



**PENINSULAR
MALAYSIA**
ELECTRICITY SUPPLY
OUTLOOK 2017





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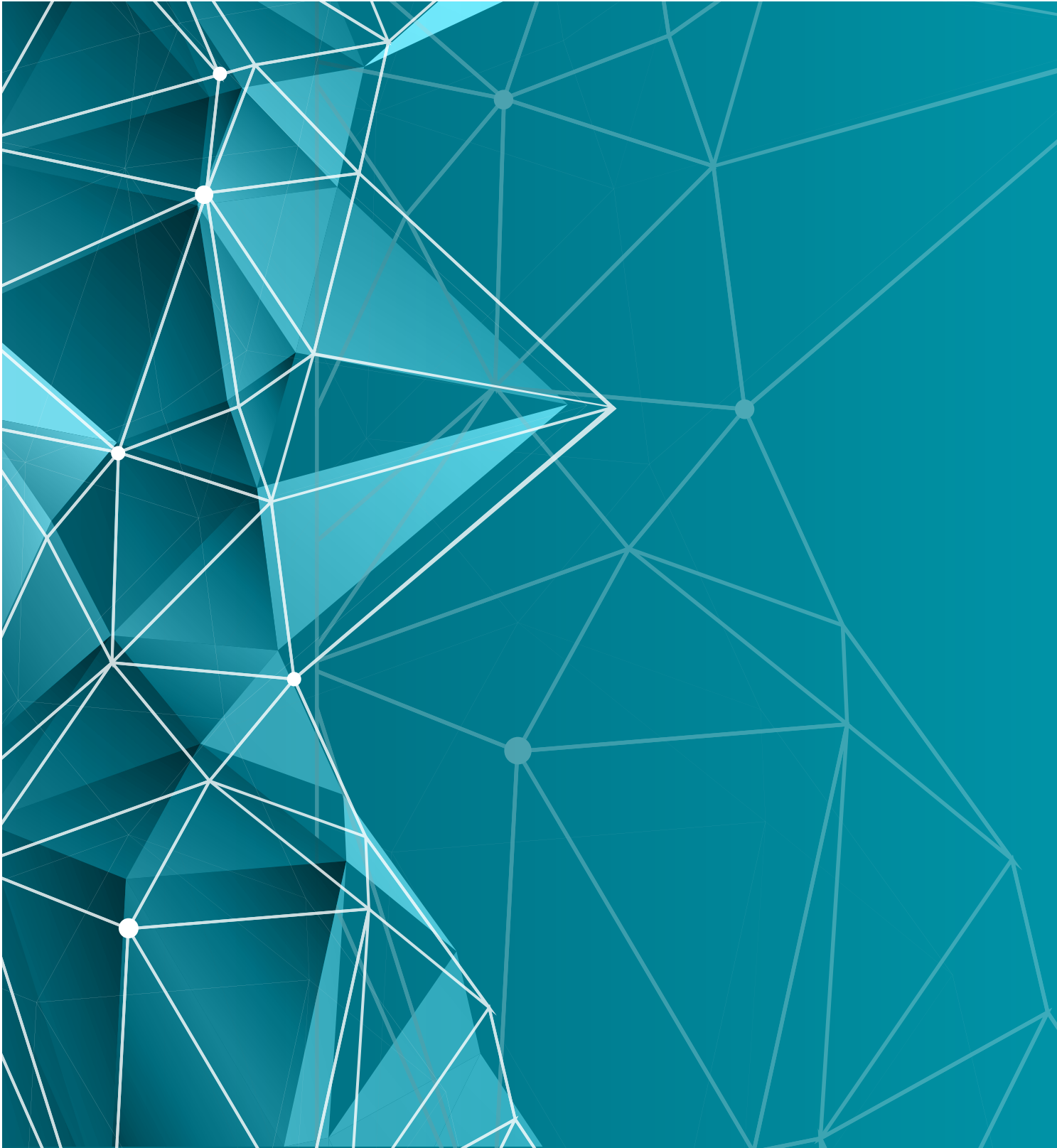
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Year In. Review-2016

Year In Review - 2016

Subdued nature of current economic situation in the wake of prolonged low commodity prices and vulnerability of international financial market conditions called for concrete measures from the Government. Lower oil-based revenues were mitigated through implementation of the Goods and Services Tax (GST). Amidst moderate growth projection, the Malaysian economy expanded by 4.3% in the third quarter of 2016 as reported by Bank Negara Malaysia.

The World Bank in June has projected 2016 global economic growth of 2.4% against the International Monetary Fund's projection of 3.1% in October. Emerging market and developing economies are projected to grow at between 3.5% to 4.2% whereby East Asia and Pacific regional growth is projected at 6.2% in 2016 against 6.5% recorded in 2015. And, while the global economy continued to experience moderate growth, the Malaysian economy is expected to achieve the targeted growth rate of between 4.0% to 4.5% in 2016.

In terms of electricity growth, unusually high temperature between December 2015 to May 2016, attributed to El Nino phenomenon, caused a sudden surge in electricity demand. Maximum peak demand of 17,788MW was recorded on 20th April 2016, surpassing the initial target of 17,317MW by 2.7% while the highest daily energy generation of 372GWh was recorded on 20th April 2016 against previous record of 355.8GWh in 2014. Total sales recorded for FY2016 of 108,858GWh is also significantly higher compared to 104,653GWh in FY2015 resulted in growth of 4.0% in FY2016 compared to 2.2% in FY2015 and 2.5% in FY2014.

Gazetting of the Gas Supply (Amendment) Act 2016 amendments on 9th September 2016 marked another milestone to the expected changing landscape of the energy industry. Platform for the Third Party Access regime in the gas industry is now set with new provisions in the Act providing legal framework to the new arrangement. Next, regulations, codes and guidelines will be established in line with the need of the industry.

The Environmental Quality (Clean Air) Regulations 2014 was gazetted and came into force in June 2014 to replace the Environmental Quality Clean Air Regulations 1978. The regulations aim to regulate emissions of air pollutants from industrial activities including power plants, waste fuel plants and asphalt mixing plants. The power sector will be required to invest significant amount of money for emission control improvement as compliance to the regulations will be mandatory by June 2019.

The Gas Framework Agreement (GFA) signed between Petroliam Nasional Berhad (PETRONAS) and Tenaga Nasional Berhad (TNB) is set to be the instrument to manage the nomination and allocation of gas for power sector. Issuance of guidelines on the GFA by Suruhanjaya Tenaga acts as a framework to define the roles of parties in relation to nomination and allocation of gas to the power sector and the applicable billing arrangement. Trial period starts from August 2016 to December 2017 and will be used to resolve operational issues that may arise due to operationalization of the GFA.

Following pathway set through the Paris Agreement, global theme for the energy sector in 2016 was centred around challenges in addressing climate change. The International Energy Agency stated that growth in energy-related CO₂ emission stalled completely in 2015, reflection of an improved energy intensity of global economy as a result of energy efficiency gains and wider use of renewables.

Improvement of overall system reliability and efficiency continue when a total of 2,825.5MW new power generation projects entered the Grid System in 2016. For the gas-fired projects, TNB Prai 1,071MW, also the first H-class CCGT in the system, was commissioned on the 20th February followed by TNB Connaught Bridge 375MW on the 27th February. For the coal-fired project, utilisation of ultra supercritical technology (USC) continues with the commissioning of Tanjung Bin Energy 1,000MW on the 21st March. Following successful operation of Hulu Terengganu (Puah) 250MW in 2015, TNB Ulu Jelai 372MW was commissioned in stages on the 15th August and 27th September followed by additional 7.5MW capacity in Hulu Terengganu (Tembat) in December of 2016.

Operational extension of expiring power plants were conducted to mitigate completion delay of new transmission line projects. Through restricted bidding exercise, three gas-fired plants namely Powertek 434MW, Port Dickson Power 436MW and YTL Power 585MW were selected for operational extension until end of 2019. Extension of TNB Paka 257MW until end of 2019 was also approved in principle, subject to terms to be agreed upon. At the opposite

end, TNB Putrajaya 324MW, TNB Jambatan Connaught 362MW and TNB Pasir Gudang 210MW with a total capacity of 896MW were retired from the system in 2016.

Implementation of Large Scale Solar (LSS) bidding exercise for year 2017-2018 started with issuance of Request for Qualification document on 1st March followed by issuance of Request for Proposal (RFP) document to the qualified participants on 26th May. Through the bidding exercise, a total solar capacity of 434MW in Peninsula and 16.9MW in Sabah will be expected to be commissioned in 2017 and 2018 with levelised tariff ranging from 39.95 – 44.95 sen/kWh in Peninsula and 45 – 51 sen/kWh in Sabah.

The New Enhanced Dispatch Arrangement (NEDA) Phase 2 Trial Run will be conducted for a period of 6 months starting from 1st October 2016 to 31st March 2017. The objectives are to test the proposed bidding arrangement and for NEDA participants to be able to prepare the necessities and to familiarise with the new arrangements.

Net Energy Metering (NEM), a mechanism where an eligible consumer installs a PV system primarily for his own use and the excess energy to be exported to the grid, was launched by the Honourable Minister of Energy, Water and Green Technology in October. Online system for submission of NEM applications to the Sustainable Energy Development Authority (SEDA) is already in operation. Through the mechanism, renewable energy utilisation in the energy mix is expected to accelerate in the next few years, in line with the Government initiatives under the 11th Malaysia Plan.

The Enhanced Time-of-Use Tariff (EToU) scheme was introduced on 1st January 2016 as an option for medium voltage and high voltage consumers. It is one of the initiatives of demand-side management (DSM) to manage electricity demand effectively. Consumers who opt for EToU will be able to reduce their electricity bill if they use less energy during peak hours and move their time of energy use to off-peak times such as night and weekends.

Regional cooperation is further strengthened through the Lao PDR-Thailand-Malaysia Power Integration Project in which Memorandum of Understanding between the three member states was signed during the ASEAN Ministers on Energy Meeting in September 2016. Work on legal and regulatory framework, commercial arrangement and tax and tariff continues whereby existing interconnection arrangement also needs to be relooked. Power transfer of up to 100MW from Lao PDR to Malaysia through Thailand is expected to commence in 2018.

New 500kV and 275kV transmission line projects are now under construction for commissioning in 2017 to 2019. Except Yong Peng East-Lenggeng lines that has shown promising progress and in line for completion by end of 2019, delay of all other projects continues mainly due to wayleave issues. Resolution of these issues is very critical so that all the delays will not be dragged further and jeopardise system security especially in the Central area. In addressing the delay, extension of expiring generation capacities have to be done to ease Northern line congestion and minimise the impact to system security.

In early 2016, PETRONAS proposed for power sector to utilise natural gas at minimum average weekly basis of 1000 mmscfd against the minimum planning criteria of 600 mmscfd. In anticipation of lower gas utilisation by power sector after all USC coal plant projects are completed, operational sustainability of petrochemical plants can be at risk due to uncertain feedstock level. However, higher gas offtake will pose operational challenges to coal plants with possibility of frequent start-stop operation. Therefore, the Planning and Implementation Committee of Electricity Supply and Tariff (JPPPET) in August decided to revise planning criteria to 800 mmscfd minimum gas offtake in line with the approved generation development plan. Nevertheless, in view of Malaysia's commitment towards the Paris Agreement, a review of the overall generation mix will be carried out in the near future.

Review of generation reliability standards for Peninsular Malaysia as a high income country post-2020 was conducted by Single Buyer. Through this study, review of existing planning criteria was conducted in addition to proposal for additional criteria to be added for future generation capacity expansion. Appropriate adoption of the proposed new planning criteria will create a more resilient system that can be compared upon with developed nations.

Subsidy rationalisation of gas to the Power Sector continues with three price revisions from RM15.20/mmBtu in the period of January – June 2015 to RM19.70/mmBtu in the period of July – December 2016, an increase of 30% in 18 months. Meanwhile, lower coal prices with an average price of between RM10.00/mmBtu to RM11.00/mmBtu in 2015-2016 allowed for tariff rebate ranging from 2.25 sen/kWh to 1.52 sen/kWh in 6 months interval between the period, a reduction of 5.8% from base tariff of 38.53 sen/kWh approved in January 2014.

However, towards the end of 2016, the upward trend of coal prices coupled with weaker Ringgit Malaysia and increased volumes will have a significant impact on the electricity tariff as we move into 2017.



Prospect For 2017



Prospect For 2017

Better economic outlook is anticipated in 2017 whereby the International Monetary Fund in October 2016 has projected recovery of global growth from 3.1% in 2016 to 3.4% in 2017. Policy direction post-presidential election in the United States will be among the key influencing factors affecting the global growth. As such, more clarity can be expected after political transition in the United States is completed.

Being one of the commodity exporter nations, Malaysia is also affected by prolonged lower prices of major commodities such as crude oil, gas, palm oil and rubber. However, as the economy becomes more diversified, Federal revenue dependency on the oil and gas sector reduced markedly from 41.3% in 2009 to 14.6% in 2016. In the 2017 Federal budget presentation, Malaysia's economy is anticipated to grow at between 4.0% to 5.0% in 2017.

In terms of electricity growth, industrial sales is expected to remain subdued while commercial and domestic sectors are projected to contribute significantly towards the overall demand growth. Reasonable y-o-y growth was seen in 2016 even after the El Nino phenomenon subsided in late May. Therefore, electricity sales is projected to grow at between 1.0% to 2.0% while peak demand is projected to grow at between 2.0% to 2.5% in 2017.

Regulatory instruments are further strengthened with the passing of the Electricity Supply (Amendment) Act 2015 and the Gas Supply (Amendment) Act 2016. Existing regulations, codes or guidelines will be revised from time to time while new instruments will be introduced in order to keep up with changes in the industry.

Two new thermal power generation projects are expected to be commissioned in 2017, Pengerang Co-generation Plant with initial export capacity of 400MW scheduled in June and TNB Manjung Five with capacity of 1,000MW scheduled in October. Solar plants under LSS and direct award are expected to start commissioning by year end in addition to renewable energy (RE) plants under the Feed-in Tariff (FiT) scheme. The second phase of the LSS bidding programme for commercial operation in 2019 will start in first quarter of 2017.

The NEM scheme is opened to all domestic, commercial and industrial consumers with total target capacity of 500MW and maximum allowable installed capacity of 1MW peak for commercial and industrial consumers. More consumers can now participate in the scheme as the annual capacity is capped at 90MW (Peninsula) and 10MW (Sabah) for the period between 2016 to 2020. However, based on the initial response, certain requirements will need to be revisited to boost consumer participation.

The Enhanced Time-of-Use Tariff (EToU) scheme that is offered to medium voltage and high voltage consumers under tariff category of C1, C2, E1, E2 and E3 will be extended to low voltage industry under tariff category D starting 1st January 2017. The number of application for EToU scheme is expected to increase since customers under tariff category D will enjoy more benefit under EToU as compared to other categories of customers due to flexibility of their load pattern.

After many years of delay, the 275kV Bukit Tarek - Chubadak transmission line is at the final stage of construction and scheduled for commissioning by second quarter of 2017. The much awaited lines will help ease transmission capacity congestion from the Northern to Central area. For other transmission projects currently under construction stages, approval and physical works will have to be expedited to minimise delay.

The First regulatory period of the Incentive-Based Regulation (IBR) will be completed by end of 2017. Assessment of Key Performance Indicators and overall performance of TNB's regulated business units will be made as IBR turns to the second regulatory period in 2018.

As Malaysia aims to become a high income country post-2020, a higher generation adequacy target may be needed to ensure the reliability of electricity supply does not hamper the economic growth of the nation. Based on early findings and take into consideration losses in relation to economic activities disruption due to supply interruption, the most optimal system cost post-2020 can be achieved at between 30% to 35% reserve margin. Detail deliberation is expected as revision in planning criteria will change the outlook of future capacity planting-up.

The Paris Agreement on climate change, entered into force in November 2016, is expected to influence the direction of future generation planning especially in the Peninsula. As a party to the Agreement, Malaysia has to find ways to mitigate the greenhouse gas (GHG) emission especially by the Energy Sector particularly the Energy Industries: Public Electricity category. Preparing the Third National Communication to the United Nation Framework Convention on Climate Change (UNFCCC), the forms of mitigation measures need to be identified and agreed upon by the stakeholders.

