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SECURITY OF ENERGY SUPPLY

ABSTRACT

Energy usage in Malaysia continues to rise in tandem with the nation's growth. Malaysia has established plans, policies and strategies to power the nation. The Eleventh Malaysia Plan 2016 - 2020 contains specific strategies for the energy sector to improve security and reliability of supply; and creating a sustainable tariff framework for efficient management of energy resources.

This write-up is intended to give an overview on the current state of energy supply in Malaysia.

Keyword: Independent Power Producer, Power Purchase Agreement, Energy, Reserve Margin

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ABBREVIATION

IPP	Independent Power Producer
PPA	Power Purchase Agreement
CRF	Capacity Rate Financial
TNB	Tenaga Nasional Berhad
GLC	Government-linked Companies
EC	Energy Commission
EPU	Economic Planning Unit
FiT	Feed-in Tariff
RE	Renewable Energy
ICPT	Imbalance Cost Pass-Through
RORB	Return on Regulated Asset Base
IBR	Incentive-Based Regulation Framework

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1.0 INTRODUCTION

Energy enables us to do work. It is absolutely necessary for human existence. The discovery of fire through burning of the wood and fossil helped to provide immediate source of heat. Human learned to harness the power of natural forces -– wind, water and sun -– for the betterment of mankind. In the beginning of civilisation, the forces of wind and water had aided man to move and expand trade. By the 18th century when industrialisation revolution began to take place, technologies have unleashed creative energies and improved the standards of living. Energy provides the basic needs and supports economic growth. Without energy, there is no life. Lack of energy security is linked to sluggish economic growth and negative social impact. Malaysia's energy policy is aimed to address security of energy supply, economic efficiency and social and environment objectives.

In this write-up, we will explore the security of energy supply in Malaysia.

2.0 IPP AND POWER PURCHASE AGREEMENT

In Malaysia, electricity is generated by Tenaga Nasional Berhad (TNB) and independent power producers (IPPs). IPP is usually a privately owned entity with its own facilities to generate electric power for sale to utilities and end users. Sometimes the government holds shares in the entity. Under the IPP scheme, most IPPs are capable of generating more than 400MW of electricity to a maximum of 2,400MW. There are IPPs classified as small-scale IPPs which are capable of generating not more than 60MW of electricity – and they are mostly located in Sabah. Through the power purchase agreement (PPA) with Tenaga Nasional Berhad (TNB), IPPs are granted licences to operate power plants for a specified number of years. PPA between TNB and IPP operates on fully "dispatchable" basis, i.e. all capacity must be made available to the national grid at any time except during scheduled maintenance.

The key points of the implications of PPA are:

a) Obligation by TNB to purchase the generated electricity by IPP in any case of the reserve margin. Surplus capacity (in Peninsular Malaysia) peaked at all time high 56% in 2003, 53% in 2009 and between the period 2001 - 2013[1] in the range between 31% and 45%, 25% in 2014 and increased to 26% in 2015[2];

b) Foregone earnings by Petronas - the lost opportunity cost - if it could sell gas at prevailing market price instead of the pre-determined rate/fixed price to IPPs;

c) Higher cost of generating electricity by IPP compared to the generation cost of TNB and hence, highly likely to lead to higher purchase price to be paid by TNB for electricity generated by IPP.

The key points in the PPA are taken into account when IPPs apply to continue to generate electricity when the PPA expired.

3.0 PAYMENTS AND COSTS TO GENERATE ELECTRICITY

Payments to IPP consist of two core components which are capacity payments (comprises Capacity Rate Financial (CRF) which is fixed payments to cover debt service and a rate of return to sponsor and fixed operating costs) and energy payments (comprises variable operating rates and variable operating costs; and fuel cost).

Upon receiving instruction from TNB, IPP will proceed to generate electricity. Gas consumed during generation are quantified and billed to TNB at the fixed price set by the government. TNB will procure and dictate the cost of coal used to generate electricity based on the quantum of electricity generated and at the agreed efficiency rate. In the event that the IPP is unable to meet “dispatch” level as per TNB’s instruction, penalties will be imposed.

