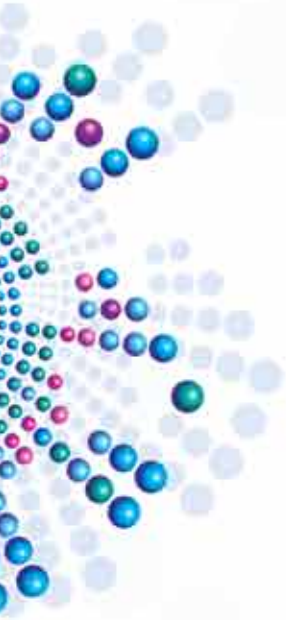
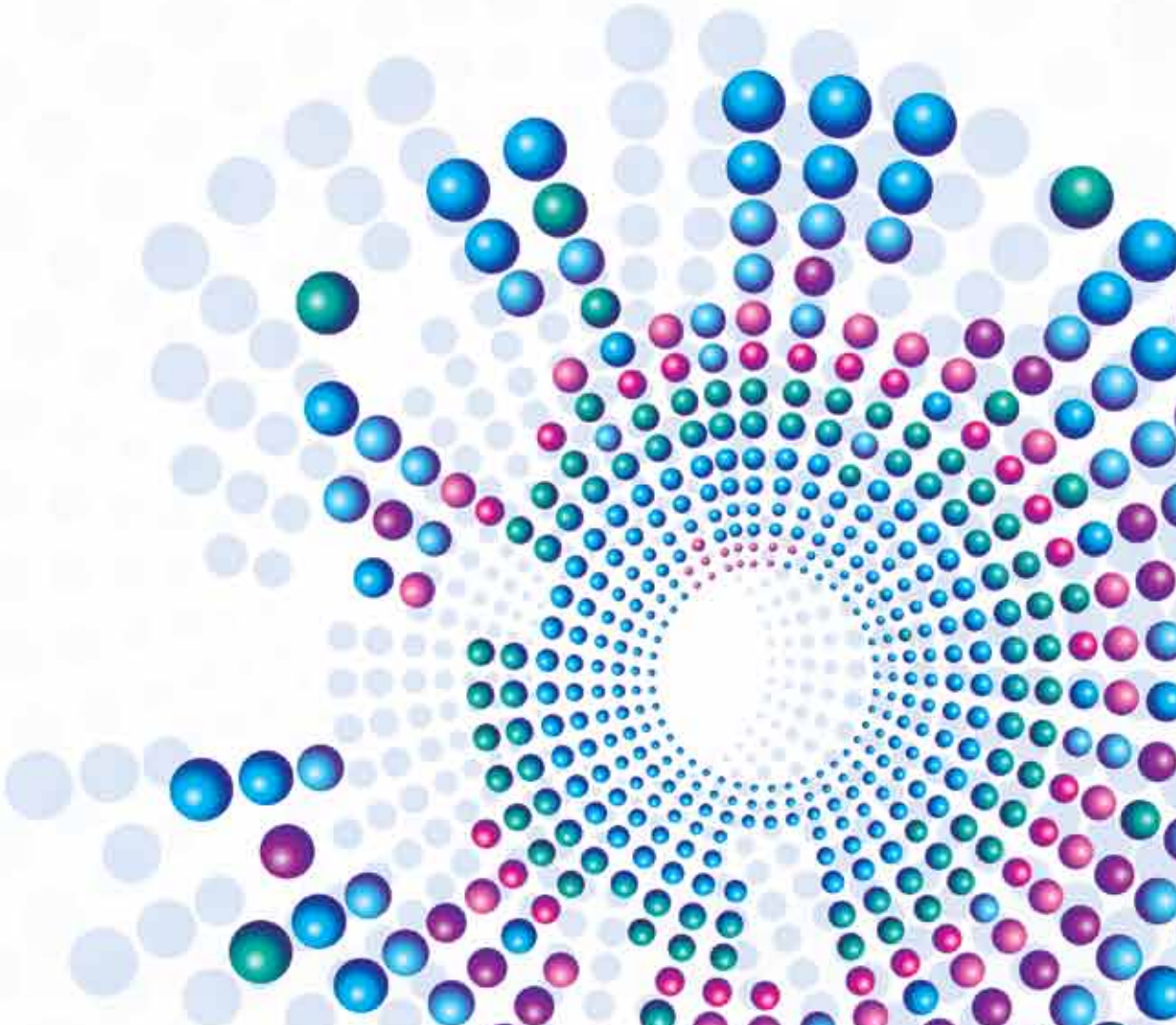
PENINSULAR MALAYSIA ELECTRICITY SUPPLY INDUSTRY OUTLOOK 2013





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Preface

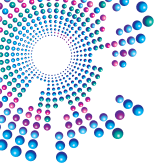
The Malaysian Electricity Supply Industry, or in short, MESI, is at a crossroad. The global trend has put pressure for Malaysia to restructure the industry to be more transparent and efficient. While we made progress in transforming the industry to be more responsive to the needs of the people, keeping the price to be affordable and competitive pose a major challenge. Under such circumstance, Malaysia is currently gearing towards a new era of electricity supply industry known as the managed market regulation. It refers to a form of government intervention designed to ensure efficient and reasonable pricing of electricity to consumers in the absence of competition. The new MESI, with managed market regulation as its platform, is gradually evolved through a major industry reform process which started in year 2010 - after the last one in the 1990s which witnessed the introduction of independent power producers and privatisation of the national utility.

Having a more transparent, efficient and credible market under the new MESI is a pre-requisite for a better management of the current and future industry infrastructure and resources. This includes the generation capacity and plant-up as well as transmission network capability and expansion. Under the new MESI, the upgrading of these infrastructures will be well publicised so as to create the openness and transparency of the industry development. With the above objectives in mind, ST would like to introduce the Electricity Supply Industry Outlook – an annual publication of the electricity supply infrastructure requirement and development prospect for the next 10 years. The publication, ESI Outlook in short, presents the current and future development of generation and transmission capacity in meeting the future growth. However, ESI Outlook will be subjected to periodic review to reflect the changes in the industry from time to time. The theme for this first edition is "Reform Initiatives for the New MESI", highlighting the activities undertaken in reforming the industry towards a more transparent and efficient structure.

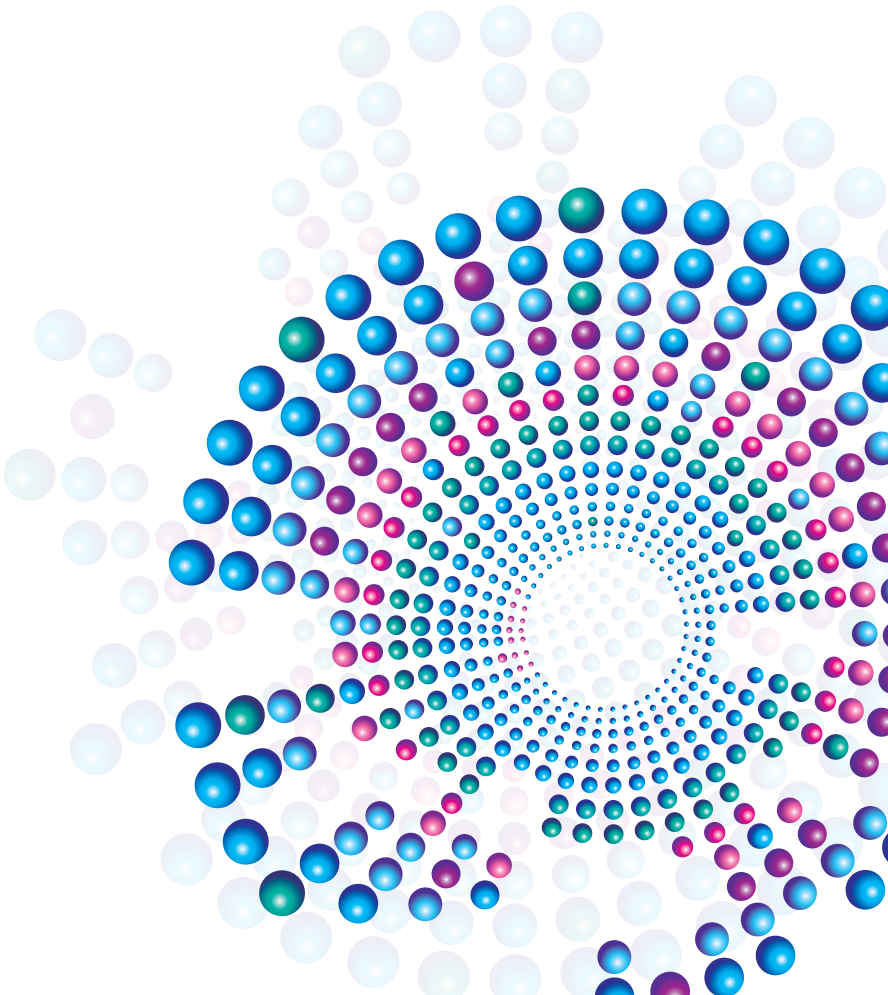
However, this publication does not offer any outlook on Renewable Energy (RE) since the promotion and development of RE projects is now under the purview of Sustainable Energy Development Authority of Malaysia (SEDA Malaysia), a statutory body mandated under the Renewable Energy Act 2011 (Act 725) to administer and manage the RE fund and the implementation of the feed-in tariff mechanism. All the information on RE can be found on their website at www.seda.gov.my.