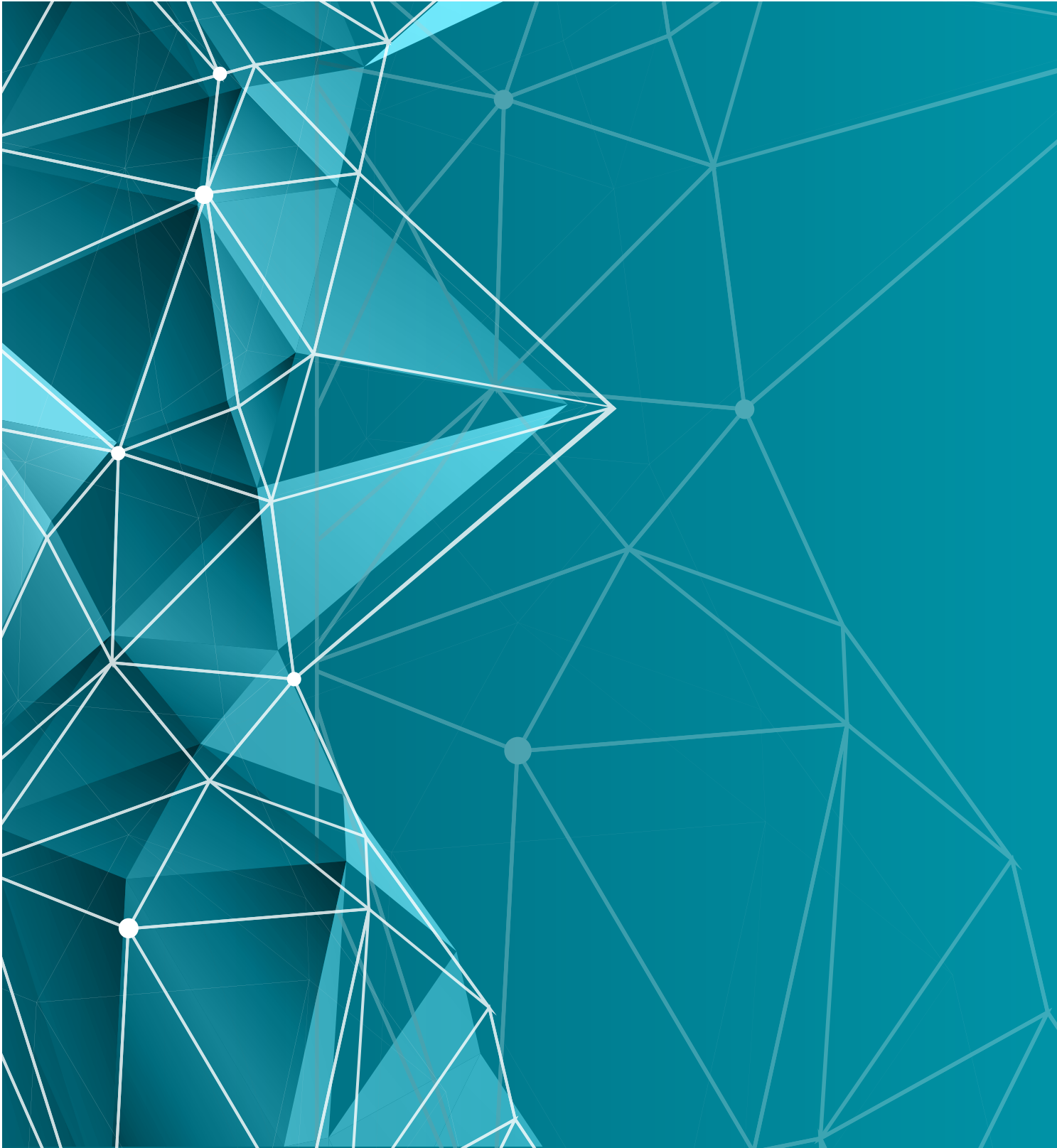
The Government has taken steps to increase shares of renewables in the overall fuel mix through programmes such as Feed-in-Tariff, Large Scale Solar PV, Net Energy Metering and development of new hydroelectric stations. Though reduction can be achieved through these measures, limitation in terms of technology, actual potential and cost are some of the factors that need to be considered if the same measures are to be expanded. Reducing 45% GHG emission intensity of Gross Domestic Product (GDP) by 2030 requires concerted efforts not only from fuel utilisation and technology deployment perspectives but also by implementing effective demand side management programmes.

Relatively low global crude oil price environment represents an opportunity to achieve market price of piped natural gas through deregulation, something the Government has attempted to achieve since 1980s. However, suitable policies, mechanisms and instruments need to be identified to manage possible future gas price volatility and price shock. The study on Managing Deregulated Natural Gas Price Volatility in Malaysia, commissioned by Suruhanjaya Tenaga, was conducted with recommendation to introduce risk sharing package that involves a gradual transition from the current arrangements to a reference market gas price for all. As the reference price will be the single market gas price for all, right sources of gas supply can be accessed while consumers receive the right gas cost signals for investment decision purposes.

The Grid Code and the Distribution Code, instruments to coordinate various activities to ensure secure, reliable and safe electricity supply, are being amended to incorporate the Large Scale Solar PV plants scheduled to enter the system starting 2017. Working Groups under the Grid Code and Distribution Code Committees were formed to study and findings were presented to the Committees, for subsequent approval by Suruhanjaya Tenaga. With the amendments, clear definition of role and responsibilities of all parties and of the processes and procedures to be followed in planning, connecting, operating, dispatching, metering and safe operation of the Grid System will also take into consideration the distinctive aspects of intermittent electricity resources including solar PV.

The World Bank in the Commodity Market Outlook October 2016 has projected crude oil prices to rise to \$55 per barrel in 2017 from an average of \$43 per barrel in 2016, an increase of close to 30%. Similar trend was seen for coal prices that surged by 30% in the third quarter due to strong demand and tightening of supply in China although miners are now allowed to raise output to help ease the prices. Australia coal price is forecasted to reduce by 5% to \$55/mt in 2017 compared to \$58/mt in 2016, though much depends on the coal policy in China. On the other hand, LNG prices to Japan, an important price marker for gas in Asia Pacific, is forecasted to increase to \$7.1/mmBtu in 2017 from \$6.8/mmBtu in 2016. Removal of gas subsidy in Peninsula is expected to continue in 2017. And, while it remains another possibility to ever changing electricity supply environment, surcharges of tariff to consumers could happen should there be price upturns for both coal and gas/LNG.





Performance Review



Brief Economic Review

In the face of global external challenges, Malaysia's economy has recorded growth of 5.0% in 2015, slightly lower than the 6.0% growth recorded in the previous year. The country's economy is anticipated to expand by 4.0% to 4.5% in 2016 before growing at a modest pace by 5.0% in 2017, subject to better growth in world trade, particularly the US, developing economies and emerging markets. Despite lower oil-related revenue, the country's fiscal consolidation remained on track, achieved through reduction in the government's operating expenditures and the implementation of the GST in April 2015. The 2016 growth underpinned mainly by continued expansion in private sector spending and additional support from net exports. Hence, the growth continued to be driven by the major economic sectors in the supply side.

In the last four decades, trading activities have been an engine of growth for Malaysia when it becomes one of the most open economies in the world, with a trade to GDP ratio of 146% (from 2010 to 2015) compared to 60% in developing countries in East Asia and Pacific. The country's main exports have over time gradually diversified into manufacturing with electrical and electronics accounting for 40% of all exports.

On the 2016 real GDP quarter-on-quarter seasonally-adjusted basis, the economy recorded a growth of 1.5% during the third quarter. Domestic demand grew at a more moderate pace in the average of all quarter, as the sustained growth in private sector activity was more than offset by the slower growth in public spending. The private consumption has grown by 6.4% (2Q 2016: 6.3%), supported by continued wage and employment growth as well as the upturn in minimum wage effective 1 July 2016, while private investment registered a growth of 4.7% in the third quarter (2Q 2016: 5.6%), supported primarily by continued capital spending in the services and manufacturing sectors. However, the private investment growth is expected to moderate given a less optimistic business sentiment and as commodity prices and global economic growth remain subdued. Businesses remained cautious in expanding more capacity, following headwinds from the external front, including the UK's EU referendum and uncertainty by Trump's policies.

Growth of public consumption moderated to 3.1% during the third quarter (2Q 2016: 6.5%) as a result of lower spending on supplies and services. Public investment growth tapered by 3.8% (2Q 2016: 7.5%), attributable mainly to lower spending on fixed assets by the Federal Government.

On the supply side, all economic sectors recorded slower growth in 2016 mainly due to modest growth in the construction, manufacturing and agriculture sector. The growth, however, was supported mainly by the services sector and remained as the largest part in the share of GDP activity which recorded a strong growth of 6.1% during the third quarter (2Q 2016: 5.7%). The expansion of services sector was underpinned by the continued expansion in domestic demand, while growth in the manufacturing sector grew at a slower pace of 4.2% (2Q 2016: 4.1%) supported by both export and domestic oriented industries. The growth in construction was slightly lower and shrunk at positive rate of 7.9% (2Q 2016: 8.8%) continued driven by civil engineering activity. However, the agriculture sector growth was negative due to slowdown in palm oil production, attributable largely to the lagged impact of El Nino phenomenon.

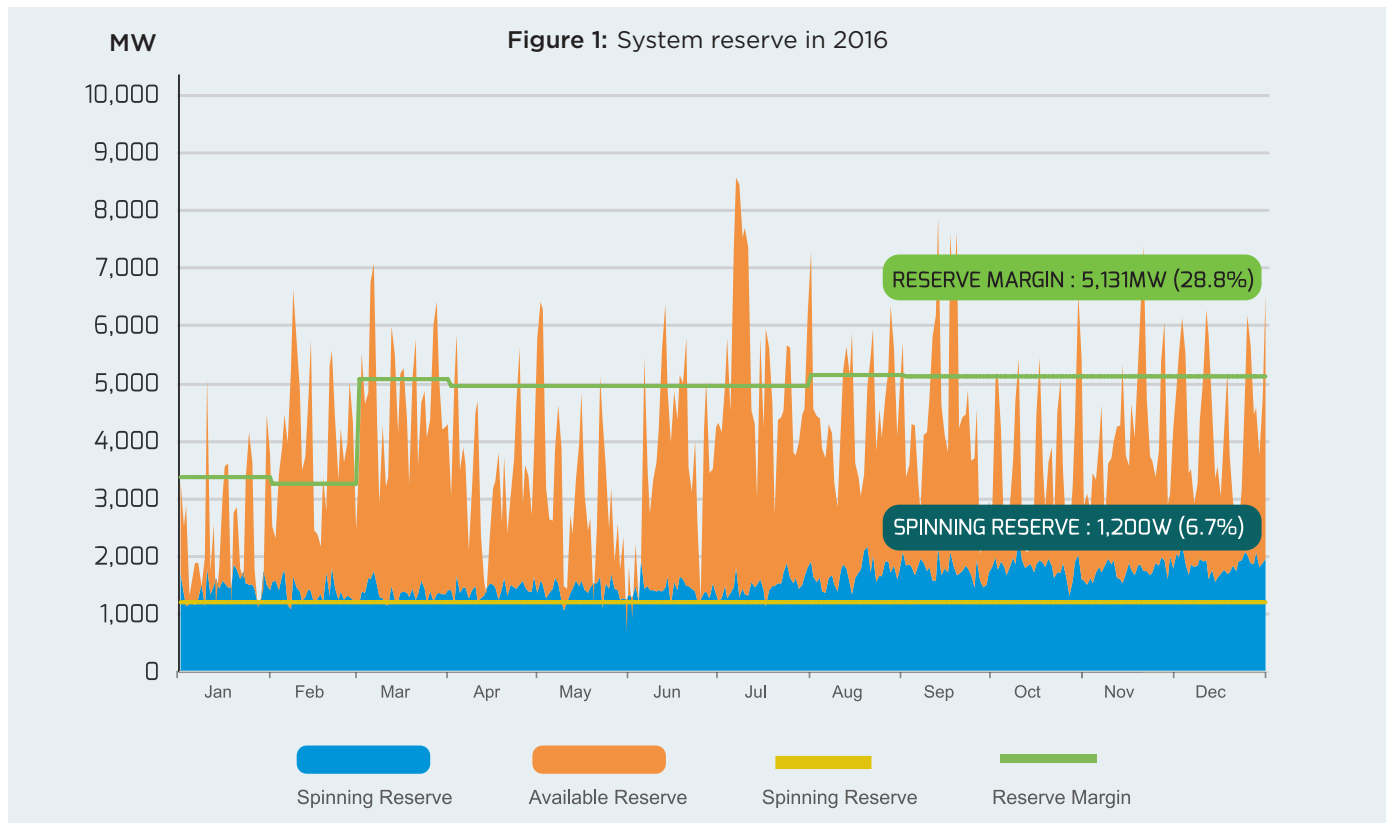


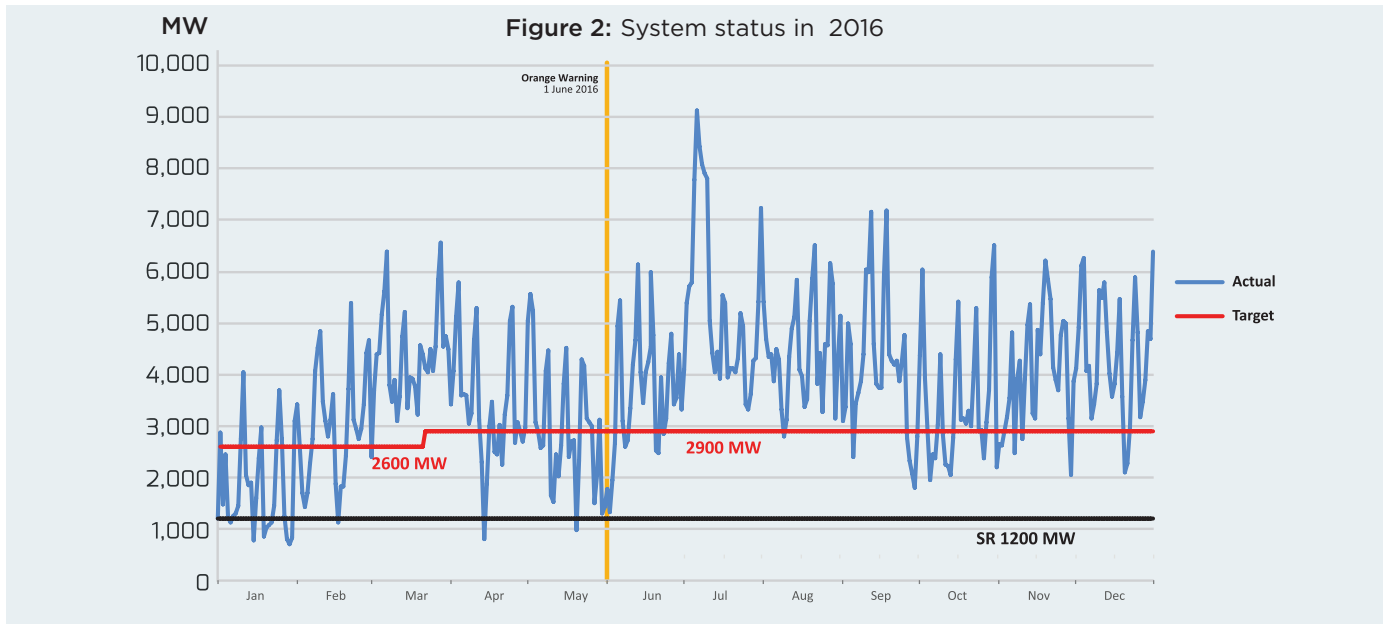
Status Of System Reserve

In the first quarter of 2016, the minimum operating reserve increased to 2,900MW, comprising 12.7% of the total installed capacity. While spinning reserve maintained at 1,200MW, the total operating reserve increased from 1,400MW to 1,700MW due to the commissioning of the next largest coal unit (Tanjung Bin Energy) with a capacity of 1,000MW. Thus, the operating reserve for 2016 – 2019 will remain at 2,900MW until larger CCGT block comes into the system.

Frequent unscheduled downtime of power plants had at all times affected the operating reserve. Although actual operating reserve figures were at times below target, the spinning reserves were allocated and maintained at 1,200MW level. Before the commissioning of the 1,000MW ultra-supercritical coal plant, Peninsular Malaysia's total installed capacity for 2016 was 22,435MW. A total of more than 2,500MW of capacity was added into the system including short term extension of existing plants in order to replace the capacity retirements. In terms of planning, the reserve margin is deemed to increase from 28% in 2016 to 29% in 2017 (peak day of the year). The system reliability criteria set at Loss of Load Expectation (LOLE) of not more than 1 day per year was observed to be met in 2016.

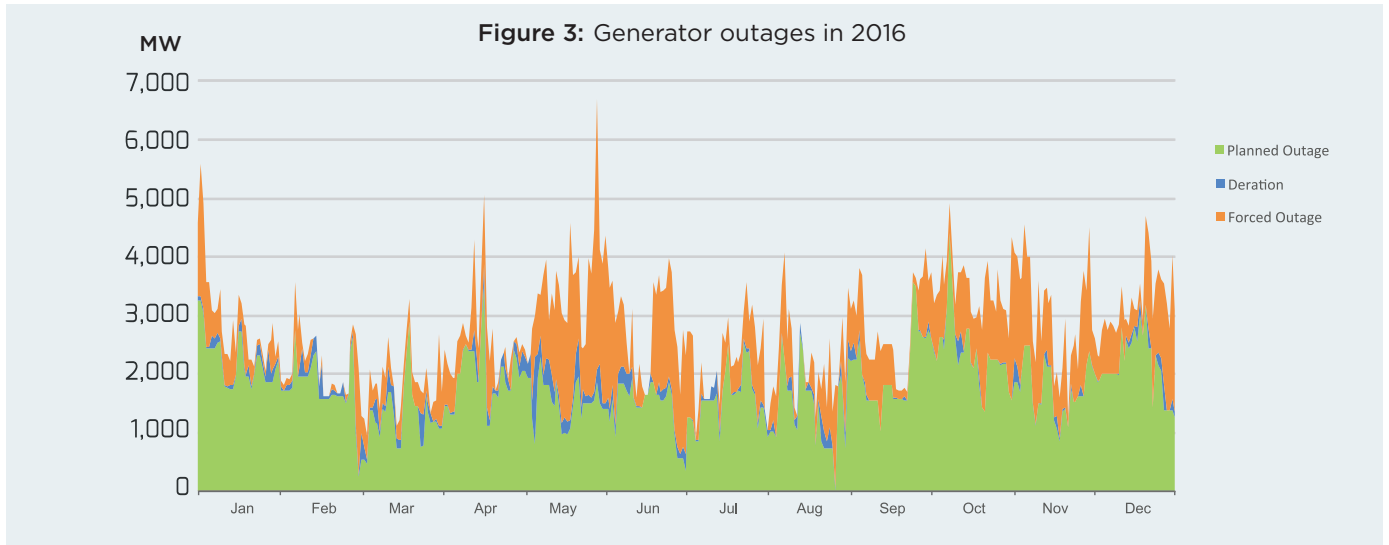
A committee was formed under the Grid Code Committee to conduct a study on the response of 1,000MW ultra-supercritical coal plant technology to the system while ensuring secure and reliable operation in the future. The study concluded that there is no issue or concern in the designed operation and performance of this technology. It is also recommended that the future generation plant to be limited at the block size of up to 800MW in order to maintain system security and reliability.





An orange warning was issued on 1st June 2016 due to sudden shortfall of 3,710MW generation capacity attributed to forced outages of two blocks of TNB Prai (1,071MW), Segari Block 1 (652MW), Tanjung Bin Unit 2 (700MW), Pahlawan GT2 (161MW), Paka GT2A (126MW) and tripping of Tanjung Bin Unit 4 (1,000MW).