[1] See Suruhanjaya Tenaga, Peninsular Malaysia Electricity Supply Industry Outlook 2014.
[2] See Suruhanjaya Tenaga, Peninsular Malaysia Electricity Supply Industry Outlook 2016.

IPP does not have any direct financial benefit from the subsidised cost of gas because fuel cost is borne by TNB. By setting a fixed price for gas sold to IPPs, it shields IPP from the volatility in gas pricing. The mechanism permits IPP to perform its sole duty to generate electricity as instructed. Savings in gas costs, i.e. the difference between prevailing market gas price and fixed price are passed on directly to electricity consumers through lower tariffs. Coal purchases are subject to vulnerability in exchange rate. Over exposure and insufficient hedging mechanisms can contribute to significant exchange rate translation gains or losses annually.

IPP incurred heavy capital cost to build power plants and this is taken into account in the PPA. The monthly payments by TNB to IPP take into account the interest on the loan taken by IPP as well as the cost of operating and maintaining the plant. Fuel is not included in the agreement as it is 100% borne by TNB. If the fixed price of fuel decreased, the cost borne by TNB will reduce as well, and vice-versa.

A full prevailing market gas price will push the average tariff rate beyond 36.28 sen/kWh. To cover the true cost of power, tariff will need to increase to close the gap between the true cost and subsidised tariffs.

Gas and coal form 49.5% and 45.0%[3] of the generation fuel mix in 2014 respectively. Four determinants for generation fuel mix are availability, accessibility, affordability and acceptability. Coal will be the main fuel for power generation when an additional 5,000MW of coal-fired capacity to be commissioned between 2015 and 2019. The Fuel Diversity Index monitors the national fuel security to ensure fuel diversification meets the minimum requirement level for continuous supply to consumers.

[3] See KETTHA Annual Report 2014, pg. 29

Table 1: OPERATIONAL THERMAL AND HYDROELECTRIC POWER PLANTS

PPA/ SLA EXPIRY YEAR	POWER PLANT	FUEL	TYPE	CAPACITY (MW)
Jan 2016	Powertek Bhd	Gas	Open Cycle Gas Turbine (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	Combined Cycle Gas Turbine (CCGT)	1,029
Dec 2018	S.J.Jambatan Connaught	Gas	CCGT	300
Jul 2019	Kapar Energy Ventures Sdn Bhd	Gas	OCGT	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
Mar 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
Jun 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
Jul 2029	Kapar Energy Ventures Sdn Bhd	Gas Coal	Conventional Thermal Thermal (U3-U6)	564 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	**20,709.5**

Source: Suruhanjaya Tenaga

4.0 SUPPLY AND SECURITY

From 1993, the energy sector paid a heavy price for the onslaught of IPPs coming onstream as a result of licences issued by Economic Planning Unit (EPU). New power plants were connected to the national grid to cater for demand that was just not there. In 2003 when TNB was sitting on a reserve margin of 56%, it has to mop up all excess supply of electricity generated as electricity cannot be stored. TNB has to pay for the excess capacity.

The excess capacity was a consequence of the favorable contract terms offered by the government in order to provide a business climate conducive for foreign investment. It placed top priority on uninterrupted and reliable power supply for business.

The excesses came to a stop in 2005 when the government initiated a 10-year programme to transform Government-linked companies (GLCs). Under the GLC transformation programme, it was decided that all IPP licences would be tendered out to attain the optimum price to generate electricity. The Energy Commission (EC) was tasked to handle the awards. However, it took another six years for the programme to kick start as awarding on competitive tender only commenced in 2011.