This publication is prepared by ST using available information as at 31st December 2012 and consists of the following:-

- Industry Overview
- Demand Forecast
- Generation Capacities and Generation Outlook
- Fuel for Power Generation
- Transmission Network Capability and Transmission Network Outlook
- Competitive Bidding
- Electricity Tariff Setting Mechanism
- Incentive Based Regulation Mechanism
- Industry Reform Initiatives



Industry Overview

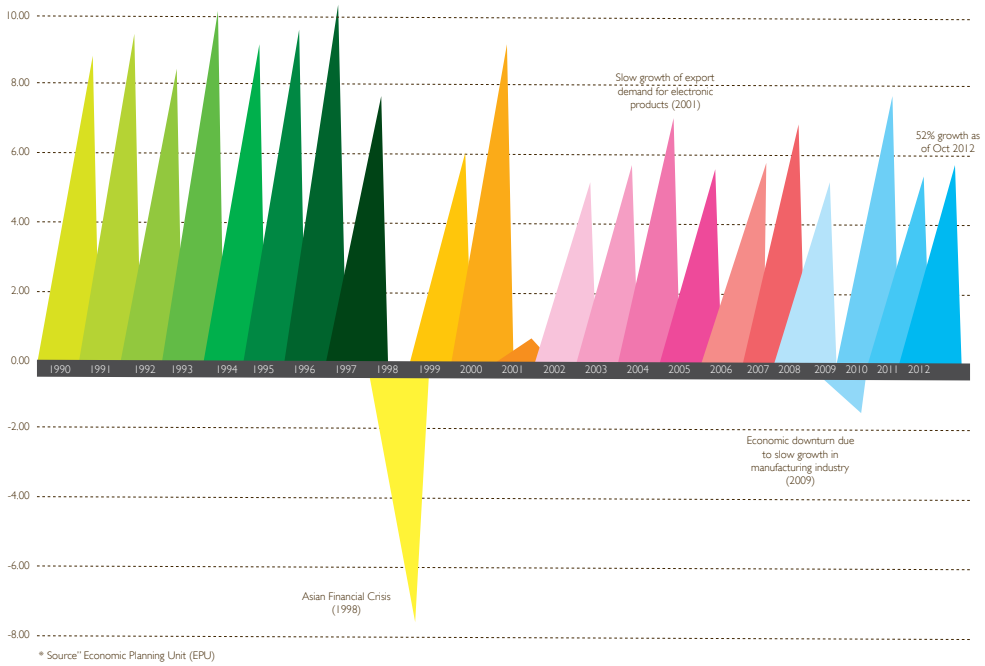


INDUSTRY OVERVIEW

Malaysia's Economic Review

Malaysia is one of Southeast Asia's successful economies and well developing country in the world. Its economic growth propelled from an agricultural and commodity-based to manufacturing and service-based economy. Over the last 20 years, Malaysia Gross Domestic Product (GDP) grew steadily at an average of 5.8% per year from 1990 to 2011, except for a sluggish growth in 1998 due to Asian Financial Crisis, slow growth of export demand for electronic products in 2001 and the economic downturn due to the slow growth in manufacturing industry in 2009.

Figure1: Country GDP (1990-2012)



* Source" Economic Planning Unit (EPU)

In 2010, the New Economic Model (NEM) was launched to transform the economy and propel Malaysia to being high income nation. Several economic transformation programme under NEM was introduced. Under such circumstances, the country GDP outlook is forecasted to grow at an average of 4.5% – 5.5% for the year 2013.

Figure 2: Historical data for energy intensity, demand and elasticity

Energy Indicators	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011
Primary Energy Intensity (toe/GDP at 2005 Prices (RM Million))	99	99	118	122	118	119	118	118	114	112
Final Energy Intensity (toe/GDP at 2005 Prices (RM Million))	61	65	69	70	70	73	70	65	61	61
Final Energy Demand per Capita (toe Per Capita)	0.73	1.07	1.26	1.45	1.5	1.63	1.63	1.46	1.47	1.5
Electricity Demand Intensity (GWh/GDP at 2005 Prices (RM Million))	0.092	0.115	0.142	0.148	0.147	0.146	0.145	0.153	0.155	0.151
Electricity Demand (kWh) Per Capita	1,101	1,902	2,603	3,048	3,152	3,285	3,370	3,452	3,700	3,708
Elasticity (of Final Energy Demand to GDP)	0.97	1.52	1.02	0.48	0.95	1.55	0.3	5.97	0.22	0.97
Elasticity (of Final Electricity Demand to GDP)	1.08	1.54	1.05	0.85	0.86	0.89	0.82	-2.48	1.19	0.54

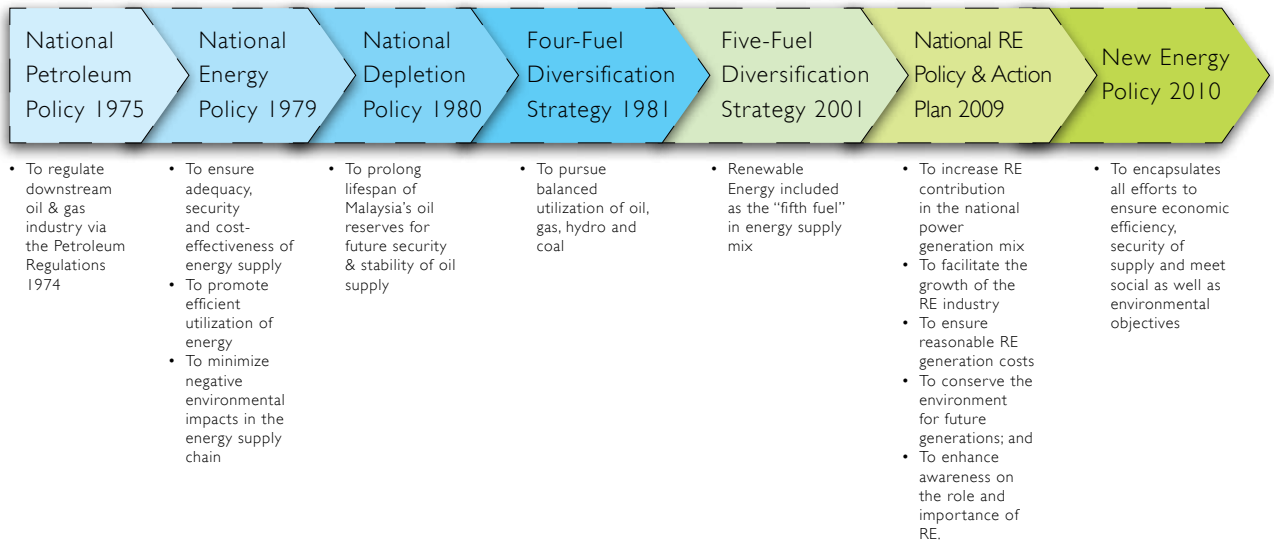
The primary energy intensity was at a lower level, albeit at increasing rate, from 99 toe/RM Million in 1990 to 118 toe/RM Million in 2000. This increase is mainly due to a shift in the economic structure; from an agriculture-based economy to manufacturing and service-based economy. Primary energy intensity remained at almost the same level from 2000 to 2011, between 112 toe/RM Million to 122 toe/RM Million which is an indication of the strong economic growth in the manufacturing and service-based economy.

The elasticity of primary energy supply to GDP gradually improved in the span of 20 years. Elasticity reduced from a high of 1.08 in 1990 to a more reasonable level of 0.54 percent in 2011; this development reflects an improvement of energy efficiency especially in the industrial sector. In addition, fuel switching from oil based to gas based in the industrial sector due to subsidised gas price reduced the electricity elasticity in the country.

Malaysia's Energy Policy

Malaysia's energy policies evolved over the years since the 1973 world oil crisis. The key policies guiding energy-related activities in Malaysia are:

Figure 3: Malaysia's Energy Policy



National petroleum policy:

The National Petroleum Policy was formulated in 1975 subsequent to the enactment of the Petroleum Development Act in 1974. The policy aims at regulating the oil and gas industry to achieve economic development needs. The policy goals include:

- Making available adequate supplies at reasonable prices to support national economic development objectives, thus, placing the application of oil and gas resources to serve national needs as a first priority;

- Promoting greater Malaysian representation and providing a favourable investment climate, including creating opportunities for downstream industries; and

- Affecting an optimal social and economic pace of exploration of the economy's endowment of exhaustible oil and gas resources, taking into account the need for conservation of these depletable assets and the protection of the environment.

National energy policy:

In 1979, Malaysia's energy policy principles were broadly defined in terms of three policy objectives. These policy objectives were instrumental in guiding the formulation of Malaysia's five-year development plans. These are:

The Supply Objective
To ensure the provision of adequate, secure and cost-effective energy supply through developing indigenous energy resources, both non-renewable and renewable energy sources using least-cost options, and diversification of supply sources both from within and outside the economy;

The Utilisation Objective
To promote the efficient utilisation of energy and the elimination of wasteful and non-productive patterns of energy consumption; and

The Environmental Objective
To minimise the negative impacts of energy production, transportation, conversion, utilisation and consumption on the environment.

National depletion policy:

The National Depletion Policy was introduced in 1980 to manage the exploitation of the natural oil and gas reserves by applying production control on major oil fields. In 1996, under the Seventh Malaysia Plan, the National Depletion Policy was extended to include gas reserves. The policy set the limit for the production of oil each day at 650,000 barrels, whilst the consumption of domestic gas in Peninsular Malaysia will be limited to about 2,000 million standard cubic feet per day (mmscfd) respectively.

Four fuel strategy:

In 1981, the Government adopted the Four-Fuel Strategy, complementing the national depletion policy, aimed at ensuring reliability and security of supply. This strategy was designed to reduce the economy's over-dependence on oil. The strategy aims for a balanced energy supply mix of oil, gas, hydropower and coal. As much as possible, local resources will be used to enhance security of supply. There was a significant shift from oil to gas as major fuel for power generation. However, when viewed in the light of the Supply Objective of developing indigenous energy resources, as well as the Environmental Objective, the gas option has been the most logical way forward.

Five fuel strategy:

The government has also been conscious of the potential of renewable energy resources. Hence, in 2001, as outlined in the Third Outlook Perspective Plan (2001-2010) and the 8th Malaysia Plan (2001-2005), the Four-Fuel strategy was changed to a Five-Fuel Strategy, with the addition of renewable energy in the national energy mix.

New energy policy:

In 2010, the government released the New Energy Policy under the Tenth Malaysia Plan. Five strategic pillars have been identified to provide the primary areas of focus to achieve the country's Energy Policy Objectives i.e. the Supply, Utilisation and Environmental Objectives. The five strategic pillars are as follows:

Energy Pricing
Rationalising energy pricing gradually to match market price, taking into account current economic condition and affordability of the rakyat;

Strategic Supply Side Developments
Undertaking a more strategic development of energy supply by diversifying energy resources, including renewable energy resources. Nuclear energy will also be considered as an alternative source of energy;

End Use Energy Efficiency
Accelerating the implementation of energy efficiency initiatives in the industrial, commercial, residential and transport sectors;

Energy Governance And Regulation
Improving governance to support the transition to market pricing, while providing assistance to mitigate impact on the low income group; and

Management Of Change And Affordability
Ensuring that the New Energy Policy is implemented based on an integrated approach and according to schedule to achieve energy supply security.