On other occurrence, a load shedding event occurred on 19th July 2016 caused by unexpected tripping of Tanjung Bin Unit 4 (1,000MW) as well as Manjung Unit 2 (700MW). The event led to the tripping of AC Interconnector TNB Plentong - Woodland Avenue, and caused system frequency to drop to 49.185Hz. Due to this low frequency, the grid system operator automatically activated the Under Frequency Load Shedding (UFLS) scheme to recover power supply shortly after the event.



Under the Coal Supply Committee, a Boiler Tube Failure task force led by Suruhanjaya Tenaga was commissioned in 2014, with membership comprised of representatives from coal-fired IPPs and fuel supplier. The task force is to study the causes of the boiler tubes failure during the services and to propose suitable recommendations to prevent repeat of such failures. Through the task force, information such as coal consumption, types of coal usage, past incident reports and remedial efforts by the operators is shared between all members. Plant improvisation was an outcome of this taskforce, which had decreased the trend of forced outages throughout the years.

Fuel Supply Situation

Energy pricing reform continues with the revision in prices of gas for power and non-power sectors. For power sector, gas price for consumption of not more than 1000 mmscfd in year 2016 were incrementally revised from RM16.70/mmBtu to RM19.70/mmBtu. Starting 1st January 2017, the price was again increased to RM21.20/mmBtu.

Gas consumption by the power sector from 2014 to 2016 are depicted in the following table:

Table 1: Gas consumption from 2014 to 2016

Year	2014	2015	2016
Average Daily (mmscfd)	1,290	1,218	1,125

Commissioning of the first LNG regasification terminal (RGT) in Sungai Udang, Melaka in 2013 further strengthens the supply capacity by another 500 mmscfd hence rectifies the gas supply constraint to the power sector. Another RGT in Pengerang, Johor is now under construction and expected to come into operation in 2017. This new RGT will add another 3.5 metric tonnes per annum of supply capacity, equivalent to 490 mmscfd of natural gas.

In short, the gas supply system is able to serve current and future electricity demand should there be any undue interruptions in the overall fuel supply chain or changes in the policy direction.

With several new coal power plants coming into the system in the next 5 years, gas consumption is expected to decrease roughly by about 12% in 10 years time. On the other hand, being the base load fuel in the generation mix due to price advantage, coal consumption is expected to increase to more than 30 million tonnes per annum. In the medium term, coal is expected to maintain its position as the most used fossil fuels in the electricity generation.

Coal consumption by the power sector from 2014 to 2016 are depicted in the following table:

Table 2: Coal consumption from 2014 to 2016 (mtpa)

Year	2014	2015	2016
Kapar	3.5	3.7	4.1
Manjung	7.1	10.4	9.5
Jimah	3.2	4.1	4.3
Tanjung Bin	4.9	6.5	7.6
Total (mtpa)	18.7	24.6	25.4



Existing Generation Capacity

The total installed capacity, as of December 2016, stood at 22,919MW inclusive of TNB Prai 1,071MW, TNB Connaught Bridge 375MW, Tanjung Bin Energy 1,000MW, Ulu Jelai Hydro 372MW, and Tembat Hydro U4 7.5MW into the Peninsula grid system. SJ Putrajaya 324MW, SJ Jambatan Connaught 362MW and SJ Pasir Gudang 210MW with a total capacity of 896MW were retired from the system in 2016. Details of the installed capacity by fuel and the list of power plants in operation as of December 2016 are described as follows:

Figure 4: Installed capacity by plant type

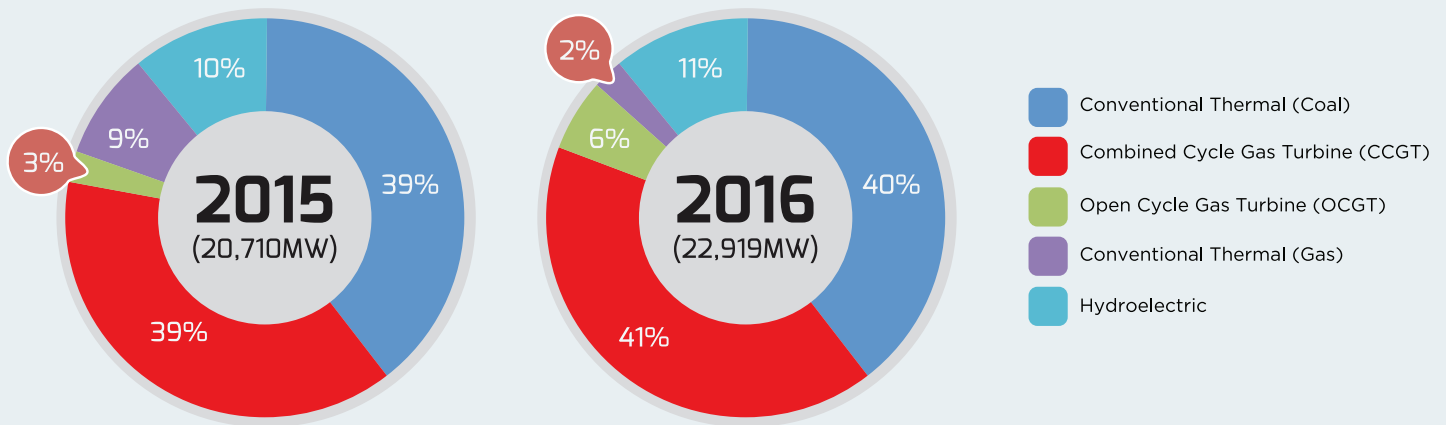


Table 3: Operational power plants

NO.	PLANT	FUEL	TYPE	CAPACITY	EXPIRY PPA/SLA
1	SJ Sultan Ismail, Paka	Gas	CCGT	1,029	Aug 2017
2	SJ Jambatan Connaught, Klang	Gas	CCGT	300	Dec 2018
3	Kapar Energy Ventures Sdn. Bhd.	Gas	OCGT	205	Jul 2019
4	Port Dickson Power Bhd.	Gas	OCGT	436.4	Dec 2019 (Extension)
5	Powertek Bhd.	Gas	OCGT	434	Dec 2019 (Extension)
6	Pahlawan Power Sdn. Bhd.	Gas	CCGT	322	Aug 2020
7	TNB Pasir Gudang Energy Sdn. Bhd.	Gas	CCGT	275	Aug 2022
8	Stesen-stesen Janakuasa Sungai Perak	Water	Hydroelectric	649.1	Aug 2022
9	GB3 Sdn. Bhd.	Gas	CCGT	640	Dec 2022
10	Panglima Power Sdn. Bhd.	Gas	CCGT	720	Feb 2023
11	Teknologi Tenaga Perlis Consortium Sdn. Bhd.	Gas	CCGT	650	Mar 2024
12	Prai Power Sdn. Bhd.	Gas	CCGT	350	Jun 2024
13	SJ Gelugor	Gas	CCGT	310	Aug 2024

NO.	PLANT	FUEL	TYPE	CAPACITY	EXPIRY PPA/SLA
14	SJ Putrajaya	Gas	OCGT	253	Aug 2025
15	SJ Sultan Mahmud Kenyir	Water	Hydroelectric	400	Aug 2025
16	Kuala Langat Power Plant Sdn. Bhd.	Gas	CCGT	675	Feb 2026
17	Segari Energy Ventures Sdn. Bhd.	Gas	CCGT	1,303	Jun 2027
18	SJ Cameron Highlands	Water	Hydroelectric	250	Aug 2027
19	SJ Tuanku Jaafar, Port Dickson	Gas	CCGT	703	Aug 2028
20	Kapar Energy Ventures Sdn. Bhd.	Gas	Conventional Thermal	564	Jul 2029
		Coal	Thermal	1,486	Jul 2029
21	SJ Tuanku Jaafar, Port Dickson	Gas	CCGT	708	Jan 2030
22	TNB Janamanjung Sdn. Bhd.	Coal	Thermal	2,070	Aug 2030
23	Tanjung Bin Power Sdn. Bhd.	Coal	Thermal	2,100	Sep 2031
24	Jimah Energy Ventures Sdn. Bhd.	Coal	Thermal	1,400	Dec 2033
25	TNB Connaught Bridge Sdn. Bhd.	Gas	CCGT	375	Feb 2037
26	TNB Prai Sdn. Bhd.	Gas	CCGT	1,071.43	Feb 2037
27	SJ Pergau	Water	Hydroelectric	600	Aug 2037
28	TNB Janamanjung Sdn. Bhd.	Coal	Thermal	1,010	Mar 2040
29	Tanjung Bin Energy Sdn. Bhd.	Coal	Thermal	1,000	Apr 2041
30	SJ Hulu Terengganu	Water	Hydroelectric	250	Dec 2045
31	SJ Tembat (U4)	Water	Hydroelectric	7.5	Dec 2045
32	SJ Ulu Jelai	Water	Hydroelectric	372	Sep 2046
Total Capacity (MW)				22,919	





Supply- Demand Outlook

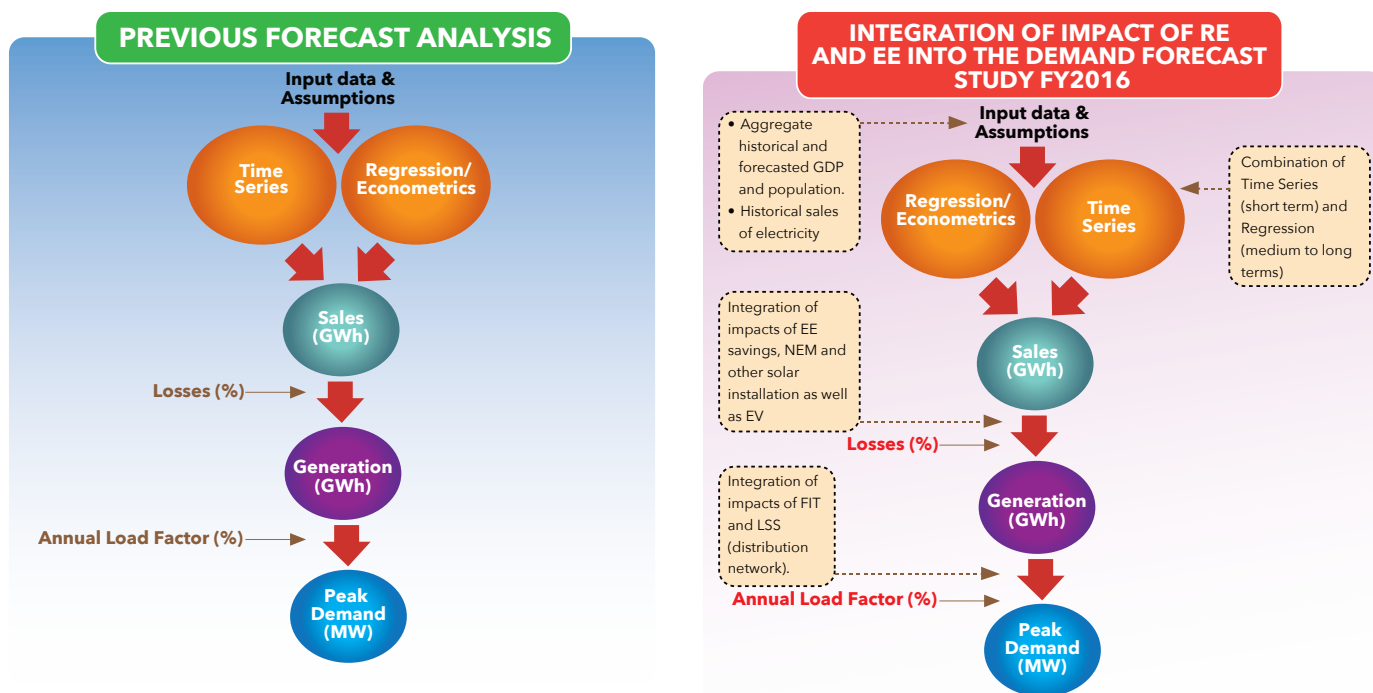


Revised Demand Forecast

Amidst the country’s healthy economic development in 2015, Peninsula however, recorded a negative peak demand growth for the first time in the recorded history. Based on the forecast performance, a variation of -3.8% between the forecasted and actual peak demand has challenged forecasters in the quest to response to the seemingly less correlation between the economic growth and electricity demand. In addition, electricity sales growth continued to decline especially for the last three consecutive years, even though the forecast-actual variation only deviated less than 1.0%.

Key factors contributing towards this less than expected trend includes structural changes in the economy. Increase in electricity tariff has also contributed to the declining sales as consumers changed their consumption behavior and adopted to energy efficiency (EE) measures. Amount of energy generated by RE sources has increased especially through self generation, be it for own consumption or feed-in to the grid system. Whatever the exact reason was, the next forecasting study cycle has successfully incorporated further improvement especially related to those emerging trends described above.

Figure 6: Demand forecast study



RE penetration in the country has increased along with incentives provided by the Government through the FiT mechanism and the recently introduced LSS framework. With that fully executed, the future grid system is expected to be rapidly injected with RE and at the user side, NEM and other unregistered solar installations (below 72kW) will minus off the consumption of electricity.

Recognising this, the Demand Forecast Study FY2016 was enhanced with integration of impact of RE generation and EE savings in its projection analysis of electricity sales, generation and peak demand. Cumulative electricity savings of 11% throughout the forecast horizon, impact of tariff increase, NEM and electric vehicle (EV) at the end-user side, FiT and LSS generation were among the new features of the 20-year forecast horizon. Other main drivers include the state income, socio demographic, technical and historical electricity demand trend, which remained as the commonly correlated factors of electricity demand.

The forecast was completed in February 2016 and was used as input to the generation development plan. In general, the demand forecast was revised downward, incorporating the new features as well as current trend of slow demand in the industrial sector. For FY2016, electricity sales is forecasted to grow at 2.1%, generation at 2.0% and peak demand at 2.9%, lower than the set of forecast earlier approved during the Planning and Implementation Committee of Electricity Supply and Tariff (JPPPET) 1/2015. The revised set of demand forecast was approved by JPPPET in August 2016.