Table 2: NEW GENERATION PROJECTS

	PROJECT	FUEL	INSTALLED CAPACITY MW	COMMERCIAL OPERATION DATE
1	TNB Janamanjung U4	Coal	1,010	14 April 2015
2	CBPS Redevelopment	Gas	375	27 February 2016
3	Hulu Terengganu	Hydro	250	U1: 3 December 2015 U2; 31 December 2015
4	Ulu Jerai	Hydro	372	U1: July 2016 U2: September 2016
5	TNB Prai	Gas	1,071.43	20 February 2016
6	Tg Bin Energy Malakoff	Coal	1,000	April 2016
7	Hulu Terengganu (Tembat)	Hydro	15	U1: Mar 2016 U2: April 2016
8	Additional Pengerang Co-Generation	Gas	200	January 2019
9	TNB Manjung 5	Coal	1,000	1 October 2017
10	SIPP Pasir Gudang/ Track 4A	Gas	1,400	April 2019
11	Jimah East Power/ Track 3B	Coal	1,000 1,000	U1: June 2019 U2:December 2019
12	Additional Chenderoh	Hydro	12	29 October 2018
13	Edra Global Energy	Gas	2,400	January 2021
14	Tekai	Hydro	168	July 2021
15	New Coal	Coal	1,000	January 2023
16	Telom	Hydro	190	October 2024
17	Nenggiri	Hydro	300	April/July/Sept 2024
18	Lebir	Hydro	274	December 2024 March 2025
19	Sarawak Import	-	2,000	January 2025

Source: Suruhanjaya Tenaga

Energy policies in place to enhance energy security are National Petroleum Policy, National Energy Policy, National Depletion Policy, Four-fuel Policy, Five-fuel Policy and Renewable Energy (RE) Policy and Action Plan. The policies aimed to promote efficient utilisation of petroleum resources, minimise negative impacts to the environment, prolong the life span of the nation's oil and gas reserves, promotes renewable energy and efficient use of energy. The RE Policy and Action Plan introduces the Feed-in Tariff (FiT) mechanism to act as a catalyst for the progressive entry of RE power generation businesses and other related aspects of RE development.

5.0 PEAK DEMAND

For the year 2013, demand for electricity recorded a drastic jump between 4.7% and 19.3% for Peninsular Malaysia, Sabah and Sarawak. The grid system maximum demand in Peninsular increased 4.7% from 2012 to 16,562MW recorded on 13 May 2013. In Sabah, the maximum demand of Sabah grid system increased by 5.3% to 874.4MW recorded on 23 September 2013 compared to 828.4MW in 2012[4]. Maximum demand in Sarawak has increased by 19.3% to 1,466 MW from 1,229MW in the previous year.

For the year 2016, electricity demand in Peninsular Malaysia continued its positive momentum. On 20 April 2016, peak demand was recorded at 17,788 MW[5]. Sabah's electricity demand is estimated to reach 934MW[6] in 2016.

Table 3: PEAK DEMAND (PENINSULAR) FOR 2010 - 2015

	PEAK DEMAND (MW)	%
2010	15,072	-
2011	15,476	2.68
2012	15,826	2.26
2013	16,562	4.65
2014	16,901	2.05
2015	17,461	3.31

Source: TNB, Suruhanjaya Tenaga

As at December 2014, the installed capacity in Peninsular Malaysia was 20,944MW. Two power plants were commissioned in 2015, i.e. TNB Janamanjung Unit U4 (1,010MW) and HEP Hulu Terengganu (250MW), whilst two power plants ceased operation, which are YTL Power (1,170MW) and S.J.Putrajaya Unit 1, Unit 2 and Unit 3 (324MW). By the end of December 2015, the installed capacity increased to 20,710MW with the commissioning of HEP Hulu Terengganu with capacity of 250MW.

[4] See Performance and Statistical Information on Electricity Supply Industry in Malaysia 2013 published on 22 December 2014.
[5] See article in New Straits Times.
[6] See article in Borneo Post online.

Table 4: INSTALLED CAPACITY IN PENINSULAR MALAYSIA, BY TYPE, 2015

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	2,149.0
Total Capacity (MW)		**20,710**