Electricity Supply Industry In Peninsular Malaysia

Electricity supply industry is one of the components under the umbrella of the energy sector. Likewise in the other countries, the electricity supply industry plays a vital role for the country's growth and development.

Authorities and institutions

The electricity supply industry in the country is spearheaded by two agencies – the Economic Planning Unit of Prime Minister's Department (EPU), responsible for overall macro-economic planning and the Ministry of Energy, Green Technology and Water (KeTTHA), who formulates electricity supply policy.

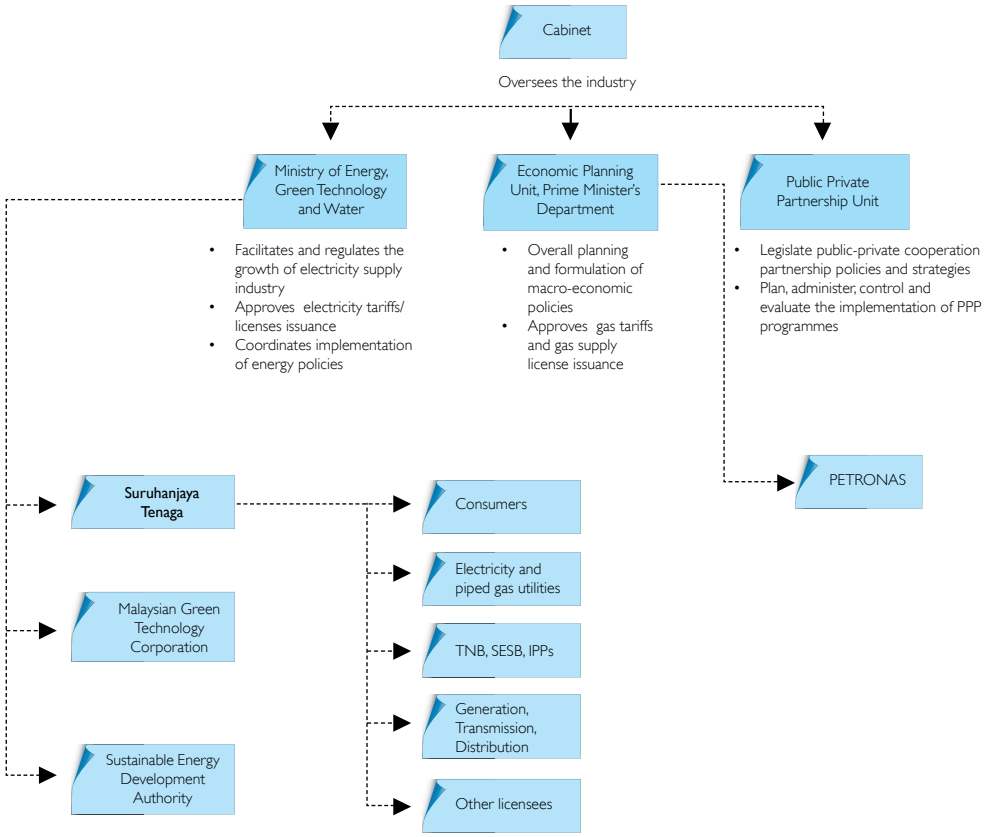
The two agencies as well as several others, formed a committee chaired by the Minister of Energy, Green Technology and Water, known as the Planning and Implementation Committee for Electricity Supply and Tariff (JPPPET). The committee is task to evaluate the supply demand situations and proposed plant-up programme, tariff revision, fuel supply situation and other issues with regards to electricity supply planning.

ST is the regulatory agency for electricity supply and piped gas supply industries in Peninsular Malaysia and Sabah. ST's main task are as following:

- To advise the Minister on all matters relating to electricity and gas reticulation industry
- To develop legal framework for economic regulation
- To recommends and improve regulatory jurisdiction
- To implement policy on electricity and piped gas industries
- To issue licenses and approvals for electricity and piped gas supply activities
- To regulate the industry on matters pertaining to safety, quality and reliability of supply.

In line with Government's transformation initiatives, starting from year 2010, the ST is tasked with implementing competitive bidding process for procurement of new generation capacity. Role of the ST will be further expanded to include regulating third party access for gas transmission infrastructure in the near future.

Figure 4: Authorities and institutions in electricity supply industry in Peninsular Malaysia



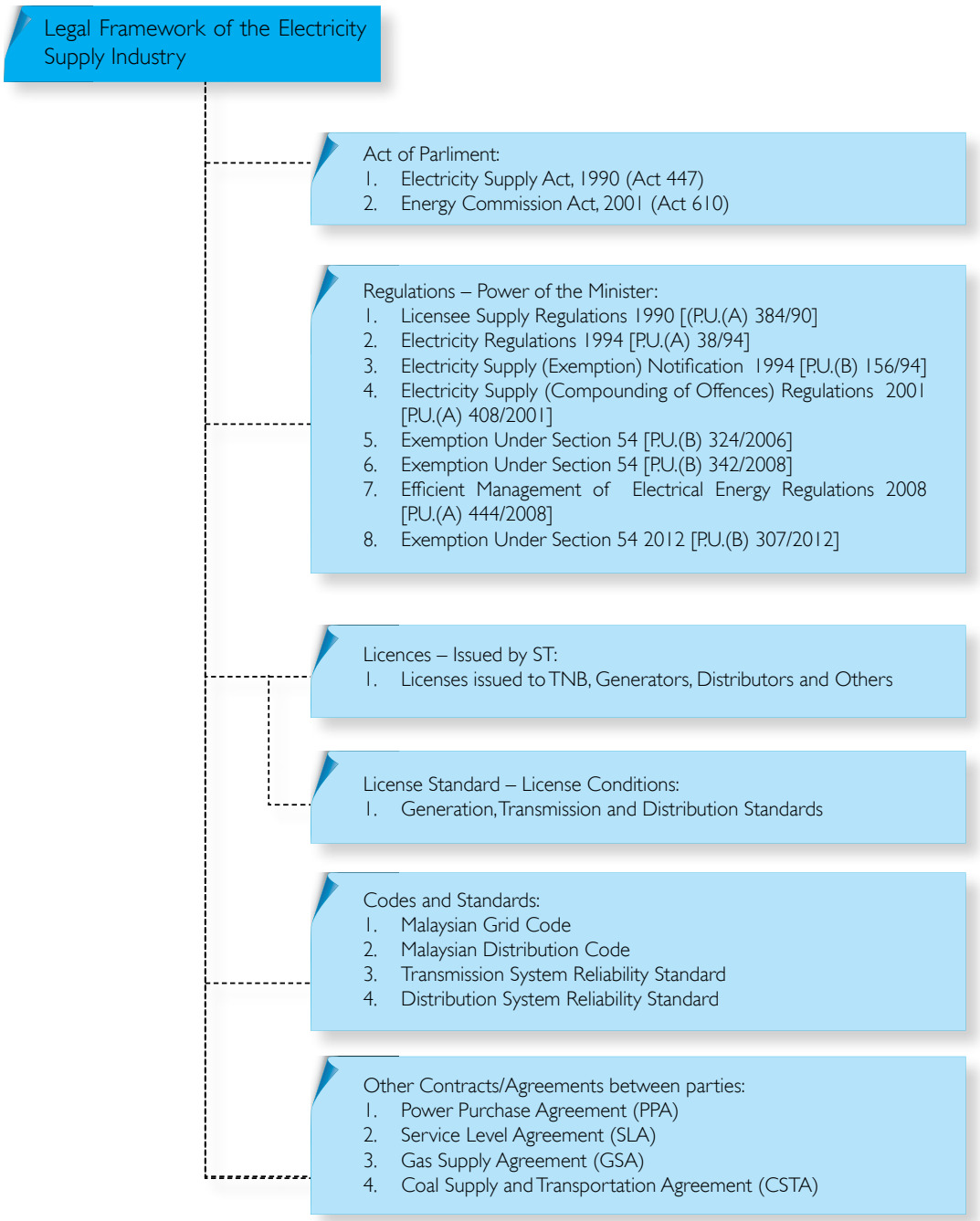
Legislation, codes and standards

The electricity supply industry related law covers several acts and regulations:

- **Electricity Supply Act 1990** is an Act to provide for the regulation of the electricity supply industry, the supply of electricity at reasonable prices, the licensing of any electrical installation, the control of any electrical installation, plant and equipment with respect to matters relating to the safety of persons and the efficient use of electricity and for purposes connected therewith.

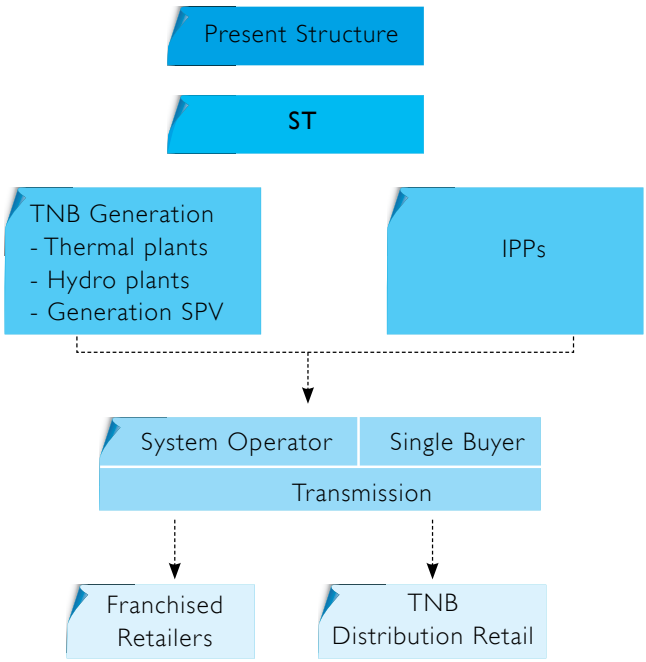
- **Energy Commission Act 2001** is an Act to provide for the establishment of the ST with powers to regulate the energy supply activities in Malaysia, and to enforce the energy supply laws, and for matters connected therewith.

Figure 5: Legal framework of the electricity supply industry



Industry structure and governance

In middle of 1990's, the Government allowed private companies to participate in the generation sector through the introduction of Independent Power Producers (IPPs). The IPPs were given licenses to supply electricity to TNB through negotiated power purchase agreements (PPA). However, transmission and distribution networks which form the national grid remains under the control of TNB.