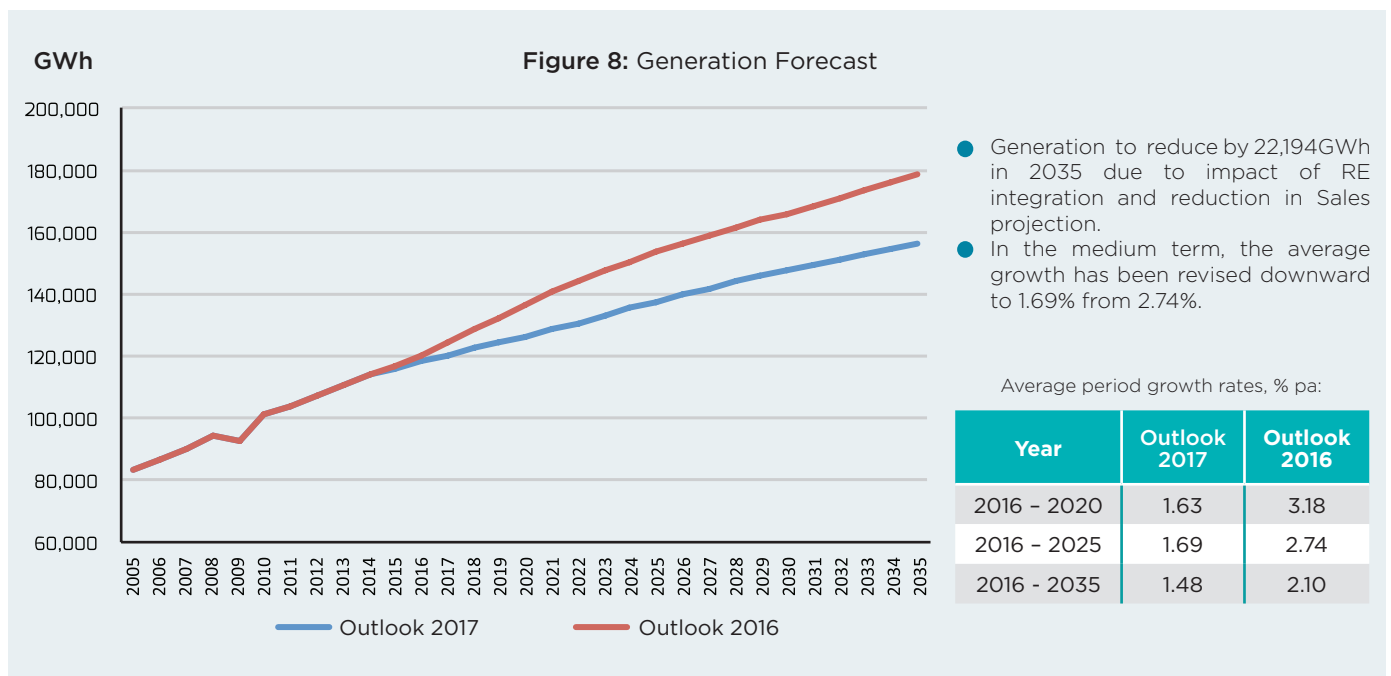
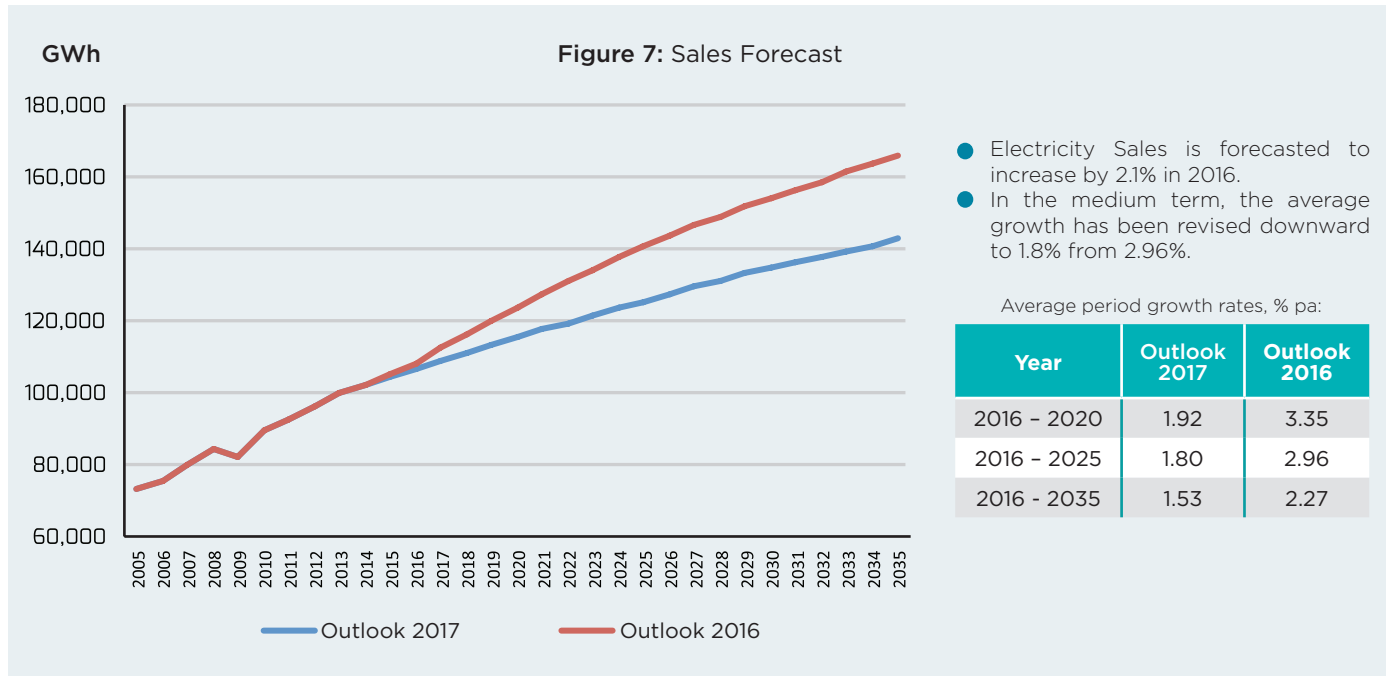
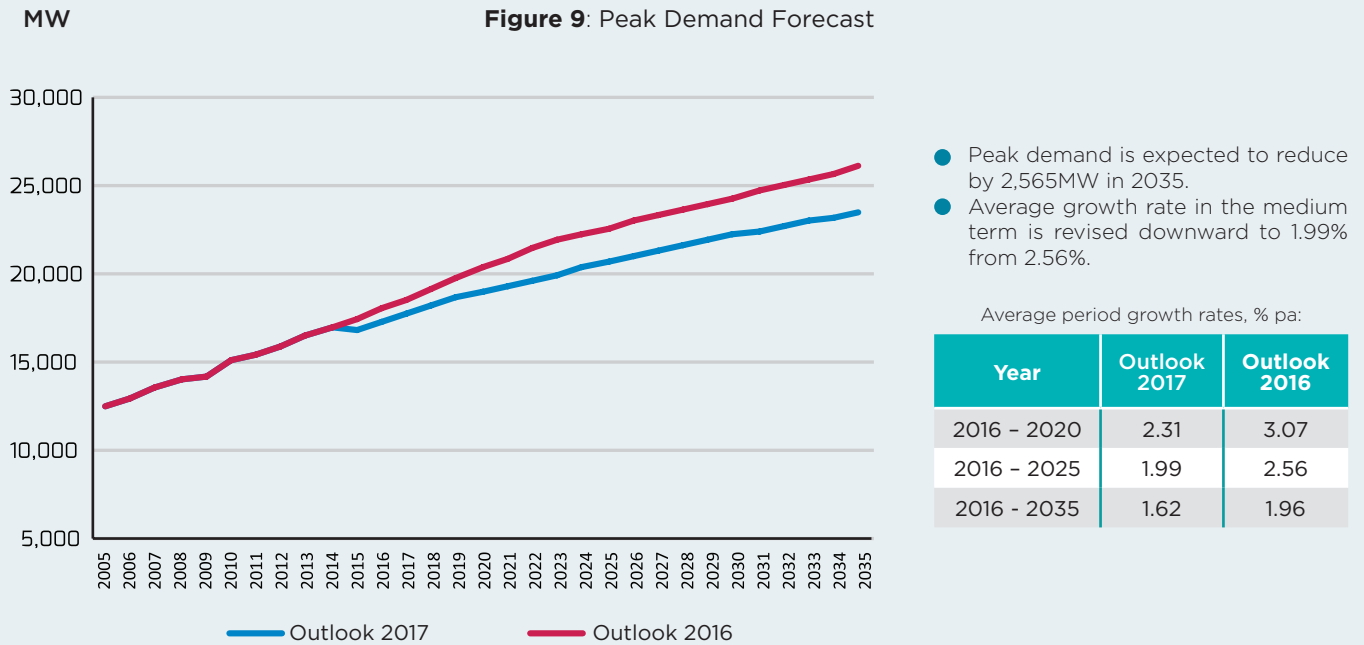


Figure 9: Peak Demand Forecast



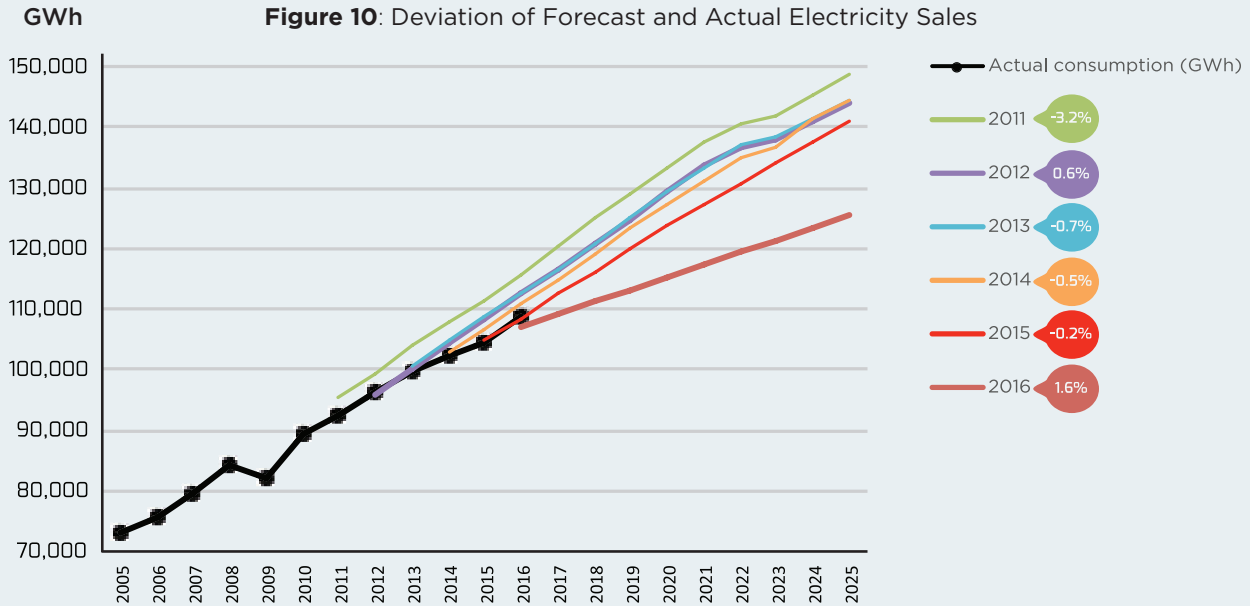
Under the approved forecast, peak demand is projected to reach 17,317MW, to be recorded during March to May - being the expected peak months for current the year. However, a strong El Nino phenomenon struck the country starting December 2015 and lasted until May 2016. The phenomenon impact caused temperature to rise 1-2 degrees above the average, led to a significant increase of electricity consumption especially from domestic and commercial customers due to the higher usage of air-conditioners.

After a negative peak growth recorded in 2015, the new peak demand was achieved on 20th April 2016 at 17,788MW, a 5.2% jumped in terms of growth compared to the previous peak demand of 16,901MW registered in June 2014. The impact of strong El Nino has indeed caused the demand to change dramatically, putting the forecasters in a more difficult situation in envisaging the next forecast cycle.

Increase in temperature has indeed contributed to the increase in electricity sales and generation but it appears that temperature has a significant interrelation with the peak demand. As such, forecasting peak demand independently from the sales and generation projection should be one of the considerations to be constituted in the future study.

Forecasting methodology shall be further improved through end-user forecasting approach, being a common approach used by forecasters in developed country in order to achieve a more accurate projection. A more detailed analysis on customer usage characteristics, capturing weather and temperature impact as well as demand pattern at the sectoral level are among the elements in the end-user forecasting approach. A comprehensive study on this is currently conducted by the Single Buyer and to be included in the next forecast cycle.

The next figure describes the variation of forecast electricity consumption against the actual recorded in the Peninsula.



Demand Forecasting Committee

Suruhanjaya Tenaga is entrusted under the Electricity Supply Act 1990 to ensure that all reasonable demands for electricity are satisfied. The function has therefore placed the responsibility of planning for fulfilling electricity demand on Suruhanjaya Tenaga.

For that reason, the Demand Forecasting Committee (DFC) was established to provide Suruhanjaya Tenaga with independent and objective inputs and advice on Malaysia’s short-term and long-term economic and electrical energy demand growth scenario so that Suruhanjaya Tenaga could forecast the country’s future electricity demand situation with more precision.

On 4th May 2016, the first DFC meeting was held with participation from 15 agencies whose membership is appointed by the Chairman of Suruhanjaya Tenaga. The DFC members comprise representatives from both public and private sector organisations which are involved in the national economic development planning and energy sector planning and forecasting. The main objective of the first meeting was to introduce members on the framework of electricity demand forecasting including the current studies conducted by both Single Buyer Departments of TNB and SESB.



The first DFC meeting was held with participation from 15 agencies whose membership is appointed by the Chairman of the Suruhanjaya Tenaga.

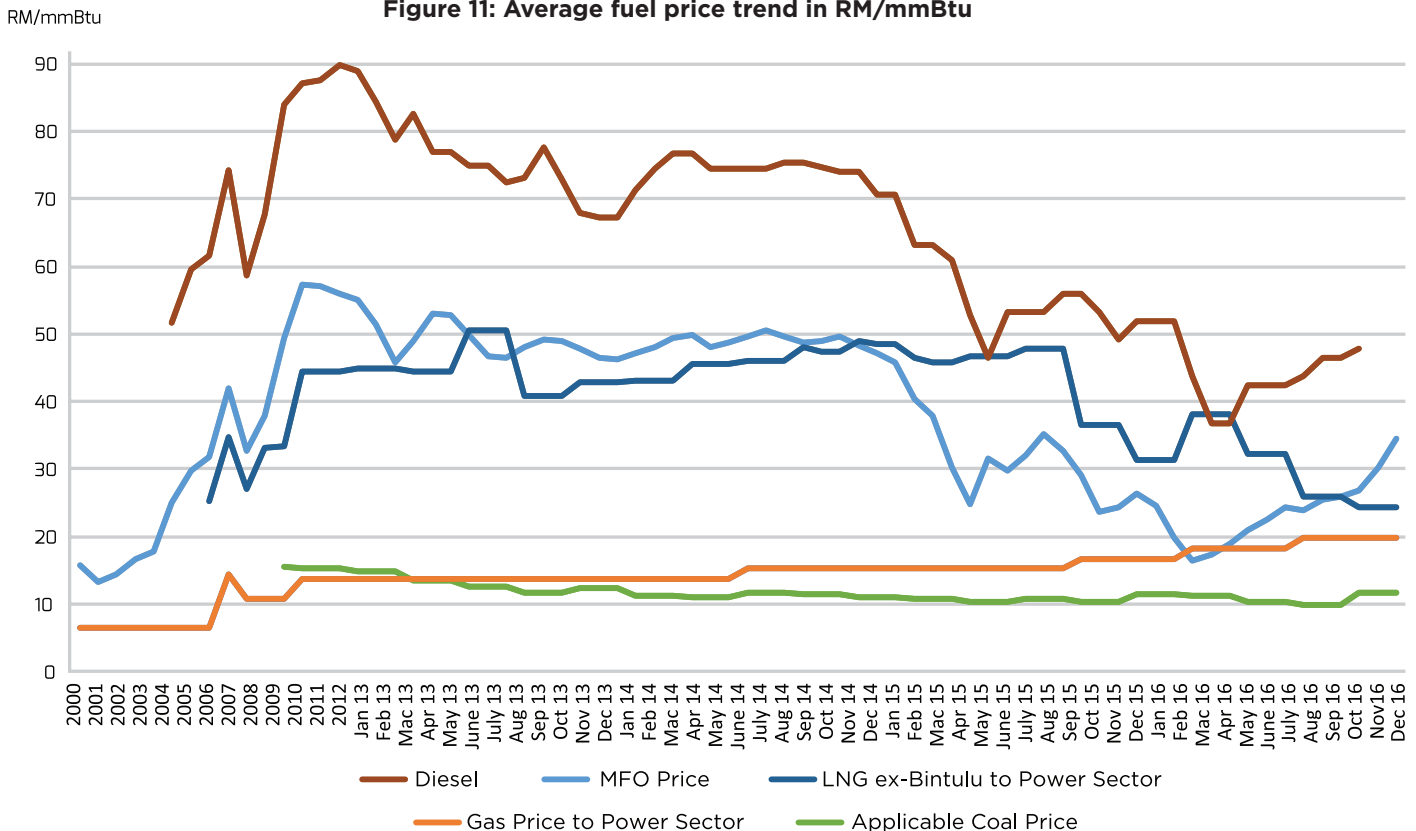
Fuel Pricing

The Government continues its efforts to rationalise subsidies of fuel and gas by increasing the price of piped gas by RM1.50/mmBtu every 6 months to reach its market price. From January until June 2016, the regulated price of piped gas increased to RM18.20/mmBtu from previous price of RM16.70/mmBtu (July - December 2015). The price continues to increase by another RM1.50/mmBtu to reach RM19.70/mmBtu (July - December 2016). Due to the decrement of global oil price, the gap between regulated price and market price is now reduced to around 20%.

Apart from piped gas price, the determination of electricity tariff also includes LNG and coal which are set at market prices. Coal being the cheapest fuel option to the system is set through the Applicable Coal Price (ACP) mechanism and stabilised at RM10.51/mmBtu in 2016, despite its lowest level of RM9.89/mmBtu during third quarter of the year. However during the latest ACP meeting, the coal price projection for first quarter of 2017 will increase to RM16.62/mmBtu. The increment is due to an increase in economic activities from developing country such as China. The price of LNG for power sector to be charged for gas consumption above the threshold of 1000 mmscf, hovered on average of RM30.12/mmBtu and this value has been constantly higher than the regulated gas price. Nevertheless, the price is still lower than diesel at an average of RM41.80/mmBtu.

Under the Incentive-Based Regulation (IBR) framework, electricity tariff consists of two components, base tariff and the ICPT. Base tariff are set at 38.53 sen/kWh from January 2014 until December 2017, being the first 3-year of TNB regulatory period after a year of trial in 2014. Whilst for ICPT, fuel and other generation costs will be reviewed every 6 months to reflect changes between the actual costs against the forecasted cost as determined under the base tariff. From this arrangement, the amount of cost pass through gained by customer during the two ICPT cycles in 2016 as translated into electricity tariff rebate is 1.52 sen/kWh.

Figure 11: Average fuel price trend in RM/mmBtu



Committed Generation Projects

Additional capacity of 9,171MW from 12 committed generation projects will be commissioned in 2017-2023 against plants retirement of 6,256MW. The new projects consist of 5,282MW capacity from gas, 3,000MW from coal and 889MW from hydro. Apart from extension of existing plants, timely commissioning of new projects is very critical in order to meet the 2.3% demand growth during the short term window.

Pengerang Co-generation Plant, a project under Pengerang Power Sdn. Bhd. a wholly owned PETRONAS subsidiary, is able to generate 1,220MW of electricity as well as 1,480 tonne per hour of steam in the PETRONAS Pengerang Integrated Complex (PIC) in Pengerang, Johor. 600MW of the electricity generating capacity will be used to supply to the Peninsula grid - 400MW in 2017 and additional 200MW in 2019. This project also covers the double circuit 275kV transmission line from PIC to PMU Tanjung Langsung with total span of 51.2km.

TNB Manjung Five project is developed based on proven ultra-supercritical technology in continuation of a series of such technology deployment in the country. The technology aims to promote higher efficiency of coal plant for less requirement of coal per MWh, leading to lower carbon emission as well as lower fuel cost. After being awarded through a competitive bidding exercise in 2013, the project development is progressing well and expected to be commissioned in October 2017.

Table 4: New generation projects

No.	Project	Fuel	Capacity (MW)	COD
1	Hulu Terengganu (Tembat)	Water	15	U1: June 2017 U2: Dec 2016
2	Pengerang Power Sdn. Bhd.	Gas	400	June 2017
3	TNB Manjung Five Sdn. Bhd.	Coal	1,000	Oct 2017
4	Pengerang Power Sdn. Bhd.	Gas	200	Jan 2019
5	Jimah East Power Sdn. Bhd.	Coal	2,000	U1: June 2019 U2: Dec 2019
6	SIPP Energy Sdn. Bhd.	Gas	1,440	Jan 2020
7	Edra Energy Sdn. Bhd.	Gas	2,242	Jan 2021
8	Tekai	Water	168	Jul 2021
9	Nenggiri	Water	300	U1: Apr 2022 U2: July 2022 U3: Sep 2022
10	Tadmax Resources Bhd.	Gas	1,000	Jan 2023
11	Telom	Water	132	Oct 2024
12	Lebir	Water	274	U1: Dec 2022 U2: Mar 2023

Operational Extension Of Existing Plants

Port Dickson Power and Powertek are the existing plants that have been operationally extended to supply 436MW and 434MW power respectively to the grid until 2019 through competitive bidding practice. The extension of SJ Sultan Ismail, Paka of 257MW had also been approved until the end of 2019. Whereas, the extension of YTL, at the point of writing, has shown little progress and pending the outcome of a judicial review.