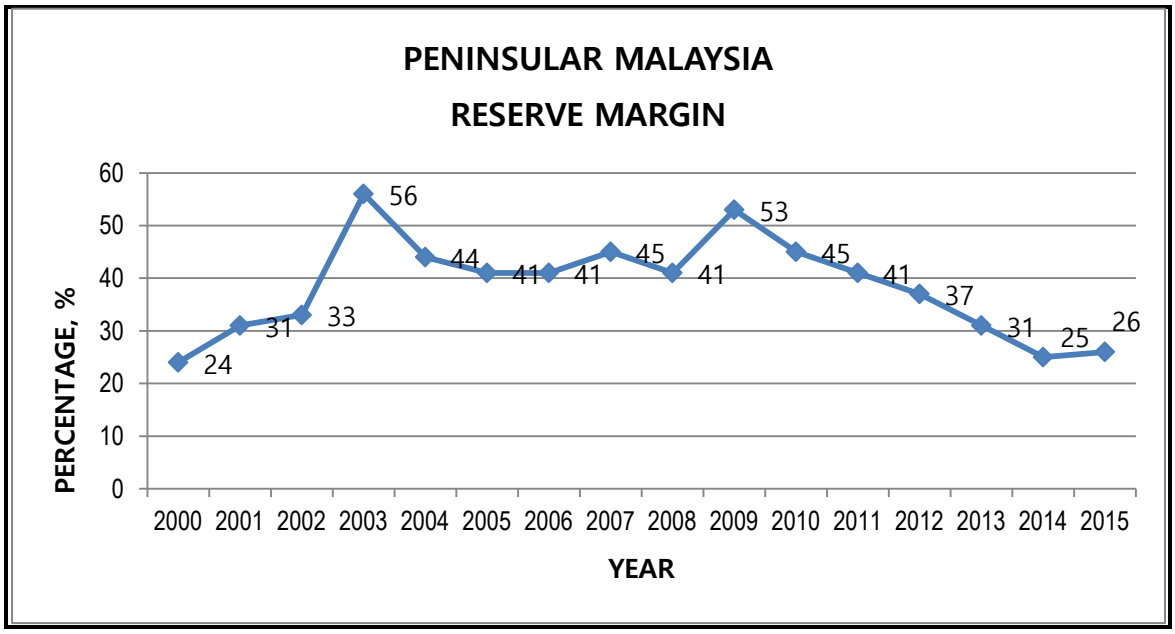
Source: Suruhanjaya Tenaga

Based on an average electricity demand growth of 3% annually and GDP of 6%, the government has projected the electricity demand will reach 20,335MW[7] (Peninsular Malaysia) by 2020.

6.0 RESERVE MARGIN

The reserve margin of electricity generated in Peninsular Malaysia in 2015 was 26%. The margin is trending downwards since 2009, from 53% to 23%, although it is still within a manageable level, i.e. exceeding 20%. The cost of reserve capacity is borne by TNB.

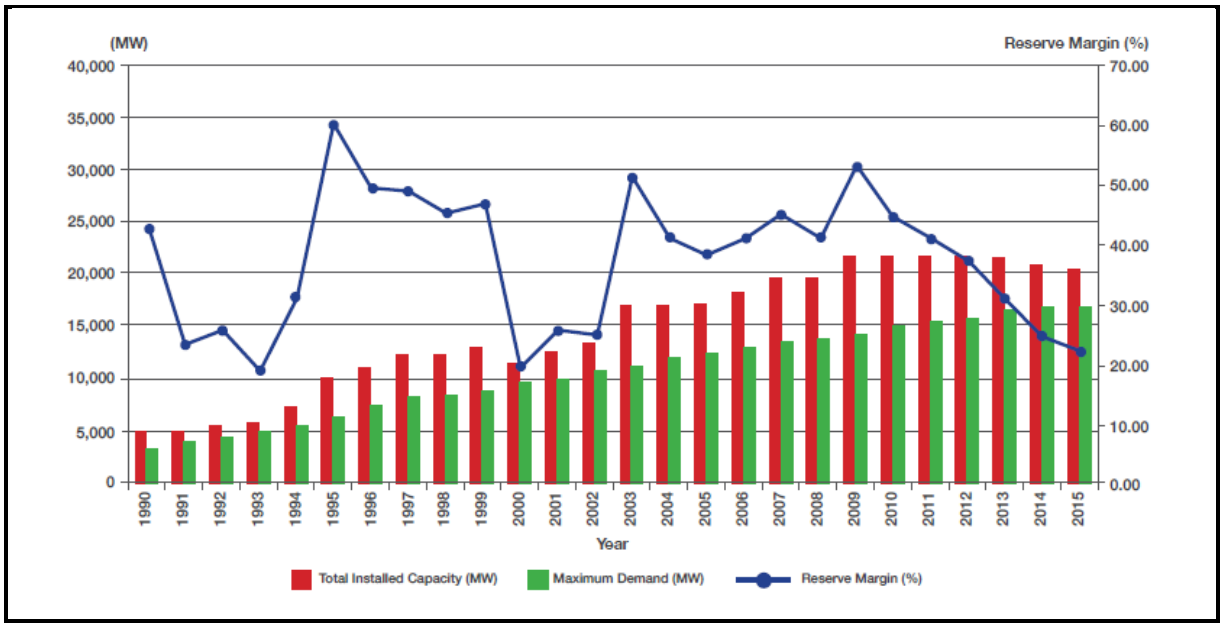
Chart 1: RESERVE MARGIN, PENINSULAR MALAYSIA