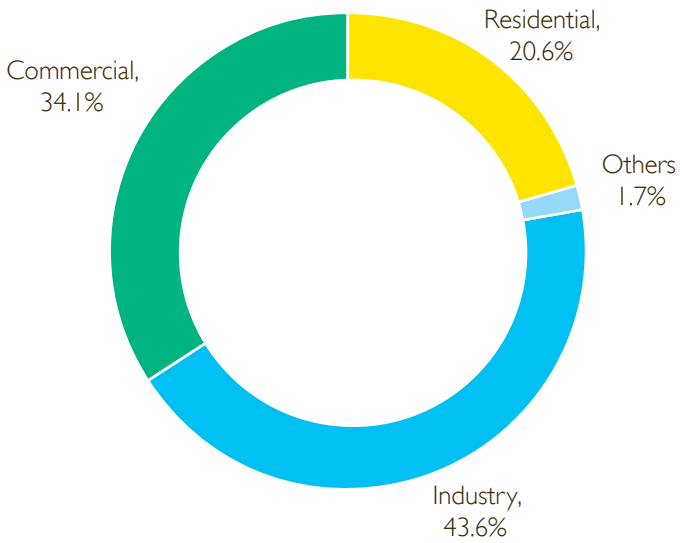
The current structure of the industry remains the same with TNB and IPPs as the main players for the generation sector. However, the business activities of TNB is segmented into 5 business entities, in anticipation of full implementation of Incentive-Based Regulation by year 2015. In general, TNB undertakes activities in generation, transmission, distribution, retail, energy procurement (under the single buyer) and system operation (under the system operator). However area specified distributors are introduced to allow for privately owned companies as franchised operators to distribute electricity within the restricted or licensed area.

In the Peninsula, the single buyer is responsible for energy procurement and scheduling of generation dispatch while the system operator is responsible for the grid system operation and real time dispatch. The single buyer and the system operator are in the process to be ring-fenced from TNB to ensure transparency, independence and fair play in generation scheduling and dispatch.

Electricity supply and demand

The reliable and adequate electricity supply is an important catalyst for the economic development in the country. Total installed generation capacity as of 31st December 2012 was 21,749 MW. With the peak demand of 15,826 MW which was recorded on 20th June 2012 , system reserve margin stood at 37%. In terms of energy generated, its gross generation for 2012 was 108,443.1 GWh (from 1st January to 31st December 2012), an increase of 2.6% percent from the previous year. The Industrial sector was the main user of electricity in Peninsular Malaysia with its share of 43.6% of the total consumption in 2012.

Figure 6: Sectoral percentage contribution for year 2012



Total consumption = 96,257 GWh

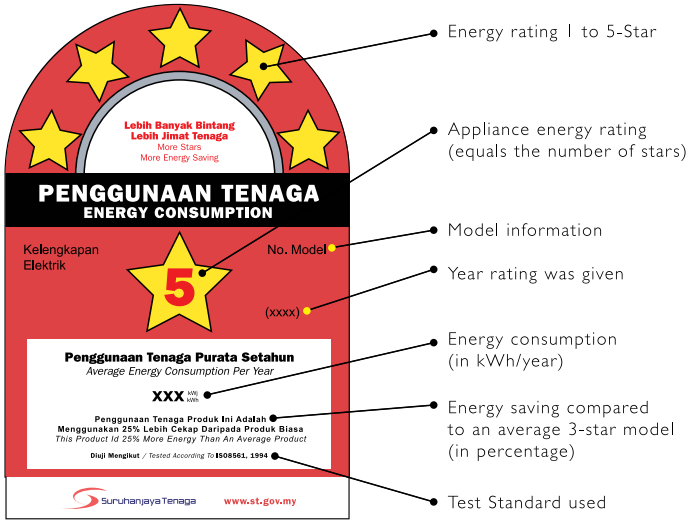
Energy Efficiency

Efficient energy utilisation remains high on Government's agenda as it contributes to sustainability of energy supply. Various incentives were introduced for energy efficiency (EE) such as Investment Tax Allowance (ITA) for energy efficiency projects, tax incentives in the form of ITA or Pioneer Status for companies that provide energy conservation services and sales tax exemption for EE products.

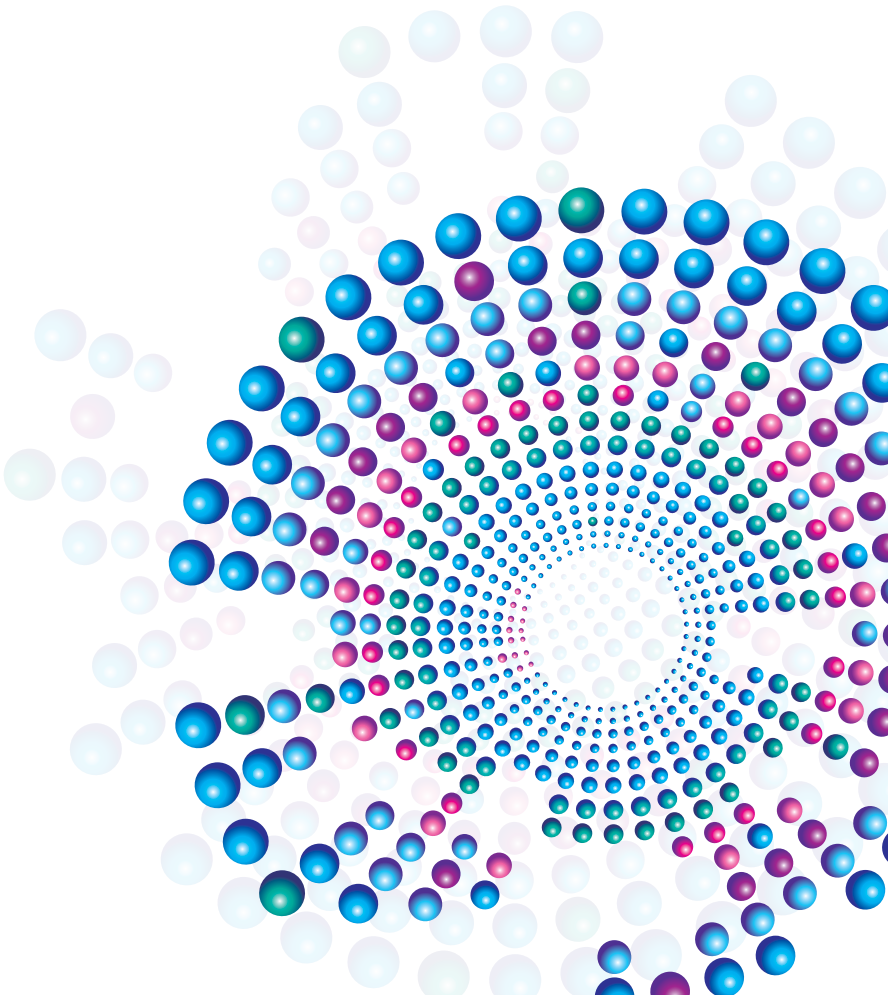
From regulatory perspective, introduction of new regulations and standards under the Electricity Supply Act 1990 will be the cornerstone for implementing EE in the country. Efficient Management of Electrical Energy Regulation (EMEER) was gazetted in 2008 to allow ST to enforce and monitor installations which receives or generate more than 3 Million kWh of electricity consecutively for 6 months. These installations are required to appoint a Registered Electrical Energy Manager. As of December 2012, there were 1,422 installations subjected under EMEER 2008 and 207 energy managers have been registered by ST. Under the Government's procurement policy, Energy Service Company who are interested to participate in the implementation of the Energy Performance Contracting in Government Buildings have to be registered with ST. Furthermore, in support of the implementation and enforcement of the 24 degree Celsius Temperature Setting Policy, proposed amendments to the EMEER 2008 has been drafted and in the final stage of approval .

For products and equipments efficiency, the focus is on 4 domestic appliances that are refrigerator, air conditioning, television and fans. Energy Efficiency Labeling for these appliances are already implemented. Moving forward, Minimum Energy Performance Standards (MEPS) will be implemented and enforced as part of the amendments to the Electricity Supply Regulations 1994. In addition, the development of 4 Malaysian Standards for MEPS has been approved by Standards Malaysia to further support the implementation and enforcement of MEPS.

Figure 7 : Comparative label



Demand Forecast



DEMAND FORECAST

Introduction

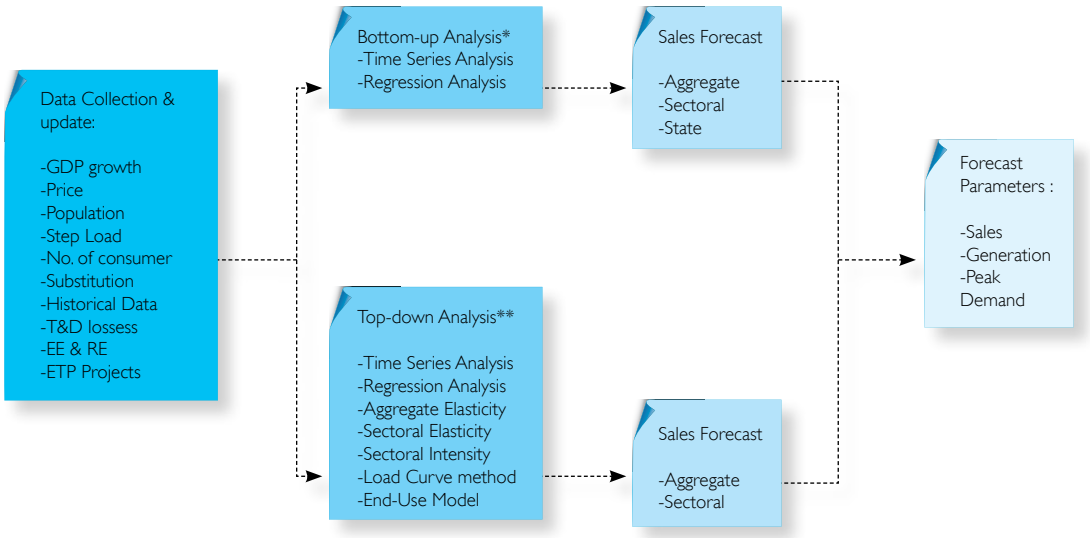
Demand Forecast, also known as Long Term Load Forecast plays a central role especially in the planning of the electric power system. This forecast was prepared by Load Forecast Unit which is currently under Planning Division of TNB and final approval through JPPPET. The forecast load will be up to 20 years ahead with focus on annual total sales, peak demand, and energy generation. In addition, TNB being the utility also conduct sectoral sales forecast such as for industrial, commercial, domestic, mining, public lighting and agriculture sector. The forecast is conducted on annual basis and with mid-year revision, which is in line with the License Condition and Malaysian Grid Code. The forecast is one of the essential inputs for the generation development plan.

Forecast Methodology

The long term load forecasting process is implemented through the use of industry-wide practice techniques as seen in the figure below. Analysis is made from macro and micro perspectives, utilizing both top-down and bottom-up approaches. The most recent economic data, information on electricity demand and technical and socio demographic data were used as inputs for the analysis. While key input to the study is the GDP forecast, other important parameters used are load factor, losses, electricity price, population, and energy efficiency (with the assumptions of 1% reduction in yearly sales forecast growth). The forecast for electricity sales, generation and peak demand are established based on various assumptions on the Malaysian economic and demographic development as well as technical parameters.

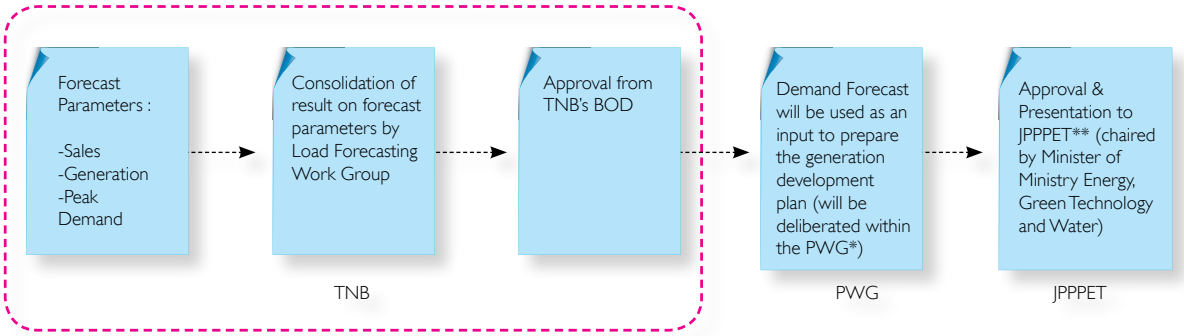
Within TNB, the input data and study findings are discussed at Working Group sessions before tabling for approval at Board of Directors meeting. The approved forecast will then be tabled to the national level Planning Working Group comprises of all key ESI stakeholders and chaired by ST. Outcomes from Planning Working Group will be deliberated for approval at JPPPET chaired by Minister of Energy, Green Technology and Water.

Figure 8: Long term load forecasting process



* *Bottom-Up Analysis : Assesses the demand at micro level e.g. growth centres/area(steps loads, number of customers)*
** *Top-down Analysis : Assesses the demand at macro level e.g. GDP, prices, population. etc*

Figure 9: Approval stages for the demand forecast



* *PWG : Planning Working Group*
** *JPPPET : Planning and Implementation Committee for Electricity Supply and Tariff*

Historical Trending

The following charts illustrate the relationship between growth rates of GDP and electricity generation, sales and peak demand. Historically, it can be seen that electricity demand was strongly driven by prevailing economic situation of the country.

Figure 10: Relative growth rates comparison

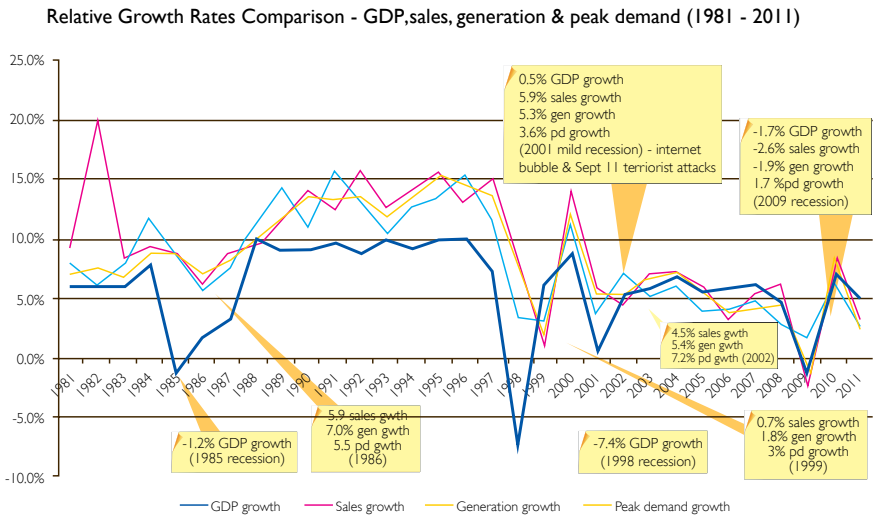


Figure 11: Peninsular Malaysia real GDP by sector

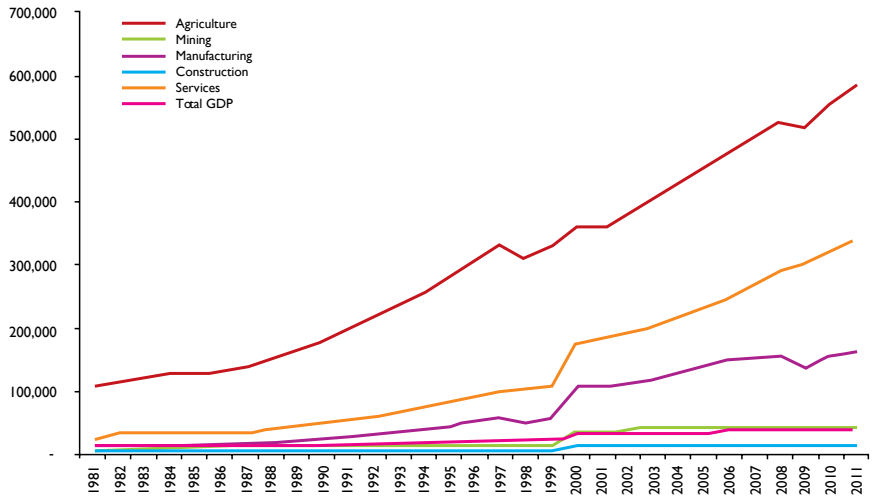
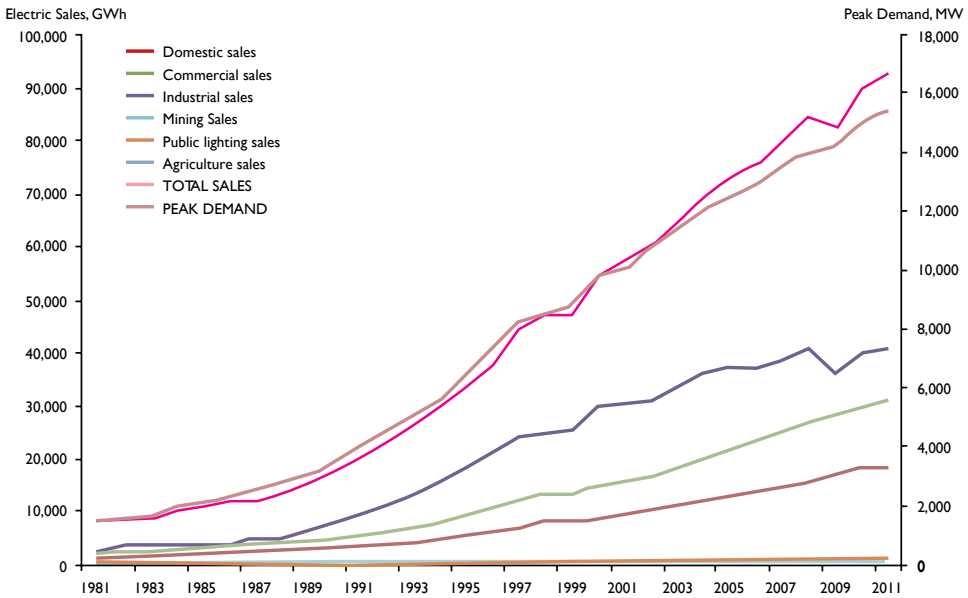


Figure 12: Peninsular Malaysia electricity sales and peak demand



GDP Forecast

As GDP determination is very important for long term load forecast, sources from various creditable agencies are used. While historical electricity intensities were less than 1 as compared to GDP, nevertheless GDP is expected to still play a major role in determining future demand growth. Thus, sensitivity studies were prepared in order to examine impact of various growth scenarios.

Based on the study, Peninsula GDP is expected to be at 4.8% for year 2012 and projected to grow encouragingly at 5.6% in 2013. The long term GDP growth is expected to remain strong at 5.9% p.a. (2016-2020) and 6.2% p.a. (2021-2030).

Table 1: Projected GDP growth for year 2012-2030

Year	2011	2012	2013	2014	2015	2016-2020	2021-2030
GDP (%)	5.1	4.8	5.6	5.7	5.8	5.9	6.2

Table 2: Comparison of periodical average growth rates for GDP and electricity sales, generation and peak demand

Period	Average period growth rates, % p.a.			
	GDP	Electricity Sales	Generation	Peak Demand
2012-2015	5.7	4.2	3.7	3.6
2016-2020	5.9	3.6	3.4	3.3
2021-2030	6.2	1.9	1.7	1.6

Long Term Load Forecast

Based on the latest electricity demand performance and current economic trends, an average electricity sales growth of 4.0% per annum (p.a) is forecasted for 2012-2015 period. The electricity sales are forecasted to reach 129,482GWh in the year 2020. Meanwhile, the electricity generation and peak demand are both projected to grow at the average of 3.5% p.a. and 3.7% p.a. respectively during the above period. Analysis conducted in latest forecast indicates that sales, generation and peak demand forecasts are higher as a result of positive recovery from the economic slowdown. The yearly forecast for electricity sales, generation and peak demand can be seen in the following table:-

Table 3: Long term load forecast as approved by JPPPET in 2012

	Year	Sales GWh	Growth %	Generation GWh	Growth %	Peak Demand MW	Growth %
HISTORICAL	2003	64,292	7.1%	73,795	7.1%	11,329	5.1%
	2004	68,963	7.3%	79,022	7.1%	12,023	6.1%
	2005	73,103	6.0%	83,303	5.4%	12,493	3.9%
	2006	75,446	3.2%	86,472	3.8%	12,990	4.0%
	2007	79,575	5.5%	90,283	4.4%	13,620	4.8%
	2008	84,464	6.1%	94,370	4.5%	14,007	2.8%
	2009	82,276	-2.6%	92,623	-1.9%	14,245	1.7%
	2010	89,533	8.8%	100,991	9.0%	15,072	5.8%
	2011	92,291	3.1%	103,354	2.3%	15,476	2.7%
	2012	96,257	4.3%	106,884	3.4%	15,826	2.3%

	Year	Sales GWh	Growth %	Generation GWh	Growth %	Peak Demand MW	Growth %
FORECAST	2013	100,135	4.0%	110,617	3.5%	16,539	4.5%
	2014	104,303	4.2%	114,689	3.7%	17,131	3.6%
	2015	108,167	3.7%	118,420	3.3%	17,671	3.2%
	2016	112,586	4.1%	123,049	3.9%	18,338	3.8%
	2017	116,540	3.5%	127,160	3.3%	18,926	3.2%
	2018	120,780	3.6%	131,573	3.5%	19,558	3.3%
	2019	124,788	3.3%	135,725	3.2%	20,149	3.0%
	2020	129,482	3.8%	140,613	3.6%	20,847	3.5%
	2021	133,640	3.2%	144,910	3.1%	21,456	2.9%
	2022	136,832	2.4%	148,153	2.2%	21,908	2.1%
	2023	138,201	1.0%	149,420	0.9%	22,067	0.7%
	2024	141,227	2.2%	152,478	2.0%	22,490	1.9%
	2025	144,188	2.1%	155,462	2.0%	22,900	1.8%
	2026	147,082	2.0%	158,371	1.9%	23,298	1.7%
	2027	149,909	1.9%	161,204	1.8%	23,685	1.7%
	2028	152,668	1.8%	163,962	1.7%	24,058	1.6%
	2029	155,358	1.8%	166,644	1.6%	24,420	1.5%
	2030	157,980	1.7%	169,250	1.6%	24770	1.4%
	Average period growth rate, % p.a. :						
	2012-2015		4.0%		3.5%		3.7%
	2016-2020		3.6%		3.4%		3.3%
	2021-2030		1.9%		1.7%		1.6%

Electricity Demand Forecast by Sector

Historically, industrial sector contributed towards the largest percentage in total sales and has grown largely by 13% p.a. between 1980-2000 and 2.9% p.a. between 2000-2011. It can be seen in figure below:-

In terms of sectoral sales, it is expected that industrial sales will grow moderately at 3.9% in year 2013, followed by 3.5% in year 2014. Commercial sector sales is expected to grow at an average of 4.0% for the next 2 years while domestic sales growth is anticipated to linger around 3.9%.

In terms of percentage contribution of sales, industrial sales share is projected to decline from 44% in 2011 to 38% in 2020. This is contributed by the increase in commercial sales share from 34% in 2011 to 39% in 2030 as the country moves towards a services-oriented economy in the future. Figure below shows the sales forecast for the various sectors.

Figure 13: Historical growth for sectoral sales

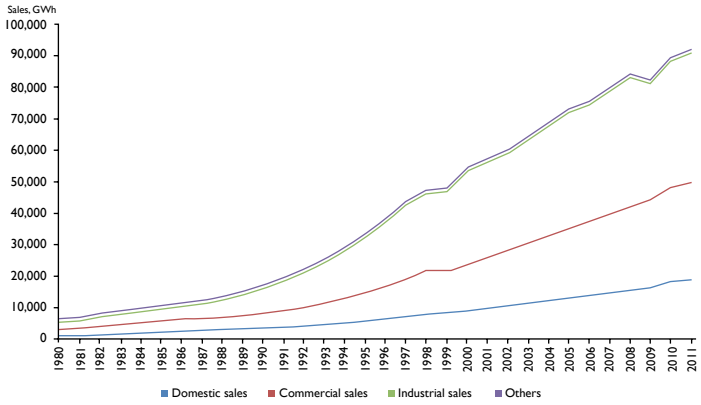
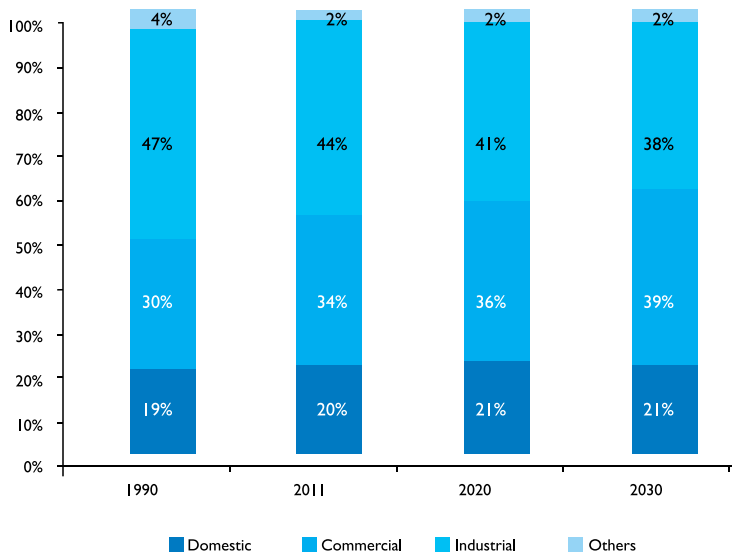
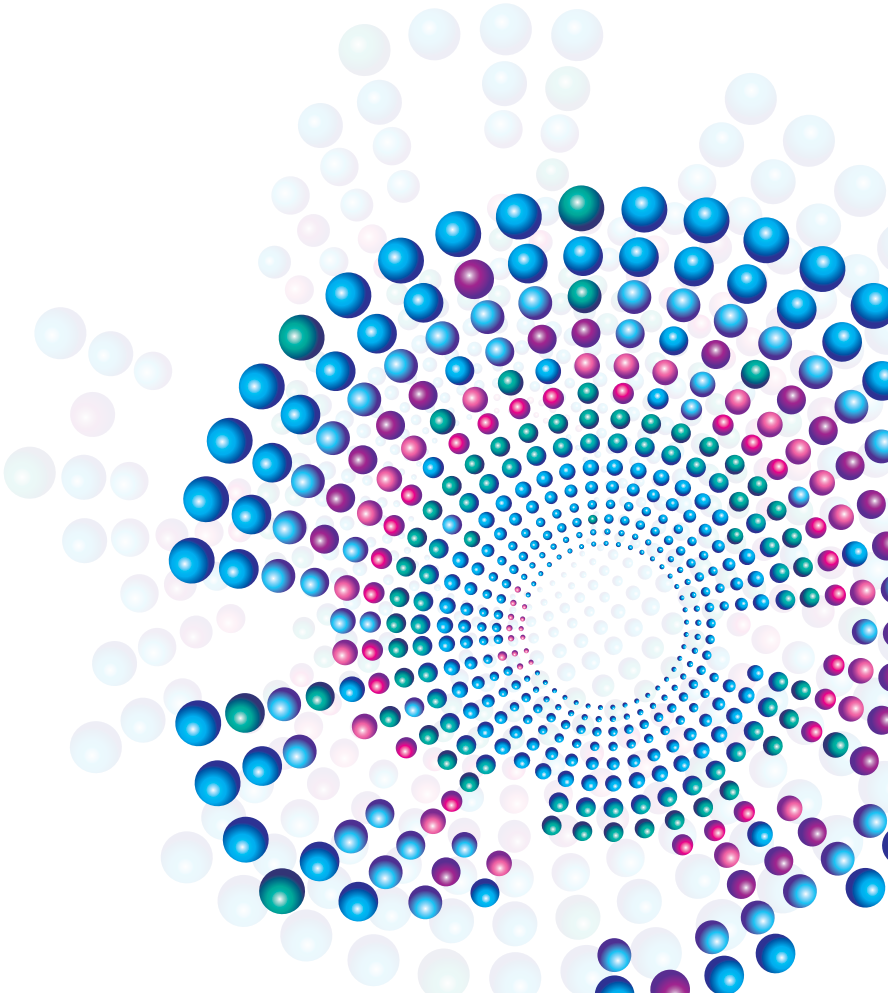


Figure 14: Latest sectoral forecast for Peninsula



Generation Capacities



GENERATION CAPACITIES

Generation Capacities

As of 31st December 2012, installed capacity in Peninsula stood at 21,749MW, primarily fuelled by natural gas and coal, and supplemented by hydroelectric. In terms of technical and commercial arrangement, the purchase of power from IPPs are through a long term PPA, and for TNB's plants, the purchase are through Service Level Agreements (SLA). Details of the installed capacity are described in the following tables:-

Table 4: Installed capacity by type

Type	Fuel	Capacity (MW)
Conventional Thermal	Coal	7,170
Combined Cycle Gas Turbine (CCGT)	Gas	9,373
Conventional Thermal	Gas	840
Open Cycle Gas Turbine (OCGT)	Gas	2,455
Hydroelectric	Hydro	1,911
Total		21,749MW

The details of current available capacity based on fuel are shown in the following charts :-

Figure 15: Available capacity mix by fuel

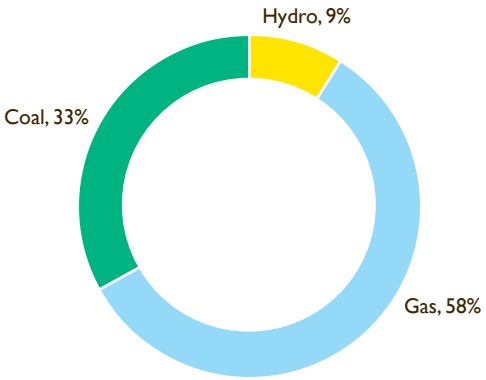


Table 5: Existing IPP power plants in Peninsula

IPP Power Plant	Fuel	Installed Capacity (MW)	PPA Expiry
YTL Power Generation	Gas	1,170	Sept 2015
Segari Energy Ventures Sdn. Bhd.	Gas	1,303	Jun 2017
Powertek Sdn. Bhd.	Gas	434	Jan 2016
Port Dickson Sdn. Bhd.	Gas	436.4	Jan 2016
Pahlawan Power Sdn. Bhd.	Gas	322	Aug 2020
Genting Sanyen Power Sdn. Bhd.	Gas	762	Feb 2016
Teknologi Tenaga Perlis Consortium Sdn. Bhd.	Gas	650	Mar 2024
Panglima Power Sdn. Bhd.	Gas	720	Feb 2023
GB3 Sdn. Bhd.	Gas	640	Dec 2022
Prai Power Sdn. Bhd.	Gas	350	Jun 2024
Kapar Energy Ventures Sdn. Bhd. (KEV)	Gas / MFO / Coal	2,420	July 2029 (U1 to U6) July 2019 (GT8 and 9)
TNB Janamanjung Sdn. Bhd.	Coal	2,070	Aug 2031
Tanjung Bin Power Sdn. Bhd.	Coal	2,100	Sept 2031
Jimah Energy Ventures Sdn. Bhd.	Coal	1,400	Dec 2033
Total Installed Capacity (MW)			14,777.4

Table 6: TNB power plants

TNB Power Plant	Fuel	Installed Capacity (MW)	SLA Expiry
S.J. Sultan Ismail , Paka	Gas	1,136	Aug 2017
S.J. Jambatan Connaught (CBPS)	Gas	832	Aug 2014
S.J. Serdang	Gas	625	Aug 2015 (GT1 , GT2 & GT3) Aug 2025 (GT4 & 5)
S.J. Gelugor	Gas	330	Aug 2024
S.J. Sultan Iskandar, Pasir Gudang (PGPS)	Gas / MFO	729	Dec 2012 (Thermal) Aug 2017 (Combined Cycle) Aug 2016 (Open Cycle)
S.J. Tuanku Jaafar, Port Dickson	Gas	1,409	Aug 2028 (PD1) Jan 2030 (PD2)
S.J. Kenyir	Hydro	400	Aug 2025
S.J. Pergau	Hydro	600	Aug 2037
S.J. Sungai Perak Scheme	Hydro	649.1	Aug 2022
S.J. Cameron Highland	Hydro	261.9	Aug 2027
Total Installed Capacity (MW)			6,972

New Generation Projects

New generation programme, to cater for imminent capacities retirement and system growth, is reviewed on annual basis through JPPPET. The Committee, chaired by the Minister of Energy, Green Technology and Water and comprises of all key stakeholders in electricity supply industry, evaluates and recommends to the Government on the new generation projects required to meet future demand.

Table 7: New generation projects

Projects	Fuel	Installed Capacity (MW)	Commercial Operation Date
Manjung IV	Coal	1,010	31st Mar 2015
CBPS Repowering	Gas	343	31st Aug 2015
Hulu Terengganu	Hydro	250	U1: 16th Sept 2015 U2: 17th Dec 2015
Hulu Terengganu (Tembat)	Hydro	15	U1: 15th Nov 2016 U2: 15th Dec 2016
Ulu Jelai	Hydro	372	U1: 13th Dec 2015 U2: 14th Mar 2016
Tg Bin Energy	Coal	1,000	1st Mar 2016
TNB Prai CCGT	Gas	1,071.43	1st Mar 2016
Pengerang Co-Generation	Gas	400	1st Jan 2017
Additional Chenderoh	Hydro	12	29th Oct 2018
Tekai	Hydro	156	12th Nov 2020
Telom	Hydro	132	25th Dec 2022
Nenggiri	Hydro	416	U1: 11th Mar 2024 U2 : 9th Jun 2024 U3 : 7th Sept 2024 U4 : 6th Dec 2024

Extension of Existing Plants

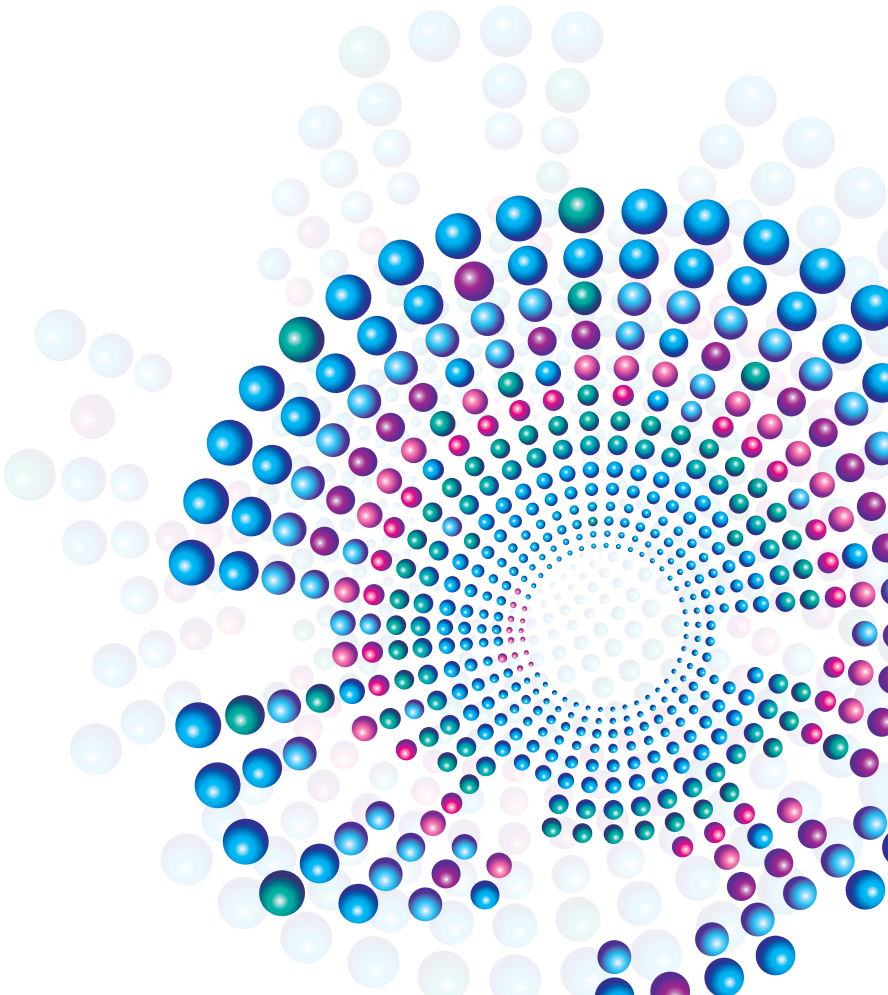
Apart from development of new power plant, other options such as plant extension were considered as possible least cost alternative to meet future demand. Subsequent to Government's decision to extend existing power plants through implementation of restricted bidding among pre-qualified First Generation IPPs and TNB (Track 2), combined cycle units in TNB's SJ Sultan Iskandar Pasir Gudang, Genting Sanyen Power and Segari Energy Ventures were awarded extension for 5 or 10 years.

Table 8: Extension of existing plant

Plants	Capacity (MW)	Fuel	New PPA Expiry Date
S.J. Sultan Iskandar - CCGT Extension	275	Gas	31st Aug 2022 (5 years)
Genting Sanyen Power Sdn. Bhd. (GSP Extension)	675	Gas	22nd Feb 2026 (10 years)
Segari Energy Ventures Sdn. Bhd. (Segari Extension)	1,303	Gas	30th June 2027 (10 years)

Based on current demand growth, identified capacity shortfall will be mitigated through medium term plant extension in addition to approved new generation projects. If the future growth exceeded forecasted growth, the need for short term extension may arise. Any short term extension of existing plants will be decided within reasonable timeframe so as to ensure adequate generation capacity be made available at all times in the grid system.

Generation Outlook



GENERATION OUTLOOK

Generation Planning Criteria

Generation Development Plan studies are carried out from time to time in order to continually assess the adequacy and robustness of recommendation in planning for future capacities. Planning criteria is based on Loss of Load Equivalent (LOLE) of not more than 1 day/year. Established analytical tools are used extensively to carry out simulations incorporate all important parameters such as fuel price, fuel mix, technology employed and demand profile. In line with the Government's effort to reduce direct fuel subsidy to the power sector, the approved Generation Development Plan already take into consideration of gradual gas price increase from RM13.70/mmBtu to reach the projected market price of RM44.36/mmBtu. Coal price and supply is expected to remain high and volatile despite slight drop in the price of late. For that reason, development such as system interconnection with Sarawak needs to be considered to ensure balance fuel mix and helps stabilizing electricity pricing.

Generation Development Plan

The approved Generation Development Plan up to 2022 is as follows:

Table 9: Generation development plan

Year	Recommended Plant-Up
2015	Manjung IV (1,010MW), CBPS Repowering (343MW)
2016	Hulu Terengganu (250MW), Ulu Jelai (372MW) Tg. Bin Energy (1,000MW), Tembat (15MW), TNB Prai CCGT (1,071.43MW), GSP Extension (675MW)
2017	Pengerang CoGen (400MW), Segari Extension (1,303MW), SJ Sultan Iskandar CCGT Extension (275MW), New Coal (1,000MW)
2018	Chenderoh (12MW), New Coal (1,000MW)
2019	New Coal (1,000MW)
2020	New CCGT (1,000MW), Tekai (156MW)
2021	Sarawak Interconnection (2,000MW)
2022	Telom (132MW)

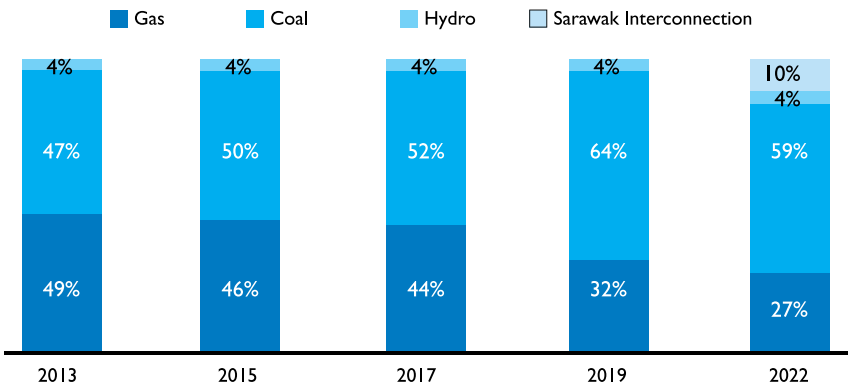
Table 10: Retirement plan up to 2021

Year	Retirement Plan
2012	SJ Teluk Ewa (68MW)
2013	SJ Sultan Iskandar - Thermal (184MW)
2015	SJ Jambatan Connaught (756 MW)
2016	SJ Putrajaya (325MW) SJ YTL Power (1,170MW) SJ Port Dickson Power (436.4MW) SJ Powertek (434MW)
2017	SJ Sultan Iskandar - OCGT(205MW)
2018	SJ Sultan Ismail, Paka (1,000MW)
2020	SJ Kapar (KEV OCGT = 220MW)
2021	SJ Pahlawan Power (322MW)
2022	SJ Sultan Iskandar - CCGT Extension (275MW)

Generation Mix

The generation mix for Peninsular Malaysia based on the approved Generation Development Plan is as follows:-

Figure 16: Generation mix



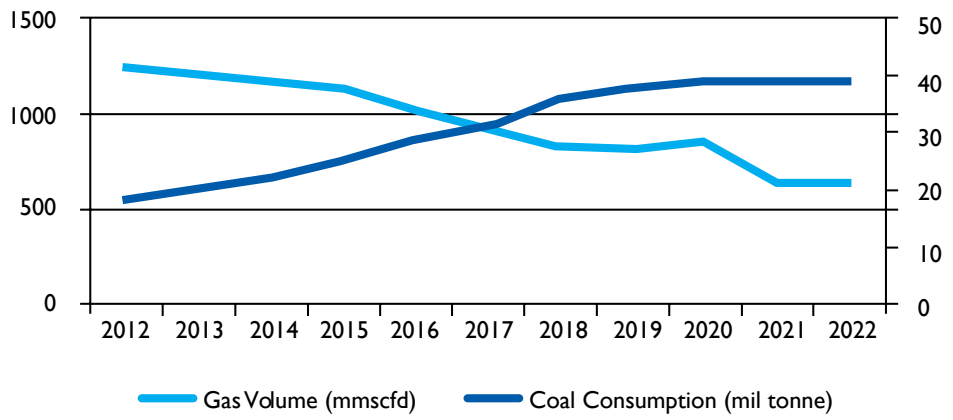
In the coming years, power generation in Peninsular Malaysia still relies heavily on two fossil fuels i.e gas and coal. To improve the generation mix, power transfer from Sarawak and possible interconnection with neighbouring countries have to be explored. On positive note, LNG regassification terminal (RGT) in Sg. Udang Melaka with a capacity of 520 mmscfd or 3.8 million tonne per year should be able to come on stream in June 2013. With commissioning of the RGT, LNG import is expected to supplement indigenous gas supply and help sustain future needs.

In 2016, gas usage will decrease due to the retirement of several gas plants. It will further decrease in 2019 to 32% where coal makes up 64 % of the overall mix and overtake gas as dominant fuel. The pattern of the mix shows that the gas usage decreases over time and will constitute to only 27% of the overall mix by year 2022. In order to have a balanced fuel mix, possible commencement of Sarawak interconnection is targeted to come on stream post 2020 onwards, resulting in less coal usage. Share of hydroelectricity in the fuel mix is forecasted to be consistent at 4% due to the commencement of new plants with total capacity of 937MW from 2015-2022.

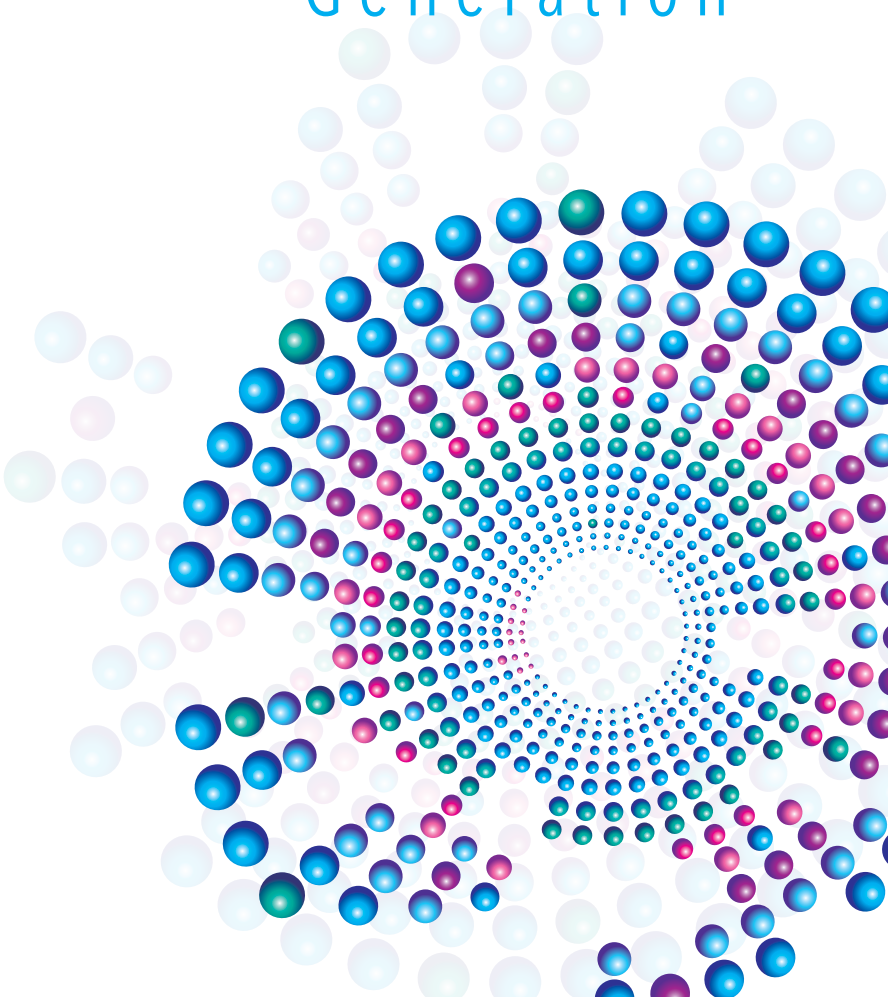
Fuel Consumption

Based on the approved generation development plan, the system will have more coal plants as the gas price increases. Gas consumption drops substantially post 2015 due to retirement of 1st Gen IPPs, replacement of more efficient gas plants and injection of power from Sarawak to the system. When coal option is made available in 2017, coal consumption will gradually increase up to 40 million tonnes per year as gas price increases.

Figure 17: Annual average fuel consumption



Fuel For Power Generation



FUEL FOR POWER GENERATION

Fuel Sources for Power Sector in Peninsular Malaysia

Natural gas, coal and hydroelectricity are the three main fuel sources for power generation in Peninsular Malaysia. For natural gas, the supply comes from two points namely Kerteh in Terengganu and Malaysia-Thailand Joint Development Area through the Peninsula Gas Utilisation (PGU) pipelines. Majority of the volumes from Kerteh is indigenous gas while the rest comes from Indonesia and Vietnam.

While gas volume allocated to power sector is 1,250 mmscfd, depleting reserves and operational disruptions caused the volume received to be less than allocated. To compensate for less gas, gas-fired power plants had to use distillate as substitute whereas thermal units had to fire medium fuel oil (MFO). In order to diversify supply, LNG regassification terminal are being built and scheduled for operation in second quarter of 2013. The gas will be supplied to the consumer through PGU pipelines.

Coal, on the other hand, is fully sourced from countries such as Indonesia, Australia, South Africa and Russia. In terms of transportation, large vessels were used for direct supply from ports to respective power plants. Bituminous and sub-bituminous coals are used for power generation. At the moment, coal consumption stood at around 20 million tonnes every year and expected to increase to more than 25 million tonnes annually after the commissioning of new capacities in Manjung and Tanjung Bin.

PETRONAS is the sole supplier of gas to power sector while coal procurement for all coal-fired power plants is carried out by TNB Fuel Services Sdn. Bhd. a wholly-owned subsidiary of TNB. In terms of arrangement, fuel supply is based on terms and conditions as stipulated in Gas Supply Agreement for natural gas and Coal Supply and Transportation Agreement for coal.

Fuel Pricing for Power Sector in Peninsular Malaysia

Right energy pricing is fundamental to an efficient allocation and use of energy resources, and also to ensure the economic, social and environmental costs are reflected in the price. Economic factors and political events, to certain extent, also play an important role in the energy pricing determination.

Indexation of gas price to power sector at 104% medium fuel oil was decided by the Government in year 1992. Subsequent revision of the gas pricing mechanism to power sector in Peninsular Malaysia was made following economic downturn and sharp depreciation of Ringgit Malaysia against US Dollar in 1997, The price was then fixed at RM6.40 per mmBtu effective from 1st May 1997 until 31st December 2000 as an interim measure to help economy recovery. However, the price remained the same until June 2008 despite recovery from recession and the ever increasing oil prices on the global market as depicted in Figure 18.

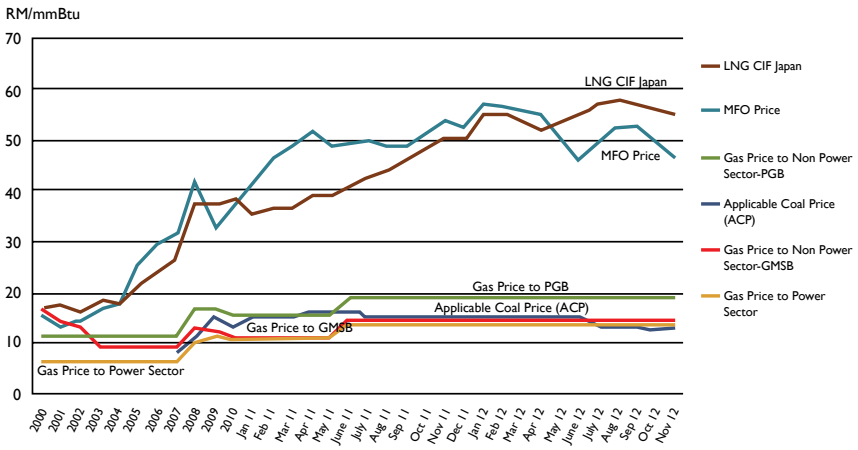
Beginning first half of year 2008, as the oil prices skyrocketed above US$130 per barrel, the Government started re-examining gas prices to both power and non-power sector. On 1st July 2008, gas price for the power sector increased from RM6.40/mmBtu to RM14.31/mmBtu, an increase of 124%. However, after 8 months, the price was then revised downwards to RM10.70/mmBtu in Mac 2009, a reduction of 25% due to declining oil price below US$50 per barrel.

Since then, MFO price rose over 100% since January 2009 and reaches its peak in early 2012. The increase is influenced by factors such as the Organization of the Petroleum Exporting Countries (OPEC) production decision and expectation about future world demand for petroleum and other liquids fuels that may affect prices in the longer term. Increase of the MFO price in 2011 to 2012 is attributed to the turmoil in the Middle East and North Africa, Greek debