered natural gas resources are estimated to last another 44 years whereas its crude oil and condensate can last for another 27 years. These can be largely credited to the National Depletion policy that had been put in place since 1980 to ensure the sustainability of indigenous resources for the future generations' benefit.

Malaysia was facing a difficult year in 2015. Whilst Malaysia is still a net hydrocarbon exporter as well as a significant producer of oil and gas, long term production figures are expected to decline against a backdrop of sustained economic growth, low oil price environment and a weakening Ringgit against US Dollar. However, PETRONAS remains committed to pursue key strategic projects, including major domestic developments that had been planned both at the upstream and downstream segments of the oil and gas value chain.

Prior to the commissioning of the first Regasification Terminal (RGT) at Sungai Udang, Melaka in 2013, the power sector in Peninsular Malaysia was faced with an acute curtailment of its gas supply which could have threatened the reliability and security of the electricity supply system if not for a closely coordinated actions by all key stakeholders related to that sector. Subsequently, the operationalisation of RGT Sungai Udang enables the importation of LNG which will boost the supply capacity into the PGU system by another 500 mmscfd, further relieving the power sector from gas shortages and curtailments. The Peninsular Malaysia power sector has been able to derive benefits from the availability of RGT Sungai Udang, particularly during a sudden surge in electricity demand or whenever there are multiple coal plant outages, where the PGU can respond to the power sector's gas demand without jeopardising the overall pressure and security of the PGU system itself.

Prior to the commissioning of the first RGT at Sungai Udang, Melaka in 2013, the power sector in Peninsular Malaysia was faced with an acute curtailment of its gas supply which could have threatened the reliability and security of the electricity supply system if not for closely coordinated actions by all keys stakeholders related to that sector.

RGT Sungai Udang

Further down in the South Eastern corner of Peninsular Malaysia lies the RGT Pengerang project. This ongoing project is expected to be commissioned in the third quarter of 2017 and will be fully dedicated to supply gas for Pengerang Integrated Petroleum Complex (PIPC) and the Pengerang Co-generation Plant. This RGT comprises a regasification terminal which will be able to receive LNG from LNG carriers to be stored in two 200,000m^3 onshore LNG storage tanks. The RGT Pengerang terminal will be equipped with a regasification unit with an initial capacity of 3.5 MTPA, equivalent to a send-out rate of 490 mmscfd of natural gas.

Figure 8: Gas supply infrastructure in Malaysia

FUEL PRICING

In line with efforts to rationalise subsidies on fuel and gas, the Government has decided to increase the price of piped gas by RM 1.50/mmBtu every 6 months to reach market prices. Therefore, beginning January 2016, the regulated price of piped gas increased to RM 18.20/mmBtu from RM 16.70/mmBtu previously. However, this regulated price is still below the market price of MFO at RM 25/mmBtu and the Government still bears a form of subsidy to the power sector at 30%.

LNG price RM 43.69 /mmBtu

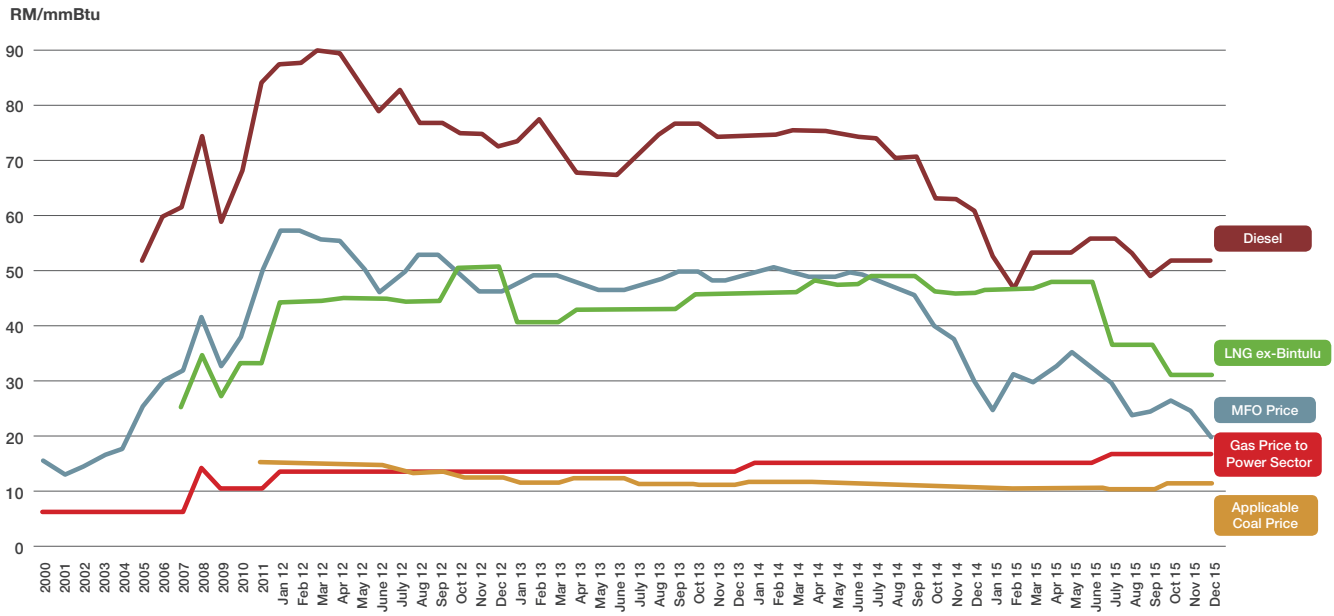
Diesel price RM 52.57 /mmBtu

Coal price RM 10.57 /mmBtu

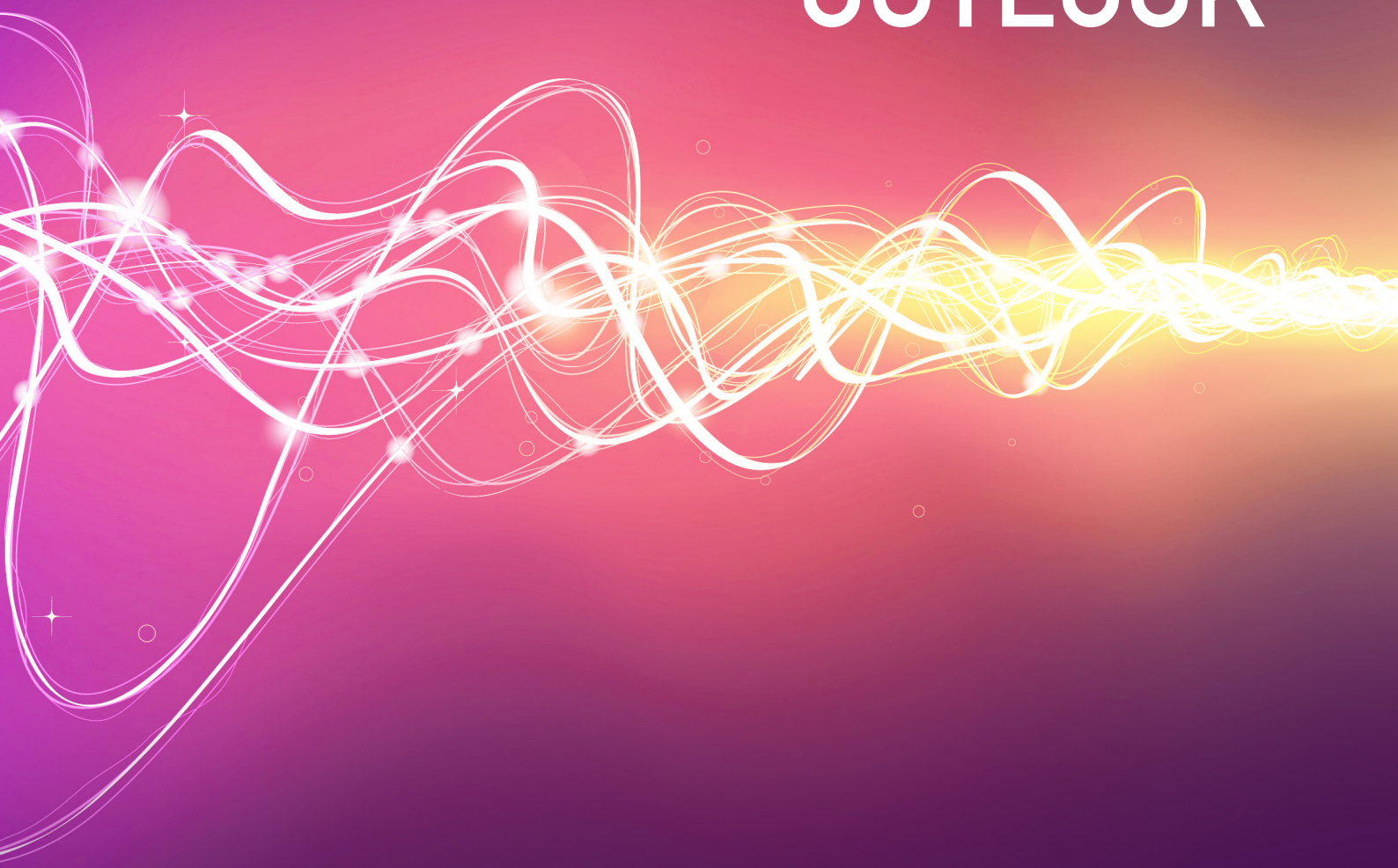
Other fuel components in the determination of electricity tariff which is LNG and coal are set at market prices. On average, the price of LNG for power sector throughout 2015, at RM 43.69/mmBtu, was higher than the regulated gas price. However, it is still lower than its alternative fuel which is diesel, at an average price of RM 52.57/mmBtu. The lowest alternative fuel option to the system is coal which is set through the Applicable Coal Price (ACP) mechanism averaging at RM 10.57/mmBtu in 2015.

Starting January 2014, the electricity tariff was reviewed under the IBR framework which consists of two components, base tariff and the ICPT. Therefore, taking into account the revision of the gas price to the power sector as well as the cost of LNG, coal and TNB non-fuel cost under the IBR framework beginning in January 2014. it has resulted in the electricity tariff being reviewed and set at 38.53 sen/kWh. Under the ICPT, the fuel and other generation costs will be reviewed every 6 months to reflect the changes, either an increase or decrease in the actual fuel cost and actual generation-specific costs against a benchmark forecast cost incorporated in the base tariff, which will then be translated into under or over-recovery. In the two cycle of ICPT in 2015, the amount of cost pass through to customer translated into the electricity tariff rebate is 2.25 sen/kWh.

Figure 9: Average fuel price trend in RM/mmBtu



SUPPLY DEMAND OUTLOOK

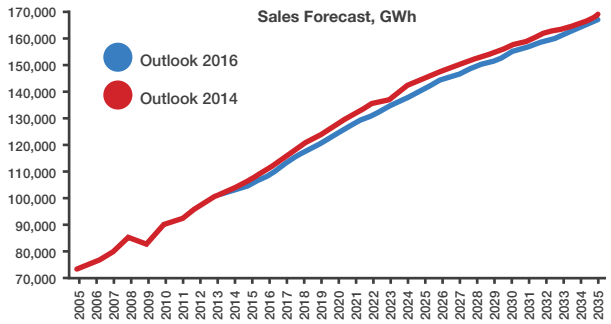


SUPPLY DEMAND OUTLOOK

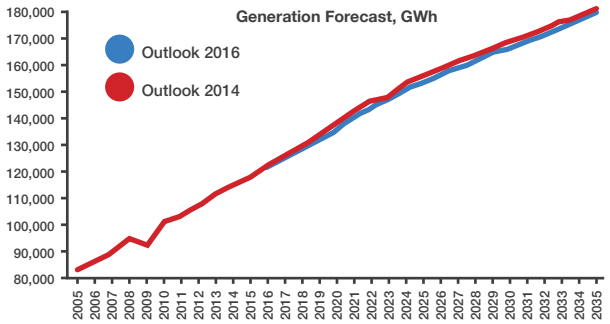
REVISED DEMAND FORECAST

The current economic growth is encouraging. However, this is not reflected in recent electricity demand trends. Various factors such as the slowdown in industrial sales (particularly from steel millers), structural changes in the economy, response of customers towards higher electricity prices and the impact of Energy Efficiency (EE), FiT, self-generation, interruptible tariff and EToU tariff are seen as contributors towards the moderate electricity growth in the near future.

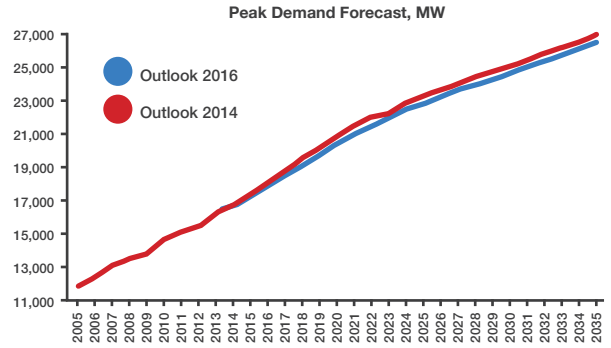
Figure 10: Demand forecast (2005 – 2035)



Average period growth rates, % pa:	
2015 - 2020	3.4%
2015 - 2025	3.0%
2025 - 2035	1.7%



Average period growth rates, % pa:	
2015 - 2020	3.2%
2015 - 2025	2.8%
2025 - 2035	1.5%



Average period growth rates, % pa:	
2015 - 2020	3.1%
2015 - 2025	2.6%
2025 - 2035	1.4%

Electricity sales are expected to reach 104,840GWh in 2015, which is a 2.4% growth from that in the previous year. Sales are estimated to rise to 3.4% in 2016 and 3.8% the following year. Electricity generation is forecasted to reach 116,813GWh in FY2015 and peak demand is estimated to reach 17,461MW in the same year. This is a 560MW increase or 3.3% growth from that in the previous year.

SUPPLY DEMAND OUTLOOK

COMMITTED GENERATION PROJECTS

TNB Janamanjung Unit U4 was successfully commissioned on 14th April 2015, 14 days from the original scheduled date of 31st March 2015. This marks the entrance of ultra supercritical technology into the system. By the end of the year, another two new projects were expected to be commissioned into the system.

Amidst the flurry of construction activities, steps are also being taken to ensure that the supply system remains robust in the event of a possible delay in the delivery of new power plants. After careful consideration, the Government has agreed to extend the operation of existing plants namely YTL Power, Powertek and PD Power for a period of between 2 years 10 months, 3 years 10 months and 3 years respectively.

Jimah East Power, a special purpose company jointly owned by TNB and Mitsui Corporation to develop a 2,000MW coal-fired power plant, is now resuming the construction works that was previously hit by delays. Scheduled Commercial Operation Dates (SCOD) are now rescheduled from 15th November 2018 to 15th June 2019 for Unit 1 and from 15th May 2019 to 15th December 2019 for Unit 2.

TNB Janamanjung U4 was successfully commissioned and marks the entrance of ultra supercritical technology into the system.

TNB Janamanjung U4

SUPPLY DEMAND OUTLOOK

In addition to the 400MW capacity from Pengerang Co-generation which is scheduled to be commissioned in June 2017, another 200MW capacity is expected to be made available to the system from January 2019 onwards. Through the showcase of an integrated combined heat and power application utilising most recently available technology, efficiency gains from co-generation operation will be translated to improved rates to the consumer.

Gas-fired fleet regeneration exercises continue with combined cycle gas turbines projects in Pasir Gudang and Alor Gajah by SIPP and Edra Global Energy for commercial operation in 2019 and 2021. Together with the new TNB Prai and plants extended through Track 2 Restricted Bidding, a balanced mix of coal and gas-fired capacities in the short and medium terms will be achieved.

The December 2014 flood incident in the East Coast called for a review of the generation development plan to include a new multi-purpose hydroelectric project with flood mitigation functions. A site has been identified in Sg. Lebir for that purpose for which details of the proposal is currently being discussed at the planning level.

Table 6: New generation projects

No	Project	Fuel	Capacity (MW)	Commercial Operation Date (COD)
1	TNB Janamanjung U4	Coal	1,010	14th Apr 2015
2	Hulu Terengganu	Hydro	250	U1: 3rd Dec 2015 U2: 31st Dec 2015
3	TNB Prai	Gas	1,071.43	20th Feb 2016
4	CBPS Redevelopment	Gas	375	27th Feb 2016
5	Hulu Terengganu (Tembat)	Hydro	15	U1: Mar 2016 U2: Apr 2016
6	Tg. Bin Energy	Coal	1,000	Apr 2016
7	Ulu Jelai	Hydro	372	U1: Jul 2016 U2: Sept 2016
8	Pengerang Co-generation	Gas	400	June 2017
9	Manjung Five	Coal	1,000	Oct 2017
10	Additional Pengerang Co-generation	Gas	200	Jan 2019
11	SIPP P.Gudang (Track 4A)	Gas	1,400	Apr 2019
12	Jimah East Power (Track 3B)	Coal	2,000	U1: June 2019 U2: Dec 2019
13	Edra Global Energy	Gas	2,400	Jan 2021
14	Tekai	Hydro	168	Jul 2021
15	New Coal	Coal	1,000	Jan 2023
16	Nenggiri	Hydro	300	Apr/Jul/Sept 2024
17	Telom	Hydro	190	Oct 2024
18	Lebir	Hydro	274	Dec 2024 Mar 2025
19	Sarawak Import	-	2,000	Jan 2025

SUPPLY DEMAND OUTLOOK

Hulu Terengganu Hydroelectric Power Plant

OPERATIONAL EXTENSION OF EXISTING PLANTS

The new 375MW CCGT in S.J. Jambatan Connaught that was slated for commercial operation has experienced a delay of 6 months. As a result, a short term extension of the existing open cycle units in S.J. Jambatan Connaught was made for a period till the end of 2015. The extension was made in order to fulfil the minimum system reserve margin requirement of 20%.

Similarly, the extension of YTL Power, Port Dickson Power, and Powertek was made as there was concern about the development of new projects that might be delayed as well and the time required for the new units to achieve operational stability.

Table 7: Short-term extension of existing plants

Plants	Capacity (MW)	Fuel	New SLA/PPA Expiry Date
S.J. Jambatan Connaught - OCGT (GT3, GT5 & GT6)	362	Gas	31st March 2016 (7 months)
YTL Power Generation Sdn. Bhd. - CCGT	585	Gas	31st December 2018 (2 years 10 months)
PD Power Sdn. Bhd. - OCGT	436	Gas	31st January 2019 (3 years)
Powertek Bhd. - OCGT	434	Gas	31st December 2019 (3 years 10 months)

SUPPLY DEMAND OUTLOOK

REVISED GENERATION DEVELOPMENT PLAN

The Generation Development Plan was revised as a result of the delay of several power plants and the further delay of the interconnection with Sarawak. Under the revised Plan, a short term extension has been proposed in the year 2017 and 2018 as mitigation for the possible delayed COD of several new projects. Also, an additional 200MW from Pengerang Co-generation will be added to the system starting January 2019. However, the power transfer from Sarawak Interconnection will be further delayed to 2025 and CCGTs are required to come on stream in 2021 as direct replacement of the Sarawak Interconnection. The approved generation development plan up to 2025 is as follows:

Table 8: Revised generation development plan

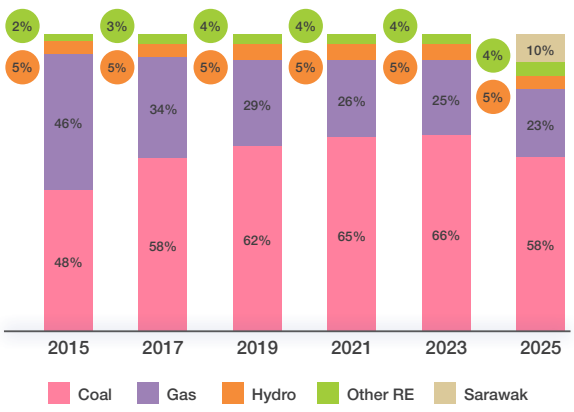
Year	Plants
2015	TNB Janamanjung U4 (1,010MW), Hulu Terengganu U1 (125MW), Hulu Terengganu U2 (125MW), CBPS GT3, GT5 & GT6 Extension (362MW)
2016	TNB Prai (1,071.43MW), CBPS Redevelopment (375MW), Tembat U1 (7.5MW), Ulu Jelai U1 (186MW) Tg. Bin Energy (1,000MW), Tembat U2 (7.5MW), Genting Sanyen Extension (675MW), Ulu Jelai U2 (186MW), YTL Power Extension (585MW), Powertek Extension (434MW), PD Power Extension (436MW)
2017	Pengerang Co-generation (400MW), Segari Extension (1,303MW), S.J. Sultan Iskandar CCGT Extension (275MW), Manjung Five (1,000MW) , Large-scale Solar (200MW)
2018	Large-scale Solar (200MW)
2019	Additional Pengerang Co-generation (200MW), SIPP P.Gudang Track 4A (1,000MW), Jimah East Power U1 (1,000MW), Jimah East Power U2 (1,000MW), Large-scale Solar (200MW)
2020	Tekai HEP (168MW) , Large-scale Solar (200MW)
2021	Edra Global Energy (2,400MW)
2022	Nenggiri HEP (300MW), Telom (190MW)
2024	Lebir HEP U1 (137MW)
2025	Lebir HEP U2 (137MW), Sarawak: 2 x 1,000MW

GENERATION MIX

Since the electricity tariff hike in January 2014, which involved an average tariff increment of 14.89% (from 33.54 sen/kWh to 38.53 sen/kWh), consumer awareness towards electricity consumption and energy efficiency have increased. Implementation of RE projects are expected to intensify and will contribute significantly to the overall generation mix. In terms of capacity. It was expected that the cumulative annual growth rate of RE capacity which consisted of mini hydro, biomass, biogas and solar PV plants by 2020 will be more than 11% to reach at least 2,080MW of installed capacity.

Latest generation fuel mix forecast includes contribution from RE plants due to sizable output expected in the future. The RE share in the overall fuel mix is projected to gradually increases up to 3% of total energy generated in 2020. However, RE is anticipated to play a complementary role to fossil fuels due to factors such as output intermittency, location and system constraints, technology development and potential limitation.

Figure 11: Approved generation mix (2015-2025)



SUPPLY DEMAND OUTLOOK

SIPP Energy Sdn. Bhd.

In the year 2018, a CCGT power plant with a capacity of 1,000 – 1,400MW, known as Track 4A is scheduled to operate on 1st June 2018. This project was conditionally awarded to a consortium consisting of YTL Power Corp Bhd, SIPP Energy Sdn. Bhd. (SIPP) and TNB, to be developed under a fast-track basis.

Suruhanjaya Tenaga had issued a Conditional Letter of Award (CLoA) for SIPP to work with TNB and YTL for the power plant project. However, YTL decided to withdraw from the consortium while both SIPP and TNB have signed the Acceptance of Terms.

Upon submission of technical and commercial proposal, the levelised tariff proposed by the Consortium was rejected, and subsequently TNB withdrew from the project leaving SIPP as the sole developer for the project. Negotiations with SIPP on the project implementation will continue into 2016.

Connaught Bridge Power Plant

Edra Global Energy Bhd.

A CLoA for the development of CCGT plant with a capacity of 1,800-2,400MW in Alor Gajah, Melaka was issued to 1Malaysia Development Berhad (1MDB) on August 2014. The SCOD is set at January 2021. Subsequently, Suruhanjaya Tenaga had authorised the novation of the project to Edra Global Energy Berhad on October the same year.

Towards the end of 2015, a rationalisation programme of 1MDB, the parent company of Edra Global Energy Sdn. Bhd. was carried out by the Government, which included the sale of existing assets and project. This move has invited controversy, and seen as opening the power sector to foreign ownership. Nevertheless, the approval for 1MDB to dispose its ownership is a “one-off” move and is subjected to regulatory requirements under the existing licensing regime and applicable law.

SUPPLY DEMAND OUTLOOK

OUTLOOK ON FUEL UTILISATION

Malaysia's electricity generation mix has always been highly dependent on fossil fuels. More than 12,000MW of new capacity will be commissioned between 2015 and 2020 in addition to the recently commissioned TNB power plant Janamanjung U4 of 1,010MW of generation capacity. Coal usage will dominate mostly the generation due to its price advantage. New technologies such as high efficiency CCGT, clean coal technologies and improved RE technologies will be given priority in determining future energy mix.

The gas price increment was revised by the Government in January 2014, with the starting price in January 2015 of RM 15.20/mmBtu. For the first usage of 1,000 mmscfd, the price will increase by RM 1.50/mmBtu every 6 months starting from July 2015 until the gas price reaches the market price of LNG which is RM 41.68/mmBtu in January 2024. Any gas volume beyond 1,000 mmscfd will be priced at the LNG market price. Moving into 2016, the gas price to the power sector will be increased to RM 18.20/mmBtu, subsequent to the revisions in July and November 2015.

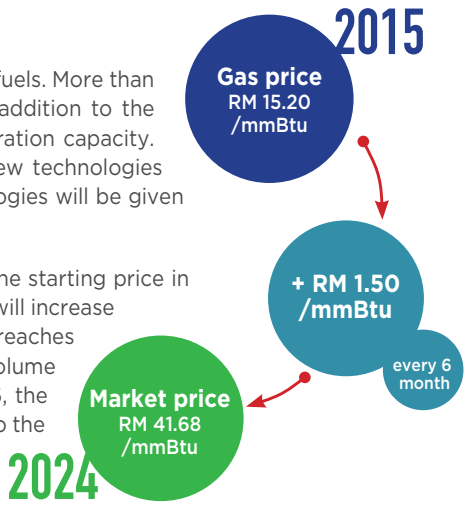
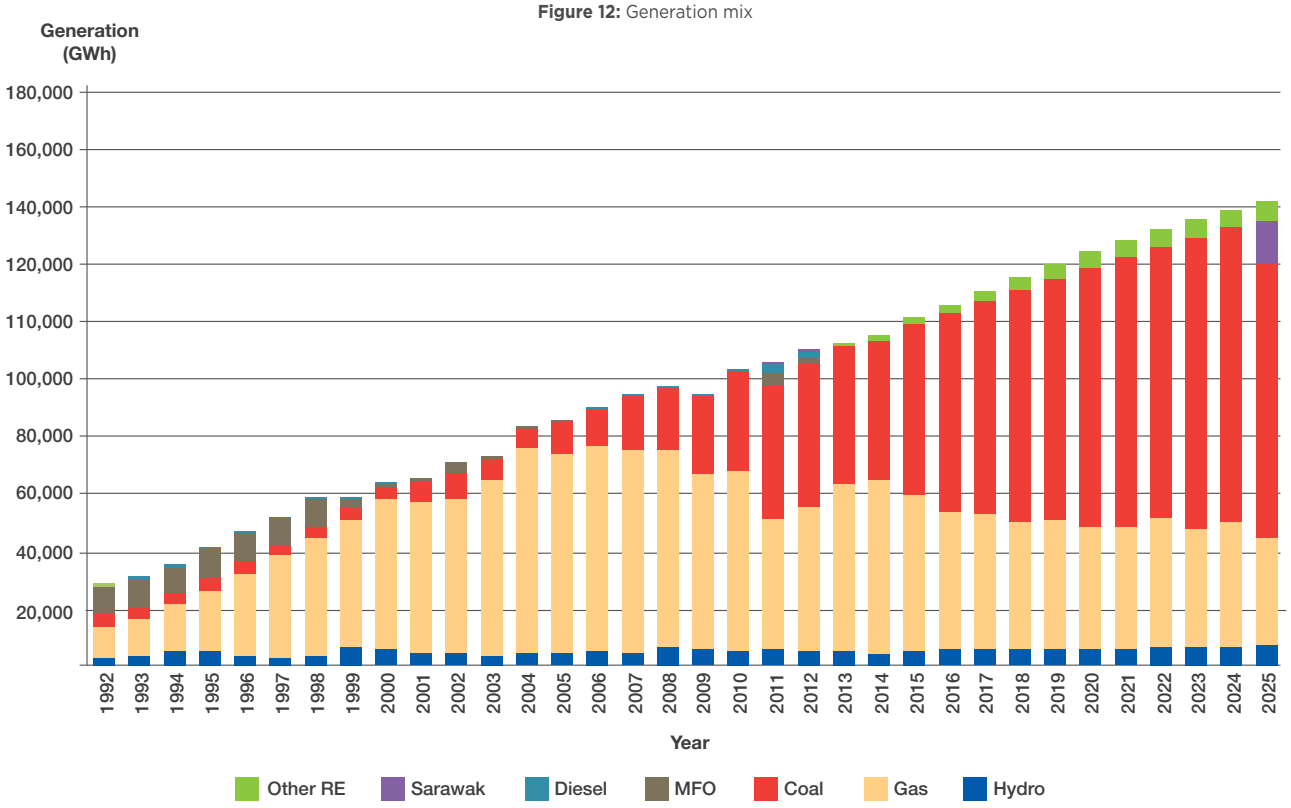


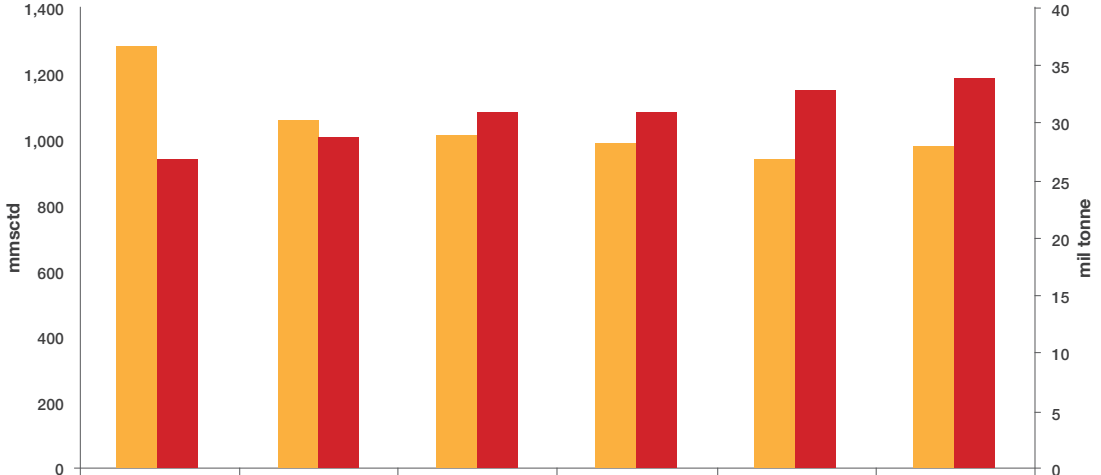
Figure 12: Generation mix



SUPPLY DEMAND OUTLOOK

Figure 13 shows the forecast trend for primary energy supply for the period 2015 – 2020. During this period, the trend shows a reducing dependency on natural gas, primarily due to the retirement of gas turbine units as well as new developments of coal power plants.

Figure 13: Projected gas and coal consumptions



	2015	2016	2017	2018	2019	2020
Gas	1,285	1,051	1,025	1,000	942	980
Coal	27	29	31	31	33	34

Tanjung Bin Energy Power Plant

SUPPLY DEMAND OUTLOOK

FUEL SUPPLY OUTLOOK

For coal consumption in the Peninsula, currently the power sector utilises 23 million metric tonnes of coal annually with the present generating capacity of 9,477MW. By 2020, coal-fired plants will make up 65% of total installed capacity compared to 45% in 2014 due to an additional coal capacity of 5,010 MW. As a result, the annual coal consumption is expected to increase by more than 75% from the existing utilisation rate to 40 million metric tonnes per year by 2020.

For power generation, coal is fully procured from the international market for both Independent Power Producers (IPP)s and TNB plants. The supply is managed and coordinated by TNB Fuel Services Sdn. Bhd. (TNBF) a wholly-owned subsidiary of TNB to match the projected energy requirements annually. TNBF is a sole coal supplier to all coal-fired power plants in the Peninsula. At present, 57% of coal requirements is procured from Indonesia followed by Australia (28%), South Africa (8%) and Russia (7%). The supplies range from medium to high grade coal, with a range of caloric value of 4,800 kcal/kg to 5,800 kcal/kg for sub-bituminous coal and caloric value of 5,800 kcal/kg to 6,750 kcal/kg for bituminous coal.

Table 9: Forecasted annual coal consumption

Coal-Fired Power Plant	Coal Consumption (mtpa)
Kapar Energy Ventures GF2 (U3 & U4)	1.5
Kapar Energy Ventures GF3 (U5 & U6)	2.5
TNB Janamanjung U1-U3	6.0
Tanjung Bin Power	5.9
Jimah Energy Ventures	3.6
TNB Janamanjung U4	4.0
Manjung Five	4.0

Peninsular Malaysia's rising demand for coal for its power plants has posed new challenge in sourcing for the required tonnage and quality for the future as global demand is expected to increase. There have been concerns that the traditional suppliers might not be able to supply the preferred coal needs in order to minimise downtime as experienced in 2014.

As stated before, most of the coal is imported from Indonesia, the world's top coal supplier with over 300 million metric tonnes annually. This dependency on a single supplier could pose major risks to supply security. Any policy change in Jakarta, such as the recent proposal to ban exports of low-grade coal from 2014, mine operators reducing production due to unattractive prices or geopolitical instability, may disrupt the supply of coal to long-term buyers. Other importing countries such as India and China have already explored other possibilities, such as diversifying strategies and venturing into coal mining. With increasing demand for coal in the Peninsula, TNBF has diversified its procurement to include suppliers as far as Russia.

Nevertheless, Peninsular Malaysia has plans to reduce its coal dependency in the coming future, targeting the right energy mix to ensure sustainability. The Government is also exploring the possibility of power import from Sarawak, which will significantly reduce the contribution of coal in the overall energy mix. Although this is still in the early stages of planning, alternative measures such as RE & EE will be aggressively promoted, before the nuclear option is considered.

TRANSMISSION DEVELOPMENT PLAN

Demand for electricity is projected to grow at a rate of 3% to 4% annually, which requires the transmission system to be further upgraded and expanded. The electricity demand forecast indicates a marginal decrease in the electricity demand in Peninsular Malaysia compared to previous years' demand forecast. Peak demand is projected to reach 23GW by the year 2025 while total installed generation capacity connected to the transmission system will be around 29GW.

Based on the Generation Development Plan that was approved by the Planning and Implementation Committee for Electricity Supply and Tariff (JPPPET) in August 2015, the site for new generation development has taken into consideration the outcome of competitive bidding exercise carried out earlier as well as the Conditional Award to the potential power plant developers. Due to the delay of the Track 3B project, a short term extension of the PPA has been awarded to YTL Paka, Port Dickson Power Station (PDPS) and Powertek to maintain adequate power generation reserve margin in Peninsular Malaysia. A conditional award has been issued for the development of two new power plants, which are located at Pasir Gudang for a capacity of 1,400MW and at Alor Gajah with a maximum capacity of 2,400MW.

In anticipation of the addition of the above mentioned new generation projects, the transmission network reinforcement has to be carried out to facilitate the flow of power to the grid system. Three new 500/275kV substations will be established together with about 85km of 500kV overhead lines.

In the long run, the 500kV transmission lines will be the backbone for the transmission system for inter-regional power transfer and possible interconnection with other systems. From the 500kV voltage level, the power needs to be transformed into lower voltage levels i.e. 275kV and 132kV. The 275kV grid system, especially connecting the highly concentrated power generation in Northern/Perak and South to Central area, will also need to be reinforced to move power to the load centres. Some of the identified 275kV reinforcement projects are as listed below:

Table 10: List of identified 275kV reinforcement projects

No.	Project
1	275kV overhead lines between Ayer Tawar to Seri Iskandar (new) substation and from Seri Iskandar to Kg Gajah (new) substation
2	275kV overhead lines from Mahkota Cheras to Salak South substation
3	275kV overhead lines from Ulu Jelai to La'loh substation for the third West to East 275kV link

SUPPLY DEMAND OUTLOOK

TRANSMISSION NETWORK

The major 500kV and 275kV network in the system for year 2017 and 2020 are shown in Figure 14 (a) and 14 (b) respectively.

Figure 14 (a): Peninsular Malaysia single line diagram 2017 (500kV and 275kV)

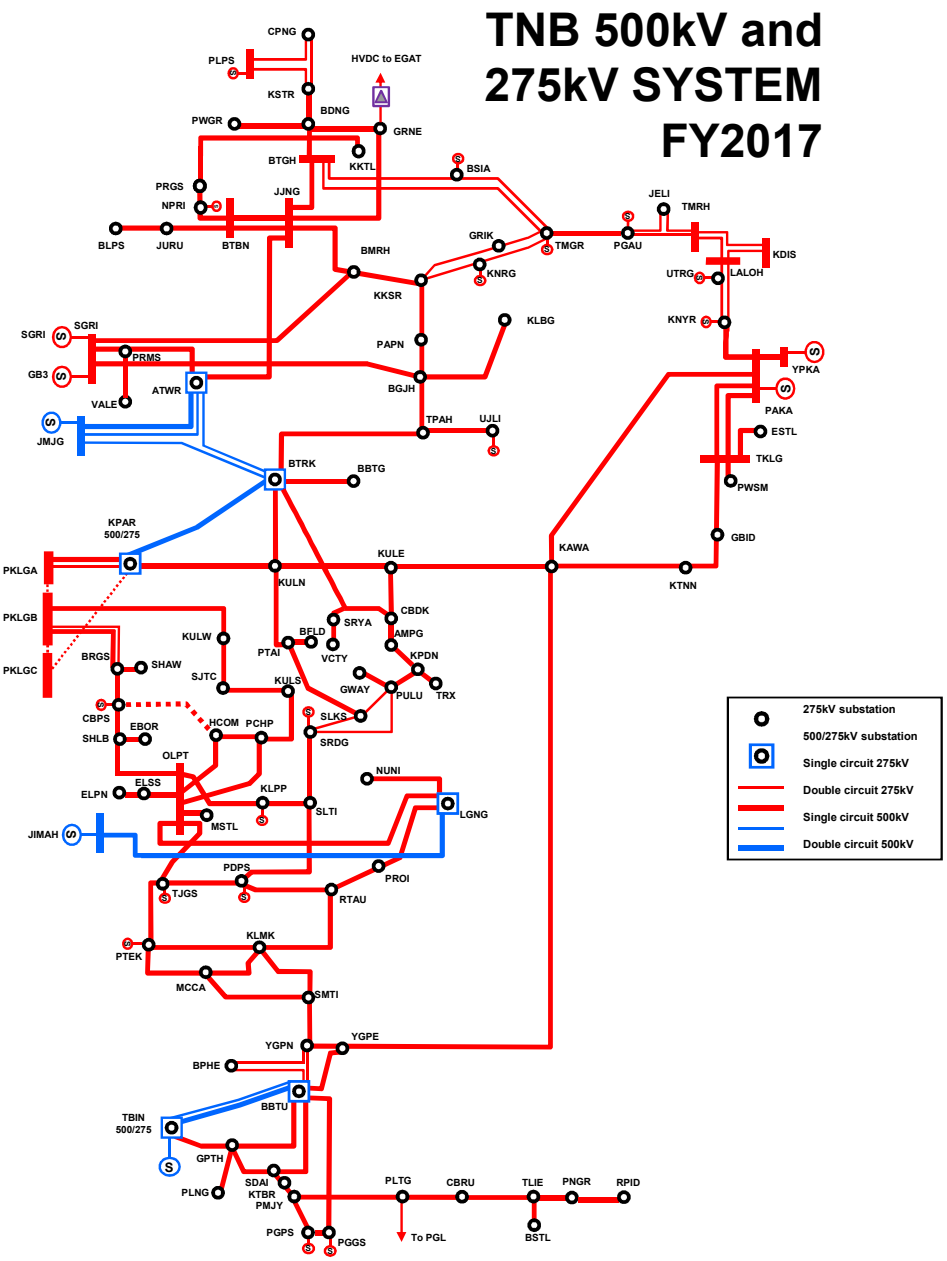
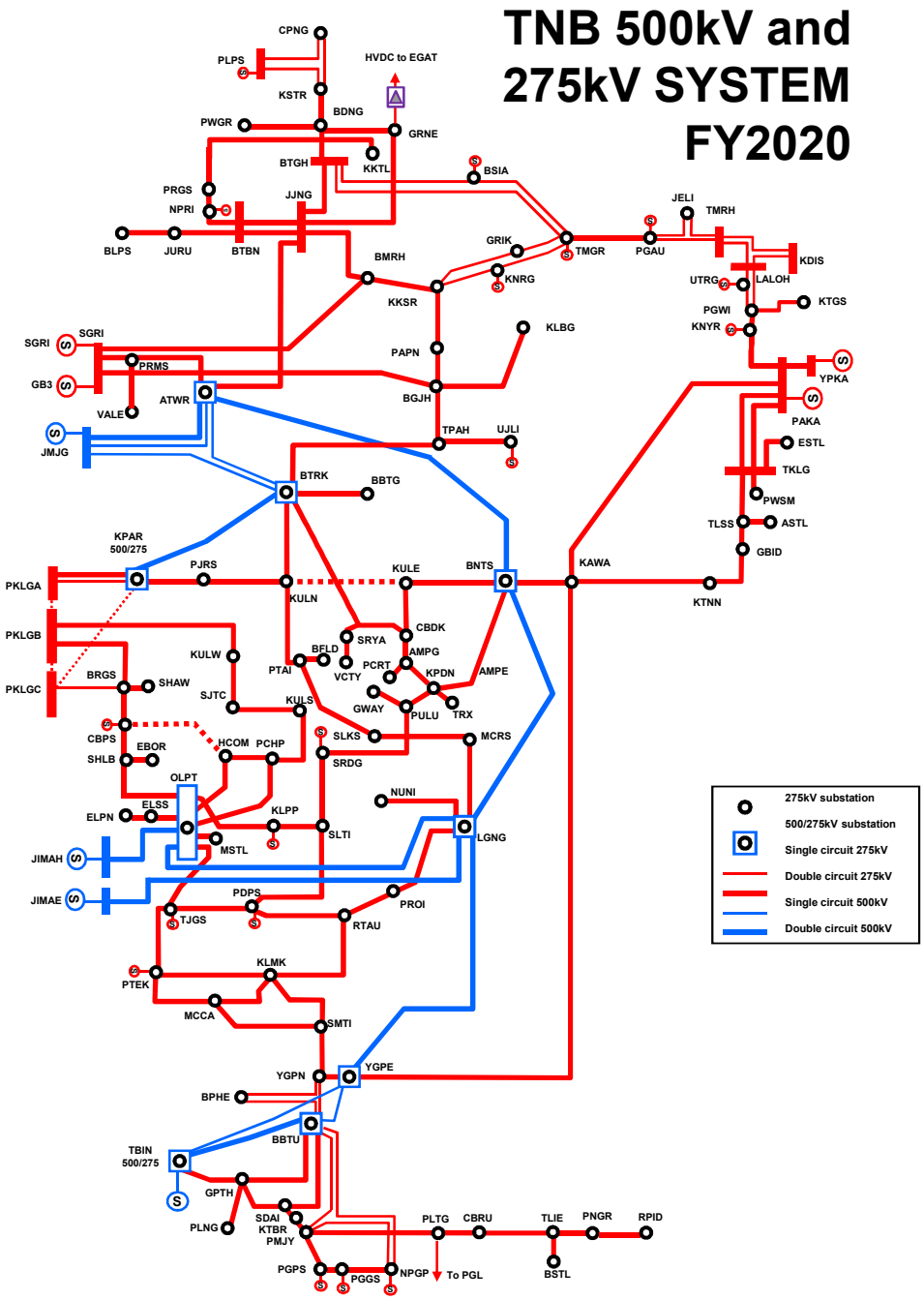


Figure 14 (b): Peninsular Malaysia single line diagram 2020 (500kV and 275kV)



INDUSTRY REFORM INITIATIVES

INDUSTRY REFORM INITIATIVES

THE NEW ENHANCED DISPATCH ARRANGEMENT (NEDA)

NEDA was proposed as one of the initiatives for the Malaysian Electricity Supply Industry (MESI) reform. The proposal came from a study commissioned by MyPOWER Corporation through the appointed consultant, KEMA DNV for the Development and Implementation of a Competitive Electricity Supply Industry. It was envisaged that the next step of reform to improve competitiveness, efficiency and transparency of the electricity supply industry is to create a competitive market that is suitable for Peninsular Malaysia. Thus, NEDA was proposed to JPPPET in April 2014 with the following objectives:

- Enhance cost efficiency in generation through short-run competition;
- Enable energy efficient options, particularly the use of efficient technology such as co-generation;
- Provide opportunity for non-PPA/SLA Generators such as co-generators, RE generators/producers, embedded generators and expired PPA/SLA Generators to operate as Merchant Generators to sell energy to the SB; and
- Enable expired PPA/SLA Generators to enhance their business options by maximising the use of the existing facilities in a cost efficient manner for the benefit of the electricity supply industry.

In addition, this will also incentivise non-PPA/SLA Generators to provide term based reserve capacity for short-term system requirements at competitive prices.

Principles of NEDA

The current cost-based bidding system is complemented by introducing an optional price-based bidding. This will enhance competition in generation dispatch and result in more competitive energy prices.

The main features of NEDA are:

- Generators with PPA/SLA can offer optional reduced heat rates & VOR (alternative to PPA/SLA rates). If dispatched, they will be paid the energy payment using the lower of the PPA/SLA or optional offer heat rates & VOR (First phase);
- Merchant Generators with a capacity of more than 10MW (non-PPA/SLA Generators such as expired IPP/SLA Generators, co-generators, RE generators/producers and embedded generators) can offer to sell energy to the SB. If dispatched, they will be paid at Price as Bid, subject to a cap price which is the variable cost of the most expensive IPP/SLA Generating Unit available for dispatch to meet demand in each trading interval (Second phase);
- Merchant Generators with small co-generation or RE generation/production of 100kW to 10MW (hereinafter referred to as Small co-gen and RE Generators) can sell energy to the Distributor. The settlement will be on monthly basis based on the monthly average of the daily average of the half hourly System Marginal Price of the SB market (Second phase);
- No major change to current generation scheduling and dispatch arrangements; and
- No violation to current PPA/SLA as the PPA/SLA Generators can choose whether to submit the optional offers or not.

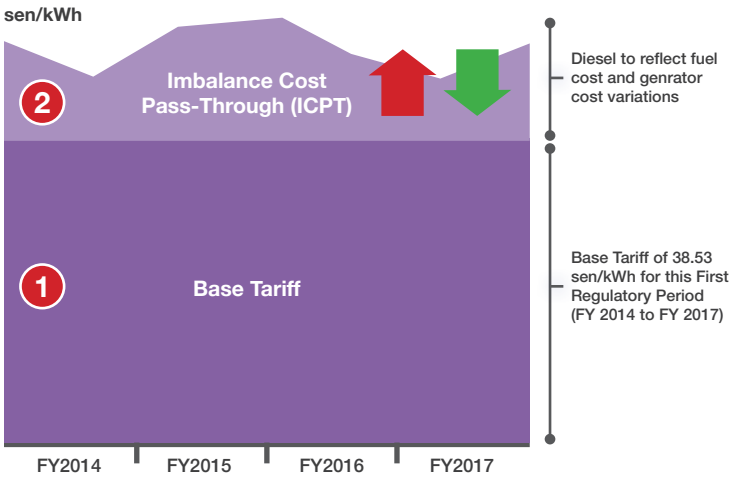
The mechanism for NEDA is documented in the NEDA Rules that is to be used with the SB Rules. SB shall schedule the dispatch of the Generating Units based on a Least Cost Dispatch Scheduling Methodology such that the lowest marginal cost Generating Unit is forecast to be dispatched first to meet demand followed by the next lowest marginal cost Generating Unit until all demand is met as prescribed in the Single Buyer Rules. The marginal cost of generation shall comprise all payments, which vary with the amount of electricity procured, that are made by the Single Buyer to the Generators, pursuant to Generator Contracts, Daily Heat Rate and Variable Operating Rate Bids or Daily Price Bids.

NEDA had undergone a Trial Run and has produced a positive outcome. Challenges were addressed to improve NEDA Rules and the mechanism further. The programme will be implemented in 2 stages starting with generators with PPA and SLA for Phase 1 and later to also include the non-PPA generators for Phase 2. Phase 1 has already started from 1st October 2015 while Phase 2 is scheduled to commence in the second quarter of 2016.

IMBALANCE COST PASS-THROUGH (ICPT)

Beginning January 2014, the electricity tariff in Peninsular Malaysia is determined through the IBR framework and the ICPT mechanism. ICPT is a mechanism under the IBR framework allowing the Government to review the tariff every six months to reflect changes (either an increase or a decrease) in fuel and other generation costs. The ICPT takes into account changes in the price of piped gas, LNG, coal, medium fuel oil, distillate and other generation costs such as those related to the PPAs, displaced cost from RE and the cost of importing electricity.

Figure 15: ICPT Mechanism



A system similar to ICPT has been adopted by many developed and developing countries such as Australia, UK as well as ASEAN countries such as Singapore, Thailand and the Philippines. The mechanism allows for the tariff to reflect the true cost of electricity with more transparency.

Taking into account the down trend of fuel prices in the last quarter of 2014 and early quarter of 2015, the Cabinet on 11th February 2015 had decided to give a tariff rebate of 2.25 sen/kWh for consumers in Peninsular Malaysia beginning 1st March 2015 until 30th June 2015 based on the ICPT mechanism, resulting in a reduction of the average tariff from 38.53 sen/kWh to 36.28 sen/kWh. Although the piped gas price has increased by an additional RM 1.50/mmBtu from July 2015 to December 2015, the Government decided to retain the rebate of ICPT at 2.25 sen/kWh for the same period. This 5.8% reduction is due to the reduction in fuel cost and cost of generating electricity in Peninsular Malaysia which comprise of:

- Changes in generation mix resulting in higher utilisation of coal; and
- Down trend in coal prices as well as the improved performances of the coal plants resulting in more electricity generated using this cheaper fuel compared to the more expensive LNG.

The next cycle of the ICPT revision was subsequently carried out in December 2015, which resulted in a rebate of 1.52 sen/kWh to be passed to consumer during the period of 1st January 2016 to 30th June 2016.

ICPT is a mechanism under the IBR framework allowing the government to review the tariff every six months to reflect changes (either an increase or decrease) of the fuel and other generation cost.

INDUSTRY REFORM INITIATIVES

GAS FRAMEWORK AGREEMENT (GFA)

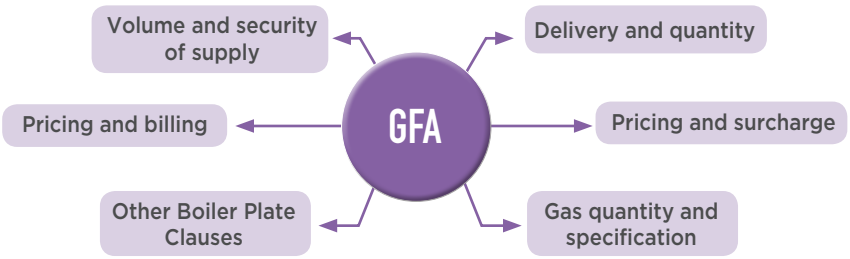
GFA was first proposed during the Track 1 competitive bidding process to resolve the issues of non-operationalisation of GSAs by governing the gas nomination and allocation for the power sector. The GFA will effectively promote the gas-fired power plant to be dispatched according to blended price of regulated gas and LNG-linked market price. This will ensure that newer, more efficient CCGTs are not penalised by its LNG-linked GSAs as by virtue of the blended gas pricing, dispatching will be based on the lowest fuel cost as well as the highest efficiency. GFA is introduced with the following objectives:

- Ensure security and reliability of gas supply to the power sector;
- Recognise the role of PETRONAS and TNB in effectively managing and allocating pipeline gas and LNG volume to the whole of power sector;
- Equitable allocation of risks with regards to the supply of gas by PETRONAS and the off-take of gas by the power sector;
- Encourage private and competitive investments in the power sector by reducing power producers risks in relation to the take-or-pay obligation under their respective GSA;
- Provide an agreed timeline and procedure for provision of gas volume requirements by the power sector to enable proper planning for such supply of gas by PETRONAS; and
- Instil discipline among industry players to ensure optimal allocation and use of gas in the power sector.

Figure 16: GSA and GFA relationship

Currently, the GFA's draft is at the final stage and as soon as the document is ready, Suruhanjaya Tenaga together with PETRONAS and TNB will hold workshops to engage with the entire stakeholders on the new arrangement. The full implementation of GFA is expected to be in early 2016.

In order to have such a clear policy, discussions have been pursued which cover six major items under the GFA as follows:



Gas Billing Arrangement (GBA) was introduced in 2011 to limit the gain accrued to first and second generation IPPs (gas-fired) whenever gas price revision takes place. The gain were due to the commercial heat rates within the PPA being less efficient than the plant's designed heat rates. Whilst, on the other side, when PETRONAS introduced Tier 2 pricing to the power sector, the billing arrangement incorporated the pricing for volumes above 1,000 mmscfd threshold used by the power sector which caused the differential amount between the market price and the prevailing regulated price being passed to the Single Buyer. GFA is mooted to incorporate the GBA and the 2 Tier pricing arrangement for the power sector.

INDUSTRY REFORM INITIATIVES

NATIONAL ENERGY EFFICIENCY ACTION PLAN (NEEAP)

Malaysia is a developing country where its growing population and expansion of economic activities especially in the manufacturing sector have been the major drivers for the increasing demand for energy supply. Historically, the nation's energy demand growth rates were higher than the growth rates of its GDP. The energy demand growth, especially the demand growth for electricity, was accelerated by the industrialisation process in the past two decades. The imbalance ratio between energy demand and GDP is indicative of the more energy-intensive economic activities driving the growth. In this regard, the need to promote efficient-use of energy in the country has become clear. However, the effort requires sound energy efficiency policies supported with good strategies and implementable programmes.

Since 2000, Malaysia's energy intensity (energy/GDP) has been rising. This implies that over time Malaysia uses more energy to produce a unit of GDP and this provides a compelling reason for Malaysia to improve its efficiency of energy use. Energy efficiency offers an effective and efficient energy policy instrument to address the energy supply security issue as well as energy-related environmental issues in the country. At the same time, energy efficiency is also one of the ways that will lead the country to in a sustainable energy path.

In this regard, the National Energy Efficiency Action Plan (NEEAP), that was developed for the country, including for Sabah and Sarawak, will focus on tackling issues pertaining to energy supply by managing demand efficiently. The plan prescribes a path towards improving energy efficiency by pursuing the implementation of measures that are considered as "harvesting the low hanging fruits", as they are viable for the nation as well as the end users. The plan is built upon the experiences and knowledge from past programmes and projects, which were implemented by various institutions and agencies, but was lacking in terms of a coherent framework to ensure sustainability in the longer term.

Initially a National Energy Efficiency Master Plan was drafted with a broader spectrum in terms of energy efficiency since it had an initiative on creating a centralised agency for energy efficiency empowered by an act specifically tailored for energy efficiency. The master plan proposal was rejected due to the cost of overall implementation at the time it was proposed.

Moreover, several of the initiatives for the Government sector prescribed in the master plan were already being implemented through directives and circulars. Examples of the initiatives are:

- 24°C cooling temperature policy in Government buildings;
- 5% reduction in electrical energy consumption in all Government buildings; and
- Implementation of Energy Performance Contracting for upcoming retrofit projects.

Hence, the National Energy efficiency Master Plan was revised and transformed into the National Energy Efficiency Action Plan. The NEEAP presents a strategy for a well-coordinated and cost-effective implementation of energy efficiency measures in the industrial, commercial and residential sectors, which will lead to reduced energy consumption and economic savings for the consumers and the nation. However, it must be borne in mind that the NEEAP is only confined to electricity use and does not cover energy consumption in other economic sectors. The aim of the plan is to promote energy efficiency in order to meet the following policy direction:

"Promote energy efficiency to ensure productive use of energy and minimise waste in order to contribute to sustainable development and increased welfare and competitiveness."

INDUSTRY REFORM INITIATIVES

In meeting the policy direction, the NEEAP will be supported by 5 main thrusts that will drive the nation towards a sustainable energy path:

- Thrust 1: Establish a planned and coordinated approach for energy efficiency;
- Thrust 2: Strengthen implementation capacity to promote energy efficiency;
- Thrust 3: Create adequate and sustainable funding mechanism for energy efficiency;
- Thrust 4: Implement energy efficiency programmes; and
- Thrust 5: Enable commercial finance institutions to support energy efficiency.

The above five thrusts will help eliminate the existing barriers and ensure that energy consumers in the targeted sectors will be encouraged to adopt and adapt energy efficiency as a way of life and reap the benefits that energy efficiency could provide.

Based on these five thrusts, energy efficiency initiatives will be developed to promote energy efficiency under the NEEAP. The initiatives can be grouped into 5 key initiatives:

Table 11: Initiatives of NEEAP

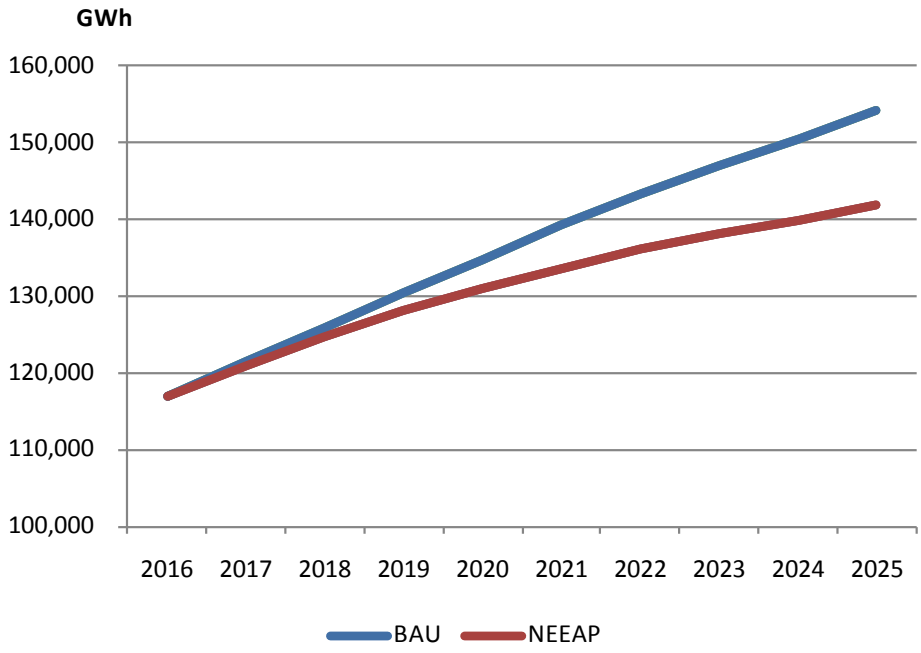
KEY	INITIAVE	REMARKS
1	**Promotion of 5-Star Rated Appliances**	Labelling of appliances is an effective tool to inform consumers about the energy consumption of the goods. Labels have already been applied for refrigerators, fans, air conditioners and TV's. Promotion of 5-star rated appliances based on the labeling is the main focus in this initiative.
2	**Minimum Energy Performance Standards (MEPS)**	The MEPS will set the minimum energy performance for energy consuming equipment to be sold in the market. By introducing MEPS to equipment, it can ensure that low efficient technologies are not dumped in the market. Currently, MEPS has been introduced for refrigerators, fans, air conditioners, televisions and lamps. MEPS will be extended for more equipment under the NEEAP.
3	**Energy Audits and Energy Management in Buildings and Industries**	Energy audits are consultancy services for identification of energy saving potentials in facilities. It has been demonstrated in earlier studies that savings of 10% or more are readily available at low or no cost, just by introducing better practices and reducing leaks etc. Energy audits and energy management will be done in commercial buildings and industries. As a kick start activity, Government facilities will be subject to energy audits and energy management as well.
4	**Promotion of co-generation**	As co-generation can have high thermal conversion efficiencies, it will be promoted. This will be done by reducing barriers to an increased uptake of co-generation process, including by having revised top up and standby rates for co-generation installations.
5	**Energy Efficient Building Design**	For new buildings, programme will be undertaken to demonstrate energy efficient design features. This will be in the form of demonstration and show-case projects within various building types e.g. offices, shopping centres, hotels and dwellings, development of guidelines and enhancement of the uniform building by-laws.

The target of NEEAP is to save electricity and reduce electricity demand growth. The effective and efficient implementation of the NEEAP supported with sufficient resources will be able to save up to 50,000GWh of electricity over the plan period against a business-as-usual (BAU) scenario.

The electricity savings will eventually lead to a reduction in peak demand and the need to build new power plants in future. In other words, NEEAP's achievement will improve the electricity load profile by better management of peaking load in the power system. In terms of peak demand, implementation of NEEAP is estimated to have a total capacity savings of 2,500MW.

The fuel savings derived from the NEEAP will also lead to less environmental impact and reduction in greenhouse gas emissions. The total reduction of greenhouse gas emission over the plan is projected to be 38 million tonnes CO_2 equivalent. A total reduction of 88 million tonnes of CO_2 equivalent will be achieved over the lifetime of the energy-efficient technologies adopted and adapted from the plan implementation.

Figure 17: Expected savings



CONCLUSIONS

CONCLUSIONS

The resilient and diversified nature of the nation's economic activities have again been demonstrated through annual GDP growth of 5% in 2015. While revenue from oil and gas exports have reduced, income generated from other sources such as GST cushioned the impact of lower oil price. In terms of headline inflation, the increase of Consumer Price Index by 2.7 per cent for December 2015 was a fair reflection of the general increase in food and fuel prices in 2015.

On the other hand, lower than expected electricity growth across all consumer sectors resulted in lower yearly peak demand and slower growth of electricity generation and sales. While electricity sales grew at 2.2% against forecasted figure of 2.4%, reduced utilisation of LNG and secondary fuels at the back of improving performance of coal plants has translated to lower fuel cost per unit. As a result, a rebate of 2.25 sen/kWh through ICPT mechanism has been passed through to the consumers.

IBR was officially implemented in January 2015 with the first regulatory period of 2015-2017 being the litmus test for the effectiveness of the mechanism. Key Performance Indicators for TNB's regulated business units will be assessed on an annual basis. Though KPI revision will only be made after each regulatory period has ended, consumers' feedbacks and utility's revenue expectation throughout the preceding period will be taken into consideration.

Introduction of larger, more efficient coal-fired power plant with ultra supercritical technology is timely with the need to comply with more stringent emission limits as prescribed in the Environmental Quality (Clean Air) Regulations gazetted in June 2014. Similarly, the latest and most efficient combined cycle gas turbine units will reduce the amount of fuel used to generate electricity, in line with efforts to preserve the indigenous natural gas. Renewables utilisation, especially solar, will be further promoted through implementation of Large-scale Solar and NEM initiatives.

As the system grows, balancing the supply demand situation will become more challenging. As the capacity may or may not be urgently required, short term extensions of retiring generation capacities are deemed to be the most costeffective stop gap measures compared to building new capacity. Although actual electricity demand was slower than forecasted and plant improvement programmes were rigorously implemented, short term extension of remaining first generation IPPs was decided in view of previously unstable plant performance and the delay of new generation and transmission projects.

Fuel, as the biggest cost component, dictates electricity tariff whereby the reduction of gas price subsidy was offset by the declining coal price. With the reduction of subsidy, gas price for the power sector for volumes of up to 1,000 mmscfd is at RM 18.20/mmBtu starting January 2016.

Reform initiatives continue with the implementation of NEDA that allows generators to submit optional offer price. Cogeneration players will be able to participate in the market when NEDA moves to Phase 2 in 2016. In addition, Suruhanjaya Tenaga will also establish a framework to promote co-generation from 100kW upwards to contribute power to the system.

On the demand side, consumers will have more motivation to consume electricity at the off-peak period due to lower tariff under EToU tariff framework starting January 2016.

As for energy efficiency, the recent Government approval of NEEAP will enable energy efficiency programmes to be implemented nationwide in a more effective manner. The NEEAP programmes will cover the domestic, commercial, industrial and government sectors. The results of these programmes are savings or reductions in terms of consumption.

The amendments to the Electricity Supply Act 1990 came into force in January 2016. This will pave the way for enhancement in governance of the electricity supply industry through various measures to ensure sectoral efficiency, reliability and safety. A Electricity Industry Fund will be established for the purpose of mitigating the impact of tariff adjustments and implementing other industry development activities. Several new codes, rules and guidelines will be issued under the amended provisions of the Act to enable more effective implementation of various industry reform initiatives.

NOTE

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