The extensions were made due to the delay of committed projects such as SIPP Pasir Gudang (1,440MW) and Northern corridor curtailment was caused by the delay of the 500kV Ayer Tawar – Bentong South new transmission line.

Table 5: Short term extension of existing plants

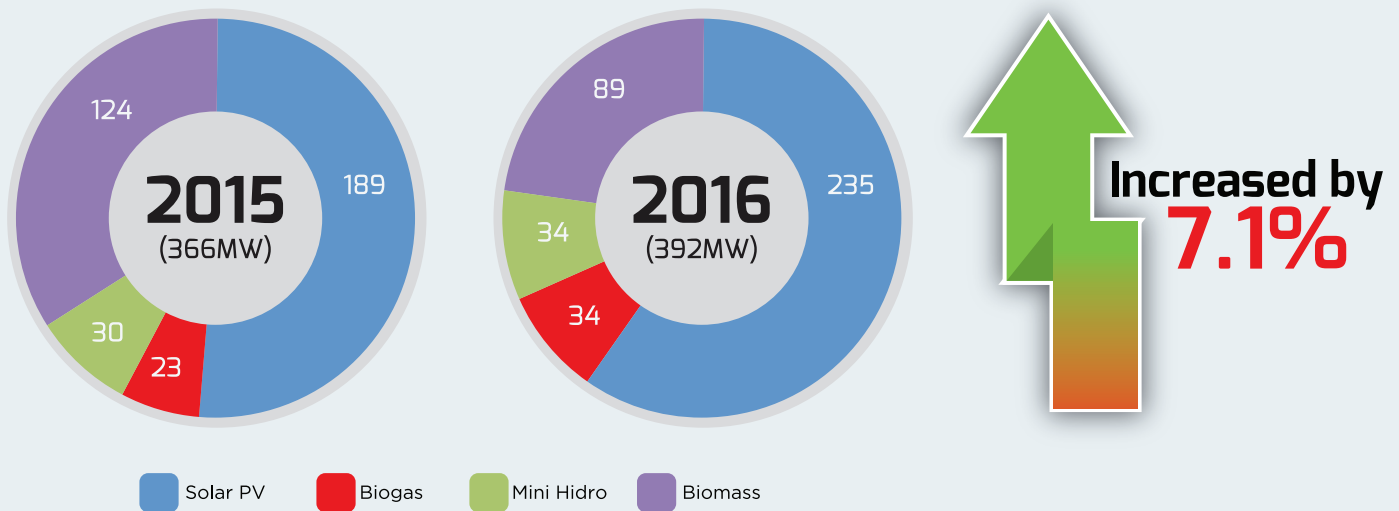
Plants	Capacity (MW)	Fuel	Expiry Date
YTL Power Generation Sdn. Bhd.	585	Gas	Pending finalisation of agreement
Port Dickson Power Sdn. Bhd.	436	Gas	31 Mar 2019 (3 years)
Powertek Bhd.	434	Gas	31 Dec 2019 (3 years 10 months)
SJ Sultan Ismail, Paka (GF4)	257	Gas	Pending finalisation of agreement



Renewable Energy

In line with the Eleventh Malaysia Plan, RE as an alternative energy source is identified to support the continuous increase of energy demand complemented by EE measures. Currently, Peninsula has a total licenced capacity of 392MW, mostly fuelled by solar PV (235MW), followed by biomass (89MW), mini hydro (34MW) and biogas (34MW). The chart below shows the increment of the licenced capacity for RE from 2015 to 2016 (y-o-y basis):

Figure 12: RE capacity mix (MW) in Peninsular Malaysia (2015 vs 2016) y-o-y



In the Eleventh Plan, major focus will be given in exploring new RE sources, and implementing NEM to further intensify the development of RE. Studies will be conducted to identify new RE sources to diversify the generation mix. New RE sources such as wind, geothermal and ocean energy will be explored.

To complement the FiT mechanism in encouraging the take-off of RE, NEM is implemented in 2016 to promote and encourage more RE generation, by prioritising internal consumption before any excess electricity generated is fed to the grid. NEM is anticipated to encourage manufacturing facilities and the public to generate electricity. This will further assist the Government's effort to increase the contribution of RE in the generation mix.

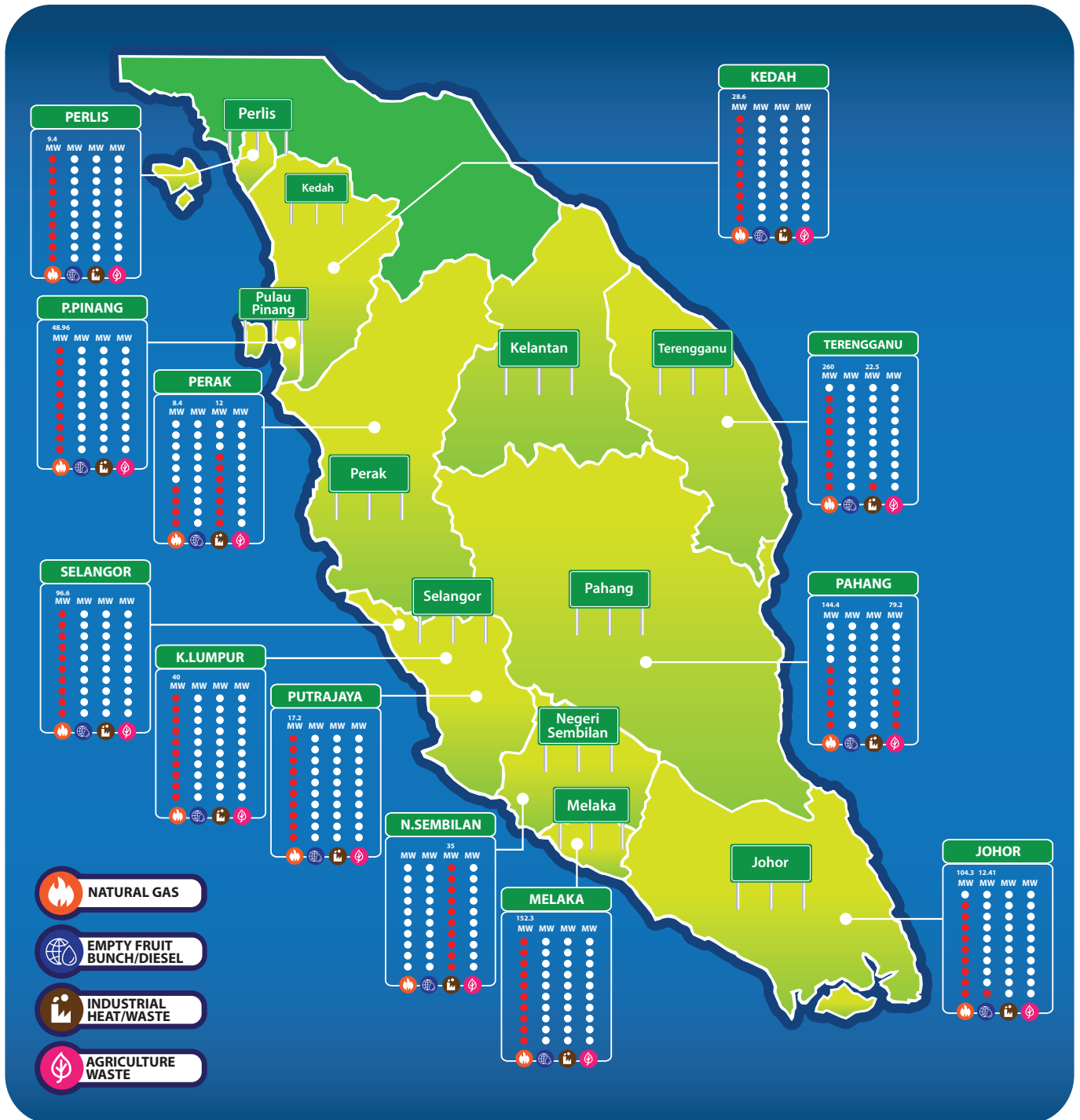
On the other hand, several biomass based power plant projects have experienced several problems in development in terms of securing fuel supply and technical matters. In 2016, Suruhanjaya Tenaga has cancelled three biomass licences due to unfeasible conditions.

A total of 1,000MW LSS projects will be introduced starting in 2017. 800MW from the total capacity will be awarded by competitive bidding in order to get the most competitive price. The 800MW capacity will enter the system by stages, which is 200MW every year from 2017 to 2020.

Figure 13: Peninsular Malaysia RE projects



Figure 14: Peninsular Malaysia Co-generation projects

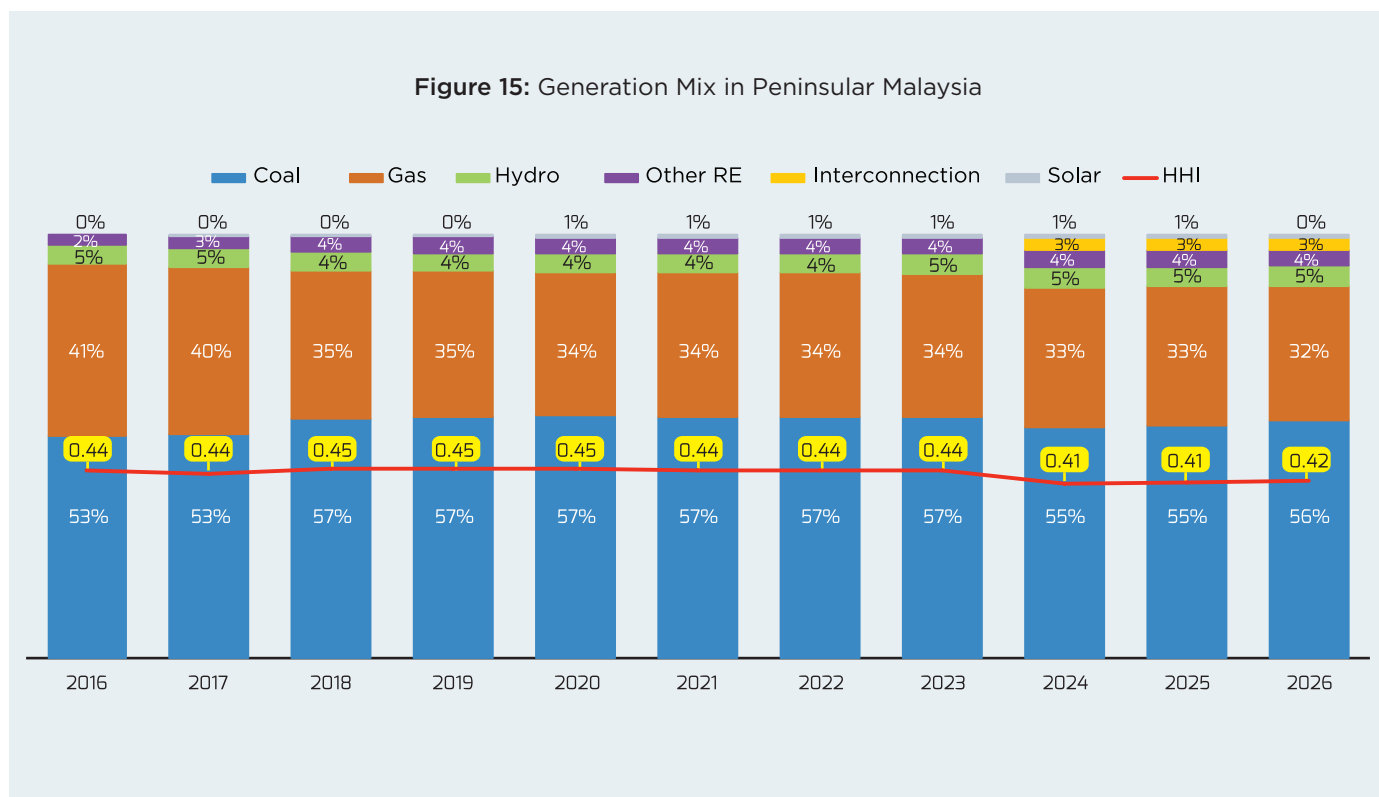


Projected Generation & Capacity Mix

The revised generation mix shows a reduced dependency on natural gas, primarily due to the retirement of gas turbine plants as well as new developments of coal power plants.

Development of hydro power plants are expected to come on stream post-2020 being among the last hydro potential in Peninsula. Serving as peaking units, it is anticipated that hydro energy will maintain its share at 5.0% from 2016 to 2017 and reduce slightly to 4.0% during the window 2018 to 2022. Although the total energy generated by hydro units each year remains almost the same, its share reduction is merely due to the upcoming coal and gas plants, as well as increment of generation from solar sources.

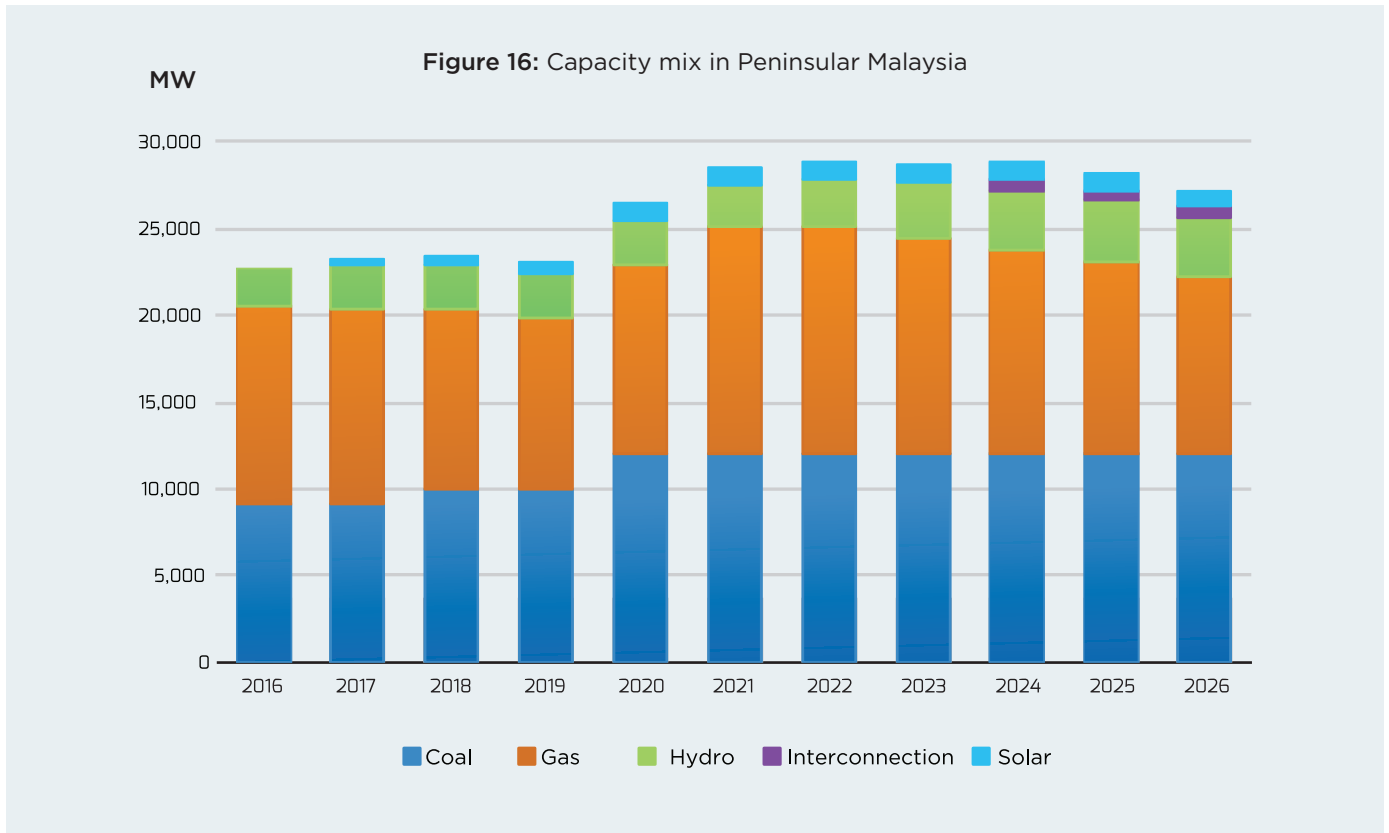
Figure 15: Generation Mix in Peninsular Malaysia



Initiatives to harvest energy from the sun with installation of 200MW per year under the LSS programme integrates solar into the grid system with a share of 0.14% during its first year in 2017 and increased up to 0.5% by year 2020. This share is projected based on several assumptions such as solar output intermittency as well as its distinctive output profile.

The future capacity mix incorporates potential power import from Sumatera, being one of the ASEAN Power Grid initiatives, beginning year 2024. The power to be supplied through this interconnection is rated at 80% of its maximum capacity. System dependency on gas is projected to reduce to an average of about 5.0% with reduction of greenhouse gas emission (GHG).

Reduction of GHG from electricity supply industry requires concerted effort from both supply and demand sides. To certain extent, replacement of coal capacity with gas can help reduce the emission but with expected increase in the cost of supply. Adding more solar capacity can help reduce some of the GHG emission but with output limitation. In this respect, efforts should also be intensified to have more electricity generated from non-solar renewable energy sources such as hydro and biomass.



Transmission Development Plan

The latest demand forecast indicated that the load will grow steadily at an annual growth rate of about 1.9% until 2026. This translates into an expected peak demand of 20,989MW in 2026 from 17,317MW in 2016. Several existing power plants will be retired within the next 10-year period. Thus, new generation capacity is required to ensure supply adequacy.

Based on the latest Generation Development Plan approved by the JPPPET, ten power plants will be commissioned in the next 10 years. In relation to the generation development, several major 500kV transmission projects, involving new lines and substations, are being constructed.

Table 6: 500kV transmission projects

No	Project
1	500kV overhead lines between Ayer Tawar to Bentong South
2	500kV overhead lines between Bentong South to Lenggeng
3	500kV overhead lines between Lenggeng to Yong Peng East

Once completed, these 500kV transmission lines and substations will reinforce supply into the Central area. These 500kV grid would also become the backbone of Peninsular Malaysia's transmission system, opening the possibility of having multilateral electricity trading via the ASEAN Power Grid.



Central area represents about 42% of the total load in Peninsular Malaysia. However only 27% of the power is generated locally. The power deficit is remedied through power import from other areas, primarily from the Northern and Southern areas. Complementing the 500kV grid, the 275kV network system will also need to be reinforced. This is to ensure power is safely delivered to the load centres. Some of the 275kV reinforcement projects are as listed below:

Table 7: 275kV transmission 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
4	Upgrading of 275kV Pantai - Salak South underground cable from 500MVA per circuit to 1,000MVA
5	275kV overhead lines from UKM to Serdang substation
6	275kV overhead lines from Bukit Unggul to Serdang East and from Bukit Unggul to Serdang substation

As evident in Europe, regional electricity interconnection has brought about tangible benefits in terms of overall system cost reduction and improved supply security in addition to providing avenue for better business community integration. In ASEAN, the ASEAN Power Grid initiatives were mooted in 1997, with mixed results almost 20 years after adoption of the agenda in the Second ASEAN Informal Summit in Kuala Lumpur.

No	Connection	Project	Status
1	Peninsular Malaysia - Thailand	132kV Sadao - Bukit Ketri (80MW)	<ul style="list-style-type: none"> Existing interconnection is at 132kV/115kV. Commissioned in year 1981. No plan to upgrade to higher rating.
		Sungai Kolok - Rantau Panjang	<ul style="list-style-type: none"> No progress Electricity Generation Authority of Thailand (EGAT) has expressed interest for connection in 2008 / 2009. Technically, the interconnection has been found to be feasible. Several discussions were held regarding the Purchase Agreement but it was not concluded due to unresolved commercial terms.
		HVDC Gurun East - Khlong Ngae (300MW)	<ul style="list-style-type: none"> Existing HVDC interconnection was commissioned in 2002. Several discussions were held on the proposal to upgrade existing HVDC from 300MW to 600MW. However, this project was not pursued further as the project cost was not economically feasible at the point of time.
2	Peninsular Malaysia - Singapore	Upgrading HVAC 2x250MVA to 2x600MVA	<ul style="list-style-type: none"> Tender for cable is ongoing. Tender for other equipment will be issued in Q2 2017. The target completion of circuit #1 is Dec 2019 and full upgrading in 2021.
3	Peninsular Malaysia - Indonesia	Proposed HVDC 500MW by 2025	<ul style="list-style-type: none"> Engineering and feasibility studies were completed and ready for tender folatation in May 2015. PLN wanted to defer the project to focus on the development of 35GW new generation capacity for domestic requirement. This interconnection project is managed as a Government to Government (G-G) through Joint Technical Committee.
4	Peninsular Malaysia - Sarawak	Proposed 2,000MW interconnection	<ul style="list-style-type: none"> The project was one of the proposed plans in the ASEAN Power Grid.

The snapshot of the 500kV and 275kV networks for 2018 and 2021 are as shown in Figure 17(a) and 17(b);

Figure 17(a): 500kV & 275kV network in 2018

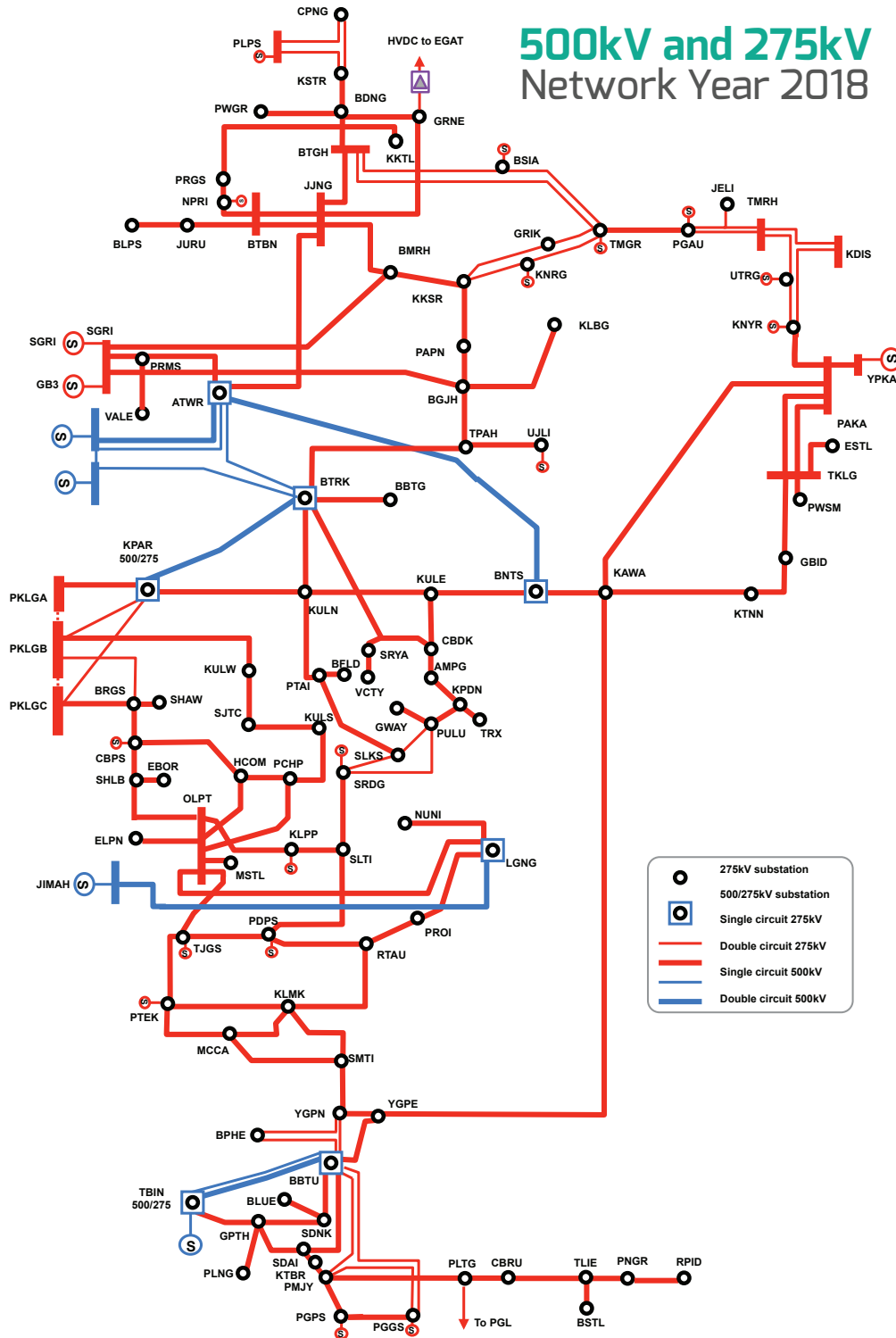
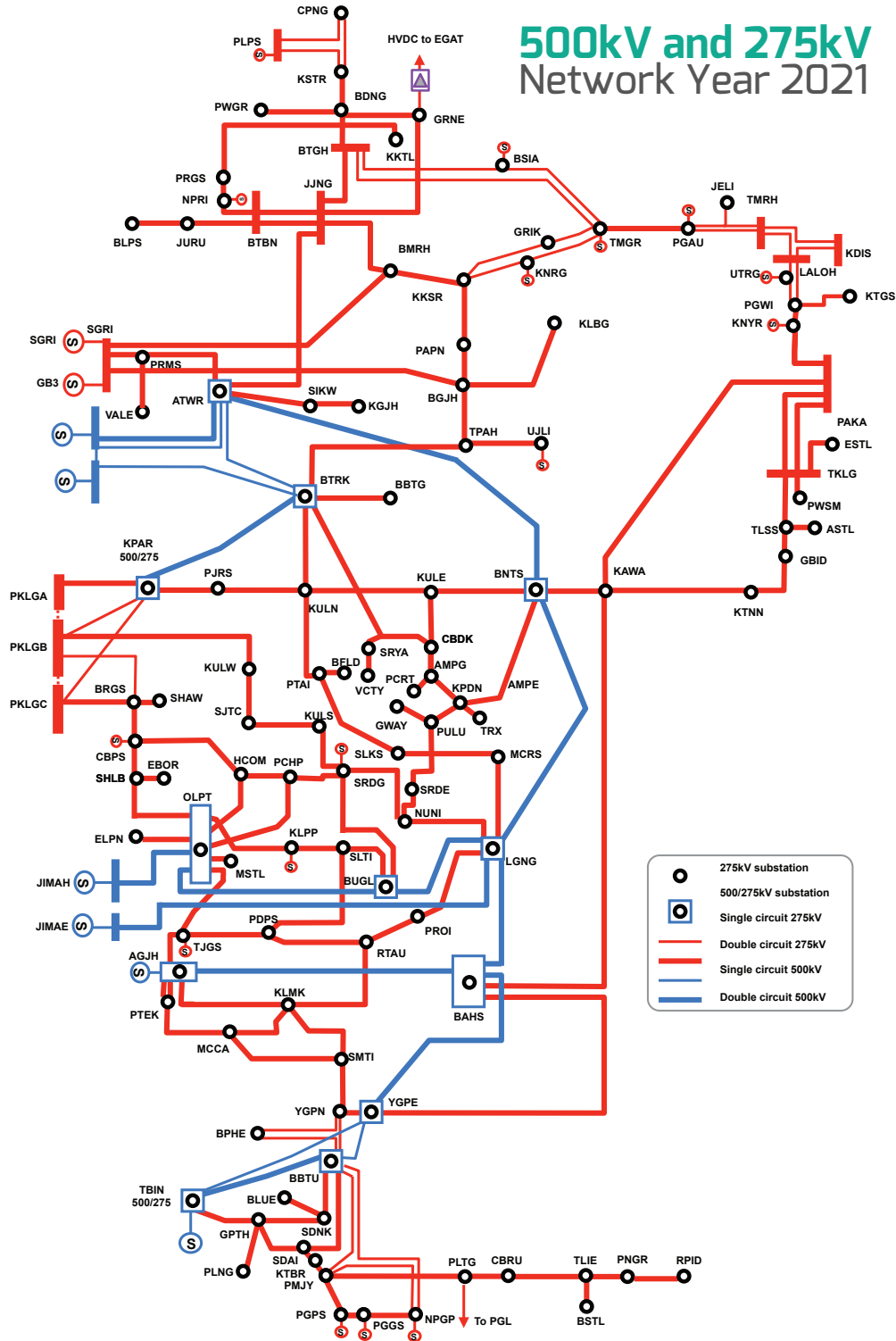


Figure 17(b): 500kV & 275kV network in 2021





Industry Reform • Initiatives

The background is a solid teal color. On the right side, there is a white geometric pattern of interconnected lines forming a network or mesh. A single white dot is positioned to the right of the word 'Reform', with a thin white horizontal line extending from the dot to the right, where it meets the geometric pattern.

Large Scale Solar Photovoltaic Plant

The Jawatankuasa Perancangan dan Pelaksanaan Pembekalan Elektrik dan Tariff (JPPPET) on 18th August 2015, has agreed on LSS programme for a duration of four years starting 2017 until 2020. Suruhanjaya Tenaga was entrusted by the Government to conduct the bidding process by inviting private sector companies to build, own and operate Large Scale Solar PV (LSSPV) plants to supply and sell energy to the utilities under long term power purchase agreements.

This initiative will be implemented in phases and at suitable locations with appropriate capacities in order not to affect the reliability and security of the power supply systems as well as not to have major impact on the electricity tariffs for the consumers. The capacity allocated for the LSS programme is 1,000MW by 2020 with annual capacity capped at 200MW for four years of implementation starting 2017. The capacity to be procured is implemented through competitive bidding process.

To ensure the successful and timely completion of these LSSPV plants to meet the capacity target for the power sector, Suruhanjaya Tenaga has conducted a pre-qualification exercise in March 2016 to short-list industry players with suitable technical and financial capabilities as per criteria set forth in the Request for Qualification (RFQ) document. Depending on the qualifications, the entities that satisfy the requirements in the pre-qualification exercise are invited to participate in the Request for Proposal (RFP) for the LSSPV plants.

RFP is an invitation for Bids from Qualified Participants to finance, design, supply, build, own, operate and maintain LSSPV plants to supply and sell energy produced by the solar PV plants to the electricity supply utilities in Peninsula, Sabah or Labuan. Successful Bidders will be required to enter into a power purchase agreement for a term of 21 years with the electricity supply utility.

Figure 18: LSS Bidding Schedule



Figure 19: LSS location and capacity awarded



Net Energy Metering

Suruhanjaya Tenaga has been entrusted by the Government to increase the capacity of solar PV installations in the power sector by introducing net energy metering arrangement to facilitate consumers to install solar PV systems for self-consumption and supply any excess energy to the electricity supply utilities.

The annual allocation of the capacity according to categories of consumers is as per **Table 8**.

Table 8: Annual allocation of capacity

Location		Peninsula				
Year		2016	2017	2018	2019	2020
Category of consumers	Domestic/Residential, MW	20	20	20	20	20
	Commercial, MW	35	35	35	35	35
	Industrial, MW	35	35	35	35	35
Sum, MW		90	90	90	90	90
Total, MW		450				

On 6th October 2016, the Honorable Minister of Energy, Green Technology and Water launched the NEM scheme which will complement the current FiT mechanism. This scheme is to encourage the deployment of RE as meted out in the Eleventh Malaysia Plan (RMK-11).

The Net Energy Metering (NEM) applicant shall be a registered consumer of the Distribution Licensee (DL) in the Peninsula, Sabah and Labuan. Connection type of NEM scheme to the Distribution Licensee Network shall be done only through indirect connection. Prior to the approval of NEM application, the applicant shall perform NEM Assessment Study to determine the technical feasibility of connecting proposed installation to the Distribution Licensee's electricity distribution network. The findings of the study will assist the NEM applicant to decide on the feasibility of the project in terms of cost and assist the Distribution Licensee to prepare the technical requirements needed for interconnection.

For NEM, the credit to consumer will be based on prevailing gazetted displaced cost for the relevant supply voltage level at the point of common coupling. The calculation for the net billing of electricity will be based on the following calculation:

$$\text{Net billing} = (\text{Energy Consumed from DL (kWh)} \times \text{Gazetted Tariff}) - (\text{Energy Exported to DI} \times \text{Displaced Cost})$$

The net electricity consumption or credit shall be allowed to roll over for a maximum of 24 months and any available credits after 24 months will be forfeited.

SEDA Malaysia, entrusted under the SEDA Act 2011 to implement sustainable energy laws has been appointed by Suruhanjaya Tenaga as the implementing agency for the scheme and will conduct a stakeholder's engagement to provide highlights on the NEM scheme mechanism. This includes the following roles:

- To administer the quota of NEM
- To administer the NEM website.
- To process the NEM application and issue NEM approval
- To collect processing fee of RM10/kW
- To ensure NEM consumers authorise Suruhanjaya Tenaga Registered Electrical Contractor or SEDA's Registered PV Service Provider (RPVSP) to lodge their applications on their behalf
- To ensure installation of PV system is carried out by Suruhanjaya Tenaga Registered Electrical Contractor
- To monitor the implementation of NEM

Towards the implementation, SEDA has developed an online registration system for electrical contractors to submit the application on behalf of their clients.

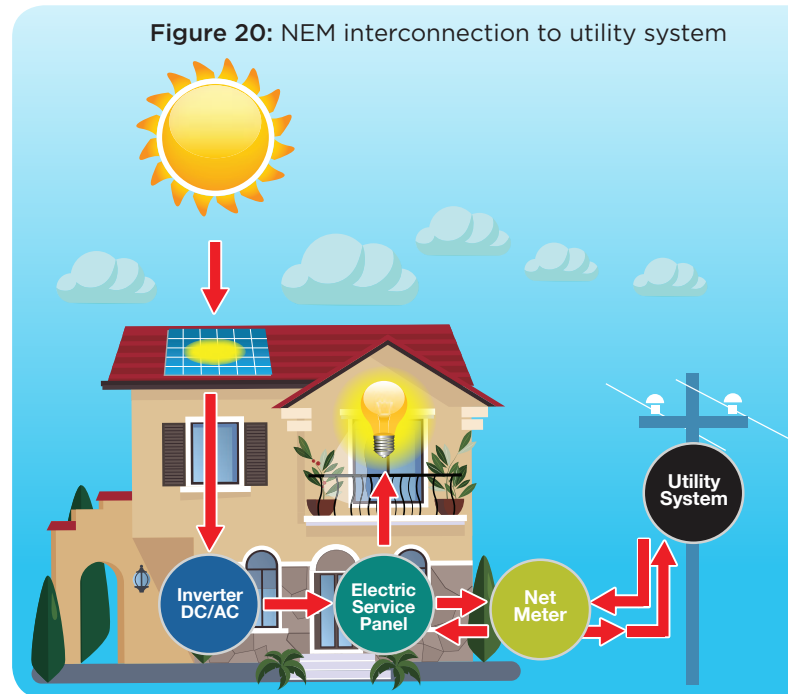
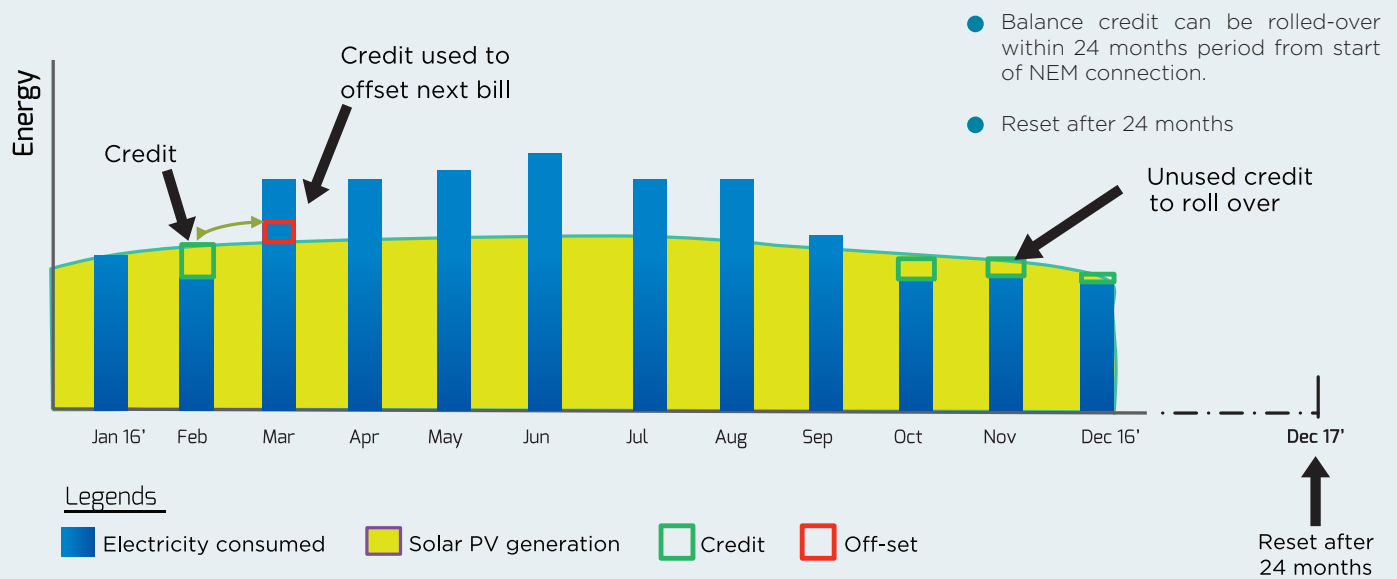


Figure 21: NEM mechanism



New Enhanced Dispatch Arrangement

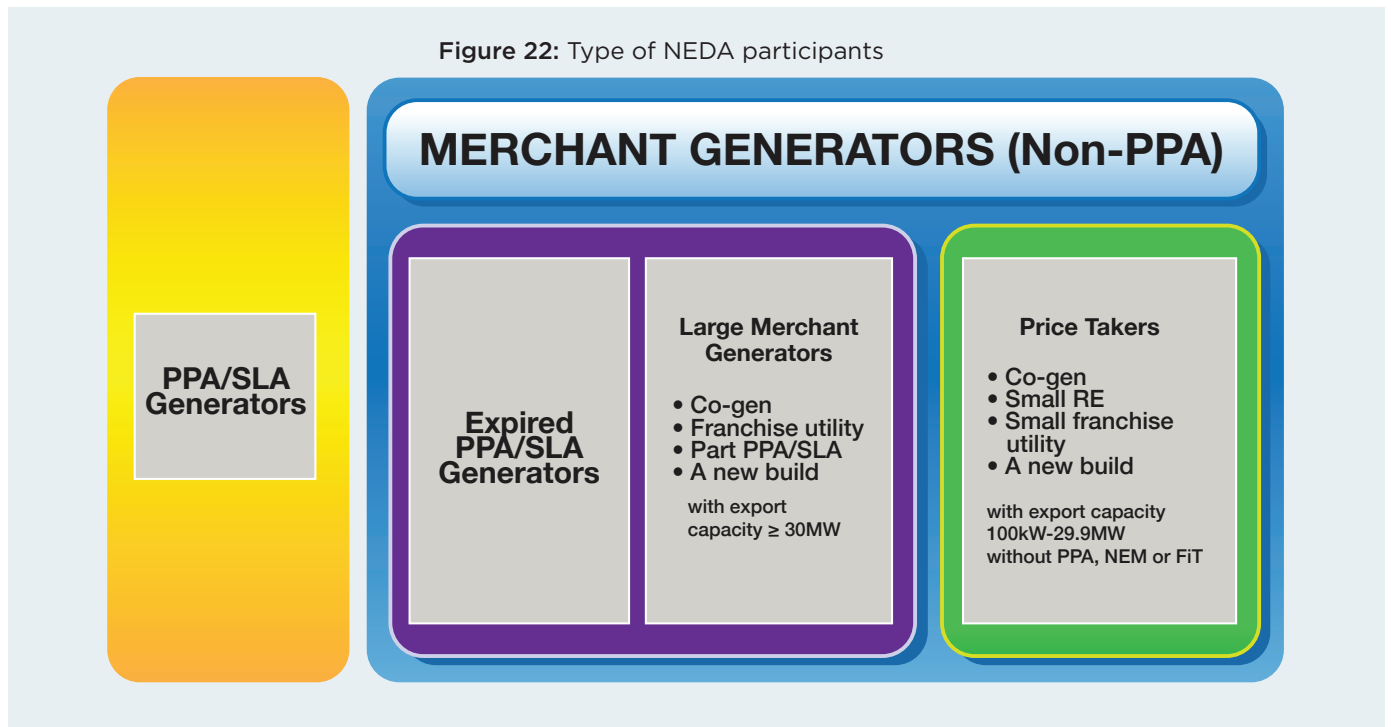
Under the later stage of NEM, which is NEDA Phase 2, generators without PPA/SLA can offer to sell energy. The categories of the NEDA participants are as follows:

1. Generators on power sector fuel - this category of NEDA participants consists of:
 - a) PPA/SLA generators;
 - b) Expired PPA/SLA generators supplying power solely to the Grid Owner and with their fuel requirements under the power sector gas supply arrangement.

This category of generators will be eligible for gas supply under the power sector gas supply arrangement.

2. Merchant generators - consist of any generator without a PPA/SLA with the Grid Owner and who manages its own fuel requirements. The merchant generators consist of the following categories:
 - a) Large merchant generators - consists of co-generation plants, part PPA/SLA generators, expired PPA/SLA generators on own fuel arrangements, franchise utilities with generation facilities and new build generation facilities (without a PPA with the grid owner) with export capacity of not less than 30MW;
 - b) Price takers - includes co-generation plants, franchise utilities with generation facilities, expired PPA/SLA renewable plants and new build generation facilities (without a PPA/SLA with the Grid Owner) with export capacity of more than 100kW but less than 30MW.

Figure 22: Type of NEDA participants



Each type of NEDA participant can sell energy based on the following:

- a) PPA/SLA generators, at lower of the PPA/SLA heat rates and Variable Operating Rate (VOR);
- b) Expired PPA/SLA generators, the heat rates and VOR as bid;
- c) Large merchant generators, the price determined by reference to the price quantity pair as bid (price as bid); or
- d) Price takers, the higher of the forecast system marginal price and the actual system marginal price.

NEDA Phase 2 Trial Run will be conducted for a period of 6 months starting from 1st October 2016 to 31st March 2017. The purpose of the NEDA Trial Run is:

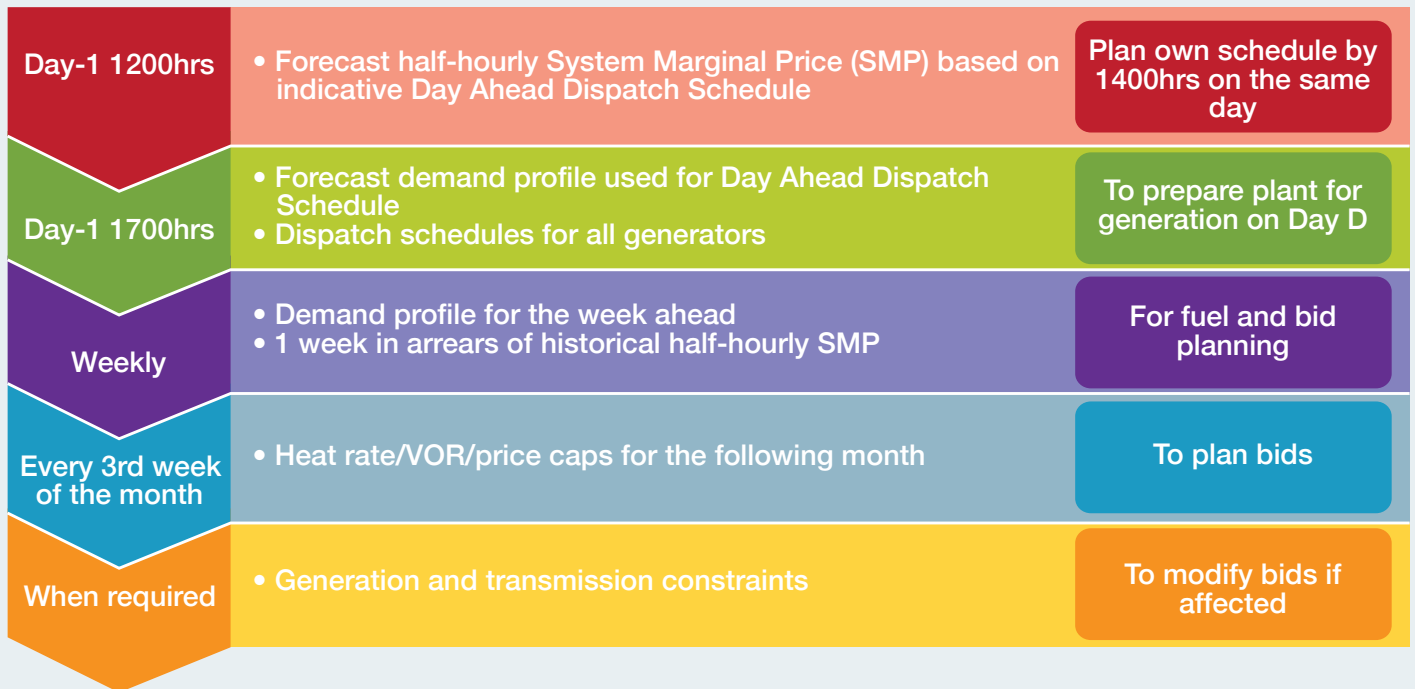
- 1) to test the proposed bidding arrangement (i.e. bidding, scheduling, dispatch and settlement);
- 2) to allow the NEDA participants to prepare the necessities and to familiarise with the new arrangements before the bidding goes-live.

During the Trial Run period, there will be two (2) parallel work streams:

- 1) Stream 1 - Current practice: Physical operations and settlement will continue to follow existing processes and rules;
- 2) Stream 2 - NEDA Trial Run: Generators will submit bids and receive dispatch instructions but will not follow them in reality. This will have no impact on the physical operations and settlement.

Go-live date will commence after the Trial Run period. Based from the outcome of NEDA Phase 1, the response from the participants was not encouraging. Thus, to implement NEDA Phase 2, feedbacks from participants and industry players in the Trial Run are crucial to ensure smoothness when NEDA goes-live.

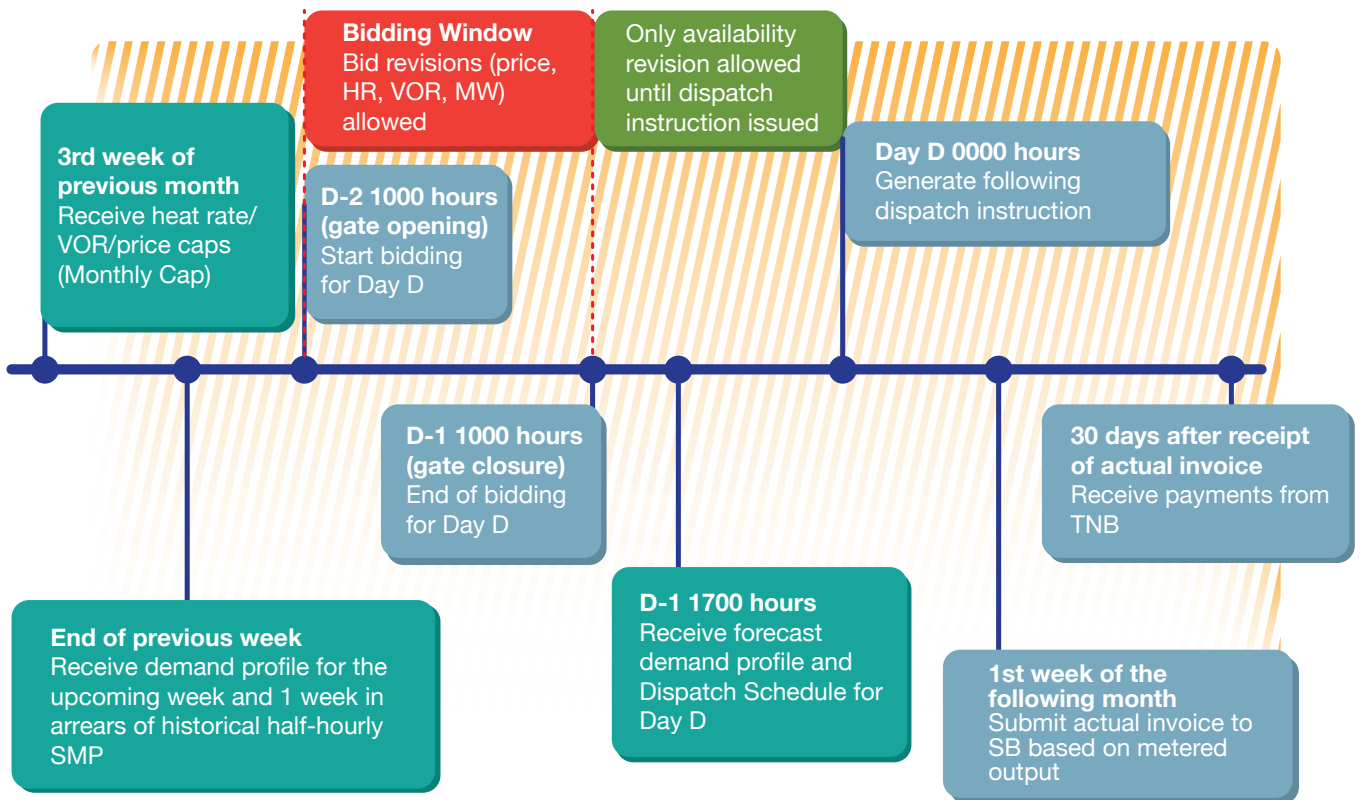
Figure 23: Pre-bidding process





To implement NEDA Phase 2, feedbacks from participants and industry players in the Trial Run are crucial to ensure smoothness when NEDA goes-live.

Figure 24: Timeline for generators who bid (PPA/SLA, Expired PPA & Large Merchant)



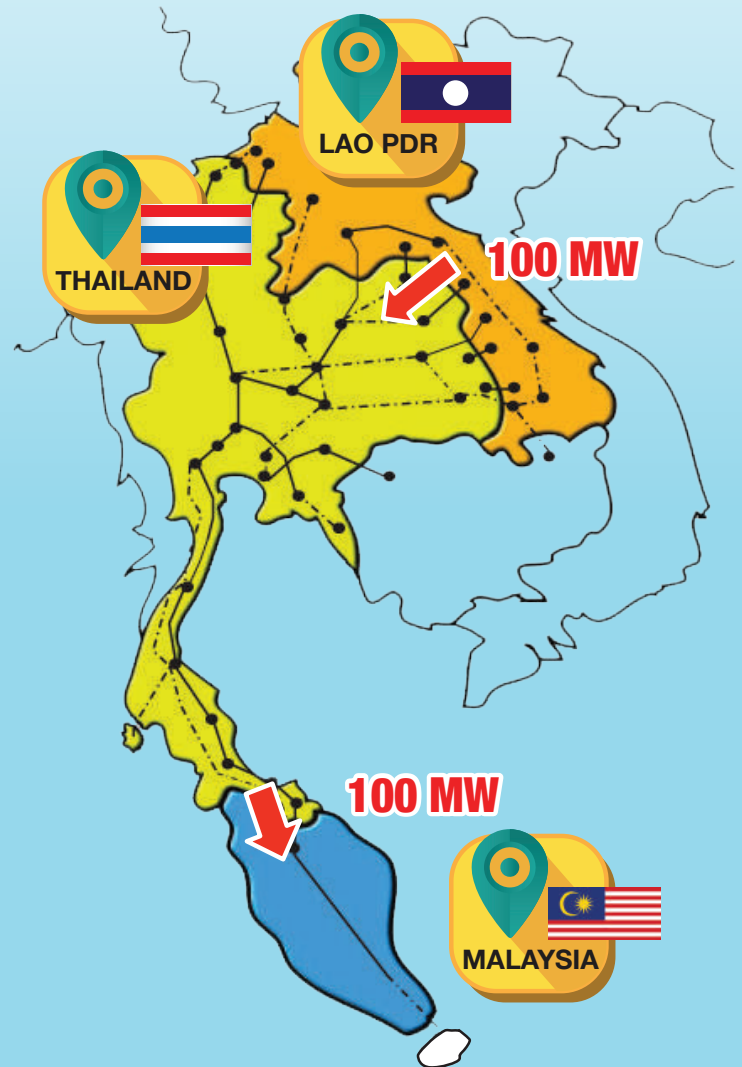
LTM Interconnection

The Memorandum of Understanding was signed between the Governments of Lao PDR, Thailand and Malaysia on 21st September 2016 during the 34th ASEAN Ministers on Energy Meeting in Nay Pyi Taw, Myanmar. As the first multilateral power trade to be implemented under the ASEAN Power Grid Initiatives, Malaysia will buy up to 100MW of power from Lao PDR through the Thailand power grid. This landmark agreement will pave the way for other multilateral trading within ASEAN Economic Community.

During the first phase, the four countries namely Lao PDR, Thailand, Malaysia and Singapore involved in setting up the Working Group to study the technical aspects of the power trading between borders of up to 100MW from Lao PDR to Singapore through existing transmission network. The initiative is actually made easier due to existing interconnections already in place between all connecting parties.

It was then agreed by all parties that the realisation of the first phase will only involve power transfer from Lao PDR to Malaysia through Thailand. Negotiation of the commercial aspects is currently ongoing. The first phase is expected to start in 2018 while second phase is expected to commence post-2020.

Figure 25: LTM interconnection map



Environmental Quality (Clean Air) Regulations 2014

The Environmental Quality (Clean Air) Regulations 2014 (CAR 2014) was gazetted and came into force in June 2014. This regulation replaces the Environmental Quality Clean Air Regulations 1978. The regulation aims to regulate emissions of air pollutants from industrial activities including power plants, waste fuel plants and asphalt mixing plants. Existing premises shall comply with the opacity and limit values as specified in regulation by 2019.

Legislation changes to the power industry are in terms of cost, time and availability.



- Under the IBR, all modification cost required by this new regulation will be passed to consumers into the tariff adjustment.
- All new power plants commissioned after 2005 (e.g. SJ Tuanku Jaafar) need to comply with the CAR 2014. However, plant commissioned prior to 2005 only need to comply with the Environmental Quality (Clean Air) Regulation 1978.
- Unavailability of power plants due to long scheduled outage for air pollution control system modification work will result in low operating reserve below the Malaysian Grid Code requirement.
- Insufficient area for installation of Air Pollution Control System in power plants such as at Janamanjung power plant and Kapar power plant.
- Some of the power plants will only continue to operate for a few months after June 2019 for example Powertek and Pahlawan power plants which may pose financial feasibility and operational reliability issues if modifications need to be done.

Currently, desktop study and audit of all power plants on the Continuous Emission Monitoring Systems (CEMS) is being conducted before the final decision. As of now, the modifications of all power plants are put on hold.

Gas Framework Agreement

The Gas Framework Agreement (GFA) is an instrument between PETRONAS and TNB in governing and managing power producers involved under Gas Sales Agreement (GSA) with PETRONAS and PPA or SLA with TNB. Development of the agreement started since 2014 to serve as an overarching agreement so as to formalise arrangement of Single Buyer and Grid System Operator (GSO) as central bodies for gas nomination and generators scheduling for power producers. In addition, the agreement also incorporates provision in relation to government intervention on gas pricing in Peninsular Malaysia and provides a preparatory platform for gas Third Party Access implementation in the future.

The interrelationship between GFA in the framework and governance of gas supply of Peninsular Malaysia’s power sector is shown in the figure.

The agreement was mutually signed by PETRONAS and TNB effective from August 2016 which kick-started the GFA’s transitional period before its full implementation by 2018. With the full force and effect of the GFA, provisions in the existing GSA of each respective power producer are superseded by corresponding provisions of the GFA in relation to following items:

- Allocated Quantity to Power Sector (AQPS);
- Forecast and Confirmation of Gas Requirements and Nomination;
- Excess Gas;
- Maintenance Shutdown;
- Operational Shutdown;
- Curtailment, Operational Flow Order;
- Failure to Deliver;
- Take or Pay; and
- Prices.

These relevant provisions will be entered with respective power producers through a supplementary agreement of each existing GSA. Apart from its direct impact to existing GSAs, the commencement of GFA also terminated the Gas Billing Agreement (GBA) between TNB and PETRONAS.

In order to operationalise the GFA, the Guidelines on Implementation of GFA in the Power Sector shall be introduced. These Guidelines are developed with the objective of establishing a framework to define the roles of Single Buyer, GSO, TNB, PETRONAS and Power Producers, in relation to nomination and allocation of gas to the Power Sector and the applicable billing arrangement.

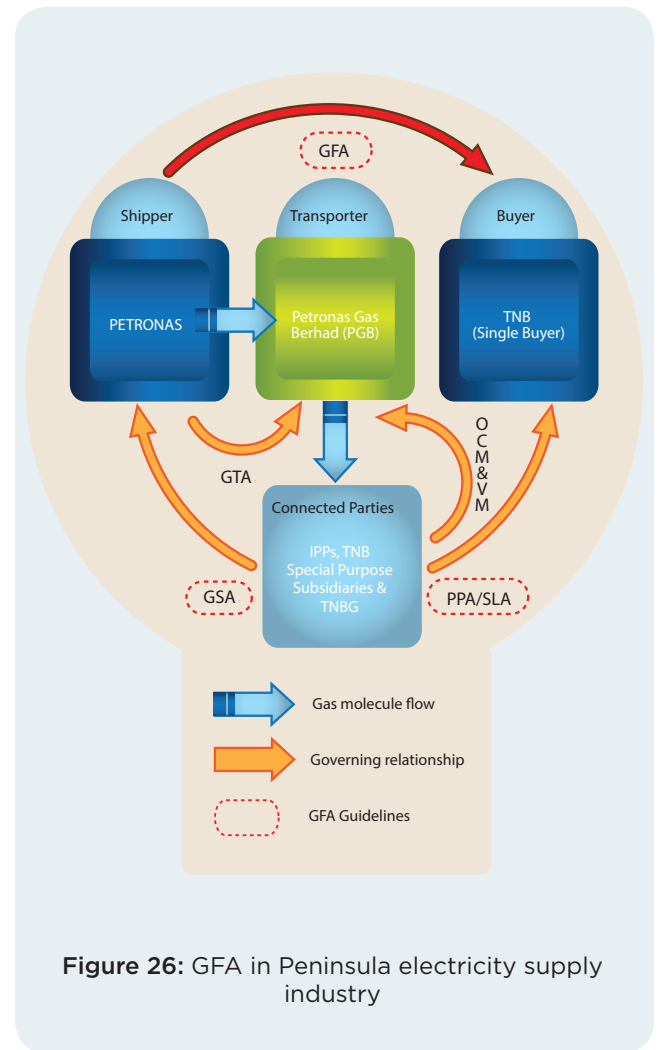


Figure 26: GFA in Peninsula electricity supply industry

Study On Managing Deregulated Natural Gas Price Volatility

Presently, the price of piped natural gas supplied via pipelines from indigenous and foreign gas supply sources to the power and non-power sectors of Peninsular Malaysia and Sabah is regulated by the Government. Since the 1980s, there were efforts by Government to deregulate gas prices, however, limited success was achieved due to volatility and price shock issues. In view of the present relatively low world crude oil price environment where the world crude oil prices have more than halved since late June 2014, it is an opportunity to accelerate the plan to achieve market price of piped natural gas in Malaysia.

However, a comprehensive study is essential to be done prior to the deregulation process in order to identify suitable policies, mechanisms and instruments to be used by the Government, energy suppliers and end-users for managing possible future gas price volatility and price shocks. For this reason, Suruhanjaya Tenaga appointed Frontier Economics Pte Ltd to carry out a study on Managing Deregulated Natural Gas Price Volatility in Malaysia for a period of 3 months with extensive consultations with key stakeholders and industries.

The Study recommends to introduce Risk Sharing package in order to achieve effective and efficient implementable policies, mechanisms and instruments for managing future gas price volatility in a deregulated Malaysian gas market. Risk Sharing package involves a gradual transition from the current arrangements to a reference market gas price for power and non-power customers, with this reference market price includes a simplified S-curve pricing arrangement designed to provide a higher level of protection against volatility. In simple terms, the modified S-curve protects consumers against high global fuel prices as well as protect suppliers against low global fuel prices.

Based on recommendations of the Study, the Economic Planning Unit (EPU) and Performance Management and Delivery Unit (PEMANDU) have done further consultations with key stakeholders to derive and agree on the wholesale gas pricing mechanism. The reference market gas price will be based on the existing LNG linked formula price, with a simplified S-curve to manage its volatility. One of the analysis required from Suruhanjaya Tenaga is sensitivity analysis on the impact of the new reference gas market price formula on ICPT should the Government agrees on the proposal of gas price deregulation for the power sector. Analysis assumptions are as follows:

- Base tariff at 38.53 sen/kWh from January 2015 until December 2020
- Actual imbalance cost pass-through quantum from January until December 2016
- Projection volume of coal and gas and electricity demand are based on JPPPET Meeting on 9th August 2016
- Projection of gas prices is from PETRONAS
- Coal price at US\$88.00/tonne beginning January 2017 until December 2020, with exchange rate of US\$1.00=RM4.20



Figure 27: Sensitivity Analysis of ICPT Projection for Electricity Tariff

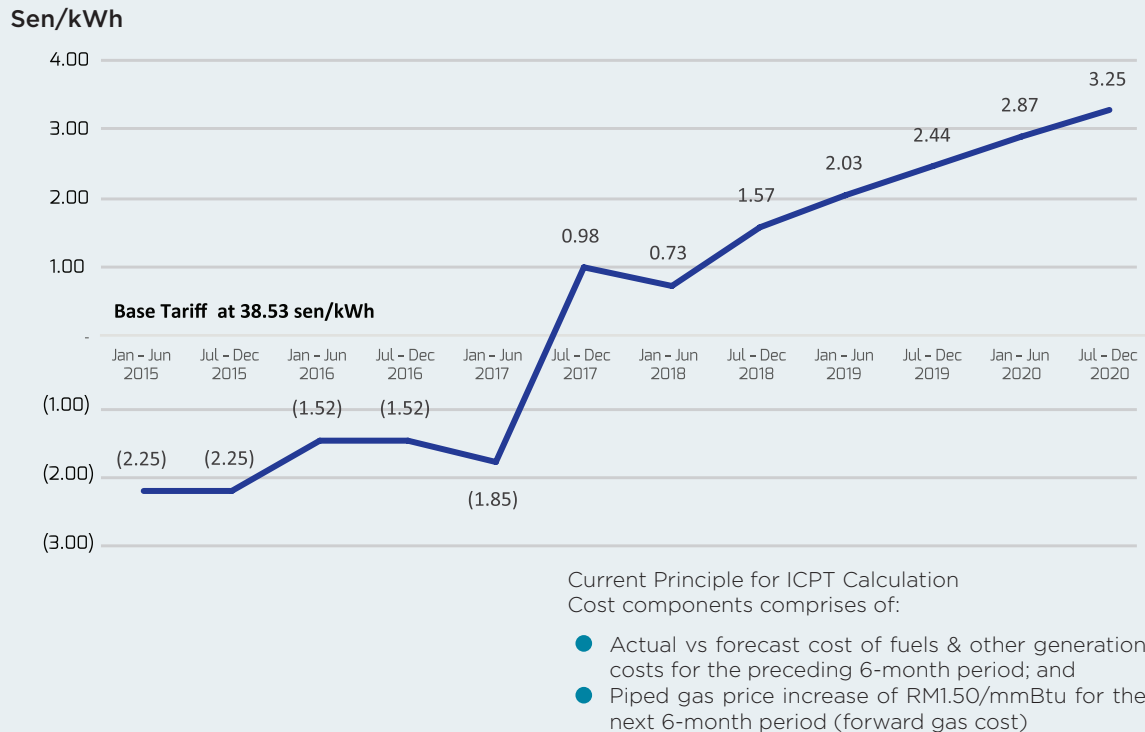


Figure 27 shows the forecast of ICPT quantum from Jan 2017 until Dec 2020 based on the proposed reference market gas price as well as future price of coal and its volume. By July 2017 onwards, a positive ICPT quantum is expected to be pass-through to consumers due to uncontrollable fuel prices.

During the transitional period of moving towards reference market gas price, the proposal is to continue with RM1.50/mmBtu increase of regulated piped gas price every 6 months until it reaches the reference market price level. Existing discounted LNG WAP ex-Bintulu price for both power and non-power sectors will be discontinued once the regulated gas price merge with reference market price. The reference market price will be the single market gas price for all gas volume for power and non-power sectors as compared to existing mechanism that is based on two-tier pricing.

Deregulation of gas price for the power sector is imminent as the Government has identified deregulation of the gas market as one of the development priorities. Plans to introduce a Third Party Access (TPA) regime to promote competition in the gas industry in Peninsular Malaysia and Sabah are well-developed, with the relevant legislation having been passed by Parliament and currently waiting Royal Assent. Efficient prices ensure the right sources of gas supply are accessed, customers receive the right signals about the cost of gas they consume, and therefore enables gas industry participants and customers to make the right investment decisions. Efficient gas prices are most likely to promote sustainable growth for the Malaysian economy.

National Energy Efficiency Action Plan

The efficient use of energy has been a national priority since the 9th Malaysia Plan was implemented between 2006 and 2010. However, since 2000, the country's energy intensity ratio has been over 1.0 whereas ratio of less than 1.0 indicates efficient use of energy. It was with this consideration that the Government introduced the National Energy Efficiency Master Plan (NEEMP) in 2010. The Master Plan involves a ten-year plan created after series of consultation processes with industry stakeholders, including government ministries, agencies, and the private sector.

To improve NEEMP, the Ministry of Energy, Green Technology and Water in January 2014 proposed the National Energy Efficiency Action Plan (NEEAP), an initiative intended to address several barriers of energy efficiency (EE). NEEAP also aims to cut consumption through a 5.0% reduction in electricity demand in all Government buildings. The table below shows the progress of the initiatives taken through this plan:

Table 9: Initiatives of NEEAP

No	Initiative	Progress
1	Promotion of 5-Star Rated Appliances	<ul style="list-style-type: none"> Suruhanjaya Tenaga have taken initiative to start the market penetration baseline study which is carried out by UNITEN. The purpose of the study is to have the current market penetration of 5-star rated appliances under MEPS regulation and also to establish a platform for monitoring the market penetration rate and estimation of energy saving achieved.
2	Minimum Energy Performance Standards (MEPS)	<ul style="list-style-type: none"> The MEPS Guideline for electric motor has been approved by Suruhanjaya Tenaga and currently in the process of establishing the Malaysian Standards (MS) of MEPS for Electric Motor. In line with the ASEAN Harmonization of Energy Efficiency Standards for air conditioners, the new minimum EER of 2.9 was approved by Suruhanjaya Tenaga to be enforced by 2018. Currently in progress of establishing the Energy Efficiency Criteria for rice cookers and washing machines with manufacturers and importers.
3	Energy Audits and Energy Management in Buildings and Industries	<ol style="list-style-type: none"> Energy Audit and Energy Management in Commercial building sector: <ul style="list-style-type: none"> 40 Commercial buildings were approved to receive the Energy Audit Conditional Grant. Energy Audit activity is estimated to complete by 1st quarter of 2017. Energy Audit and Energy Management in Industrial sector: <ul style="list-style-type: none"> 60 Industry premises were approved to receive the Energy Audit Conditional Grant. Energy Audit activity is estimated to complete by 1st quarter of 2017. Energy Audit, Energy Management and Retrofit program in government sector: <ul style="list-style-type: none"> 8 blocks at the Prime Minister Department, Parcel B Putrajaya are currently in the process of retrofitting the lighting system to LED.

Enhanced Time-of-Use Tariff Scheme

The EToU scheme 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 increasing utilisation during off-peak hours. Suruhanjaya Tenaga will continue to monitor the performance and the cost savings of this scheme as reported by TNB.


Table 10: EToU tariff category

Tariff Category	Demand Charge (RM/kW/Month)		Energy Charge (sen/kWh)		
	Peak	Mid-Peak	Peak	Mid-Peak	Off-Peak
C1 - MV Commercial	34.00	28.80	58.40	35.70	28.10
C2 - MV Commercial Peak/Off-Peak	48.40	42.60	63.60	33.90	22.40
D - LV Industrial	42.10	37.20	48.40	32.70	24.90
Ds - LV Industrial (SIT)	42.10	37.20	48.40	32.70	24.90
E1 - MV Industrial	35.50	29.60	56.60	33.30	22.50
E1s - MV Industrial (SIT)	35.50	29.60	56.60	33.30	22.50
E2 - MV Industrial Peak/Off-Peak	40.00	36.00	59.20	33.20	21.90
E2s - MV Industrial Peak/Off-Peak (SIT)	40.00	36.00	59.20	33.20	21.90
E3 - HV Industrial Peak/Off-Peak	38.30	35.00	57.60	32.70	20.20
E3s - HV Industrial Peak/Off-Peak (SIT)	38.30	35.00	57.60	32.70	20.20

Since its introduction in January 2016, eight(8) customers had applied for and was granted the EToU scheme. Starting January 2017, the scheme will be offered to medium voltage and high voltage consumers under tariff category of C1, C2, E1, E2 and E3 and will be extended to low voltage industry under tariff category D.



• Conclusions



Diversified nature of Malaysia's economy allowed the nation to record a stable and sustainable growth in the face of weakened growth prospect throughout the global economy. The National economy is projected to grow at between 4.0% - 4.5% in 2016 and between 4.0% - 5.0% in 2017. Meanwhile, sales of electricity is projected to grow moderately at between 1.0% - 2.0% in 2017 after record high due to the El Nino phenomenon in 2016.

New generation projects are expected to contribute to the overall system reliability and efficiency improvement. In the medium term, gas and coal will continue to be the mainstay of power generation with increasingly important roles of renewables especially solar PV in line with the worldwide trend.

Transmission network will be continuously developed and upgraded to ensure not only existing requirement and operation standards can be met, but also for future system growth. In this respect, continuous delay in the completion of new projects not only leads to the breach of standards but also exposure to supply disruption.

Regulatory arrangement for electricity and gas is expected to be further improved with the enforcement of the Electricity Supply (Amendment) Act 2015 and Gas Supply (Amendment) Act 2016. Expansion of regulatory scopes through the amended Acts and implementation of new regimes such as the Third Party Access and Incentive-Based Regulation require more robust and non-discriminatory frameworks that are acceptable to all industry stakeholders. Industry players also need to adapt to the introduction of more stringent environmental and social requirements.

As a signatory to the Paris Agreement, direction of future generation planting-up will be influenced by the commitment to reduce GHG emission. For comprehensive mitigation measures, programmes for both supply and demand sides have to be identified and implemented within the specified timeline so that the reduction of 45% GHG emission intensity of GDP can be achieved by 2030.

As we move into 2017, new challenges will have to be managed as we strive to implement new measures or reform particularly:

- Introducing competition in the gas supply industry through third party access arrangement;
- Enhancing independency of the Grid System Operator and Single Buyer through new measures;
- Enhancing of short term competition through NEDA;
- Managing the impact of Large Scale Solar on electricity networks;
- Managing the effect of upward movement of coal prices to the electricity tariff; and
- Taking steps to ensure that commitment to COP21 can be met.

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