Source: Suruhanjaya Tenaga

[7] See KETTHA Annual Report 2014.

Chart 2: PENINSULAR MALAYSIA RESERVE MARGIN



Source: Suruhanjaya Tenaga

Reserve capacity is necessary to cater for any loss of generating capacity due to outage or planned maintenance and refurbishment. The margin level usually makes reference to the peak demand as one of the most important indicators for planning and operation. This is in line with the practices adopted in the electricity sub-sector all over the world. The reserve margin level required is dependent on several factors including the size of the power system and the reliability level required. A small power system will need higher reliability - a higher percentage of reserve margin. The International Energy Agency (IEA) recommended a typical reserve margin in the range of 20% to 35%.

For instance, Hong Kong's reserve margin in 2012 was 31%, while Singapore keeps a margin of about 50%. United Kingdom and Japan keep their reserve margin above 35%, whereas Taiwan and USA maintain its level at 25%.

7.0 SUBSIDIES AND FOREGONE EARNINGS

IPPs do not receive any subsidies. Instead, they benefit from lower operational costs to generate electricity and a secured demand from TNB. IPP and TNB's profits are indifferent to gas price, as this is a pass-through cost.

The total revenue foregone by Petronas between July 2014 and June 2015 was RM836 million[8]. The Imbalance Cost Pass-Through (ICPT) mechanism allows the fuel price and generation cost to be reviewed every six months. When the government decided not to increase the piped gas regulated price and maintain the price at RM15.20/mmBtu from July 2014 to June 2015, the government has to subsidise a total of RM1.301 billion[9].

Payments made by TNB to IPP include capacity payment, energy payment and fuel cost. Fuel cost is the main component in TNB's operating costs and as a company, TNB is burdened by the volatility of the fuel cost. IPP fuel cost is fully passed-through to TNB as provided in the PPA. Total fuel costs (TNB and IPP fuel costs) represent about 40% of TNB's (Peninsular's power sector) total operating cost.

Table 5: COMPARISON OF FIXED GAS PRICE SOLD TO IPPs AND PREVAILING MARKET GAS PRICE

	FIXED GAS PRICE SOLD TO IPPs (RM/million British thermal unit)	PREVAILING MARKET GAS PRICE (RM/million British thermal unit)
2005	6.40	26.51
2006	6.40	30.25
2007	6.40	33.56
2008	14.31	43.80
2009	10.70	33.68
2010	10.70	39.27

Source: Hansard 20 June 2011.

The difference between the fixed gas price and the prevailing market gas price will be reduced gradually until the fixed price paid by TNB is equal to the prevailing market price.

8 See KETTHA Annual Report 2014.
9 See KETTHA Annual Report 2014.

Table 6: REVISION OF GAS PRICE, 2006 - 2016

YEAR	FIXED GAS PRICE (RM/million British thermal unit)
2006	w.e.f. 1 May 1997: RM6.40/mmBtu
2008	w.e.f. 1 Jul 2008: RM14.31/mmBtu
2009	w.e.f. 1 Mar 2009: RM10.70/mmBtu
2011	w.e.f. 1 June 2011: RM13.70/mmBtu
2014	w.e.f. 1 Jan 2014 RM15.20/mmBtu
2015	w.e.f 1 July 2015: RM16.70/mmBtu
2016	w.e.f 1 Jan 2016: RM18.20/mmBtu
2016	w.e.f 1 July 2016: RM19.70/mmBtu

In June 2011, the fixed gas price sold to IPPs was revised to RM13.70/mmBtu, reflecting an upward revision of 28%. The higher gas price led to increase in electricity tariff. Average electricity tariff rate was adjusted by an average increase of 7.12% or RM4.09 sen/kWph.

From 1 January 2014, the average electricity tariff rate in Peninsular Malaysia increased by 4.99 sen/kWh, reflecting an average increase of 14.89% from 33.54 sen/kWh to 38.35 sen/kWh. This is due to 82% increased in the fuel price. Piped gas regulated price increased from RM13.70/mmBtu to RM15.20/mmBtu, while coal price imported from Indonesia, Australia and South Africa increased from USD85/tonne to USD87/tonne.

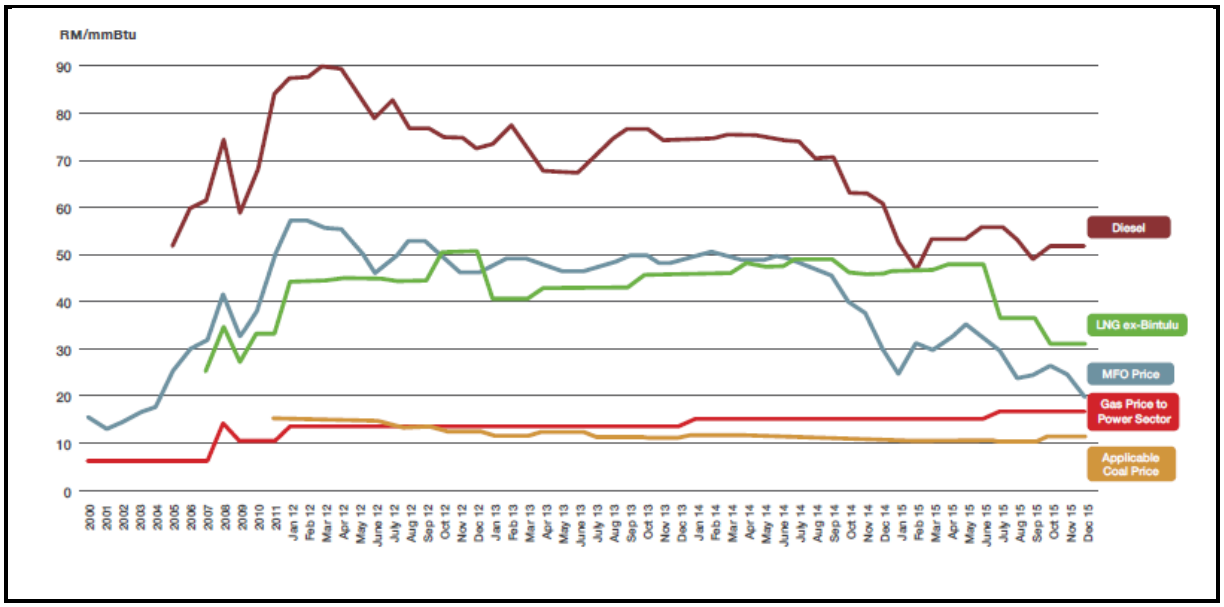
TNB has reduced tariff rate in Peninsular Malaysia by 2.25 sen/kWh for the period 1 March 2015 to 31 December 2015. Average domestic tariff rate has reduced from 38.35 sen/kWh to 36.28 sen/kWh.

From 1 July 2015, the fixed gas price increased to RM16.70/mmBtu. As the electricity tariff remained no change for the year, TNB paid more for the supply of gas from Petronas. The lower fuel cost and benefits from restructuring of the PPA amounting to RM500 million has enabled TNB to absorb the higher cost of gas.

In 2016, the price of piped gas increased twice, i.e. on 1 January 2016 to RM18.20/mmtuBtu and 1 July 2016 to RM19.70/mmtuBtu. However, electricity tariffs in Peninsular Malaysia, Sabah and Labuan remain unchanged for the year.

The government absorbed RM1.2 billion in electricity rebate until the end of 2016 to keep tariffs at the current level.

Chart 3: AVERAGE FUEL PRICE TREND RM/mmBTU



Source: Suruhanjaya Tenaga

Subsidised fuel is costing Malaysia billions of ringgit annually. Fossil fuel subsidies are exacerbating pollution problems and discouraging investment in cleaner energy resources. The benefits of the subsidies are counterproductive. The benefits flow disproportionately to the wealthy. Policies should incorporate the true cost of energy including carbon emission and other greenhouse gases linked to climate change.

Fuel subsidies reform will generate substantial benefits for both the government and the people, including support critical social programmes and projects, such as education and health care, as well as promoting new business and technology development around cleaner, more sustainable energy initiatives. However, the government needs more than concrete policy proposals to move energy subsidies rhetoric to action in today's highly charged political arenas.

By and large, gas subsidy in Malaysia will eventually be a thing of the past. It can be implemented successfully if the removal of the subsidy is done gradually. Therein lies the government's role to provide a detailed planning to ensure that our competitivenss in global market remains. The plan has to set clear goals and prescribed to the principles of transparent, accountable and fair to all.

8.0 IMBALANCE COST PASS-THROUGH (ICPT) MECHANISM

Tariff adjustments to reflect change in the fuel prices is made based on the ICPT mechanism that was re-introduced in January 2014. The mechanism was adopted to promote transparency, as well as enable subsidy rationalisation to take place so that the country's economy can be more competitive and resilient.

Under the ICPT, there are two components: base tariff and ICPT. Base tariff takes into consideration base price of main fuel, operational costs and utility development including Return on Regulated Asset Base (RORB). ICPT is a component in the Incentive-Based Regulation (IBR) framework that ensures TNB's fuel cost will be passed through, which means TNB's earnings will be more predictable. The ICPT component allows Petronas' gas price supplied to TNB to be reviewed every six months to reflect movements in fuel prices. The first review was made in June 2011 and subsequently, in 2014, the government has allowed Petronas to charge an extra RM1.50/mmBtu for gas supplied to IPP. As TNB has to pay more for gas, the electricity tariff rates were adjusted upward by an average of 14.89%. Any review on the electricity tariff will be an adjustment of fuel cost and electricity supply generation.

Through ICPT, the government gave rebates totaling to RM2.57 billion[10] between March 2015 and June 2016. This is made possible through the use of funds from savings from re-negotiation of PPA:

a) 2.25 sen/kWh for the period March 2015 and December 2015
b) 1.52 sen/kWh for the period January 2016 and June 2016

[10] See Jawapan Pertanyaan Jawab Lisan Dewan Rakyat, 17 May 2016.

Through ICPT, the review on electricity tariff rates is much more predictable. This augurs well for businesses as they can plan and adjust their plans according to the changes. Implementation of changes in tariffs should be made in a gradual slope to cushion the impact after each revision of tariff hike. As for TNB, its core earnings are much more resilient as ICPT reduces the volatility in fuel prices. TNB benefitted from the lower price of coal since the first half of the year. TNB uses more coal now. In any case, the electricity consumers have benefitted from ICPT mechanism.

9.0 CONCLUSION

The energy policies in Malaysia emphasises energy security and economic efficiency as well as environmental and social considerations. Access to diverse, reliable and affordable supply of energy is fundamental to attract new investments as well as encourage existing industries to expand into high value-added activities. The 11th Malaysia Plan supports the security of energy supply to ensure sustainability of the energy sector through resource diversification, continous investments in new infrastructure, technology enhancement, improvement in productivity and efficiency and implementation of efficient resource utilisation measures.

Energy security will be enhanced through the development of alternative resources, particularly hydro as well as importation of coal and liquefied natural gas (LNG). Development of new coal-based plants will be undertaken to ensure security of supply in Peninsular Malaysia. The application of super critical coal technology will be explored to reduce carbon emissions, hence, higher efficiency of energy use. Further improvement through continued investment in generation, transmission and distribution projects by utility providers to ensure reliability.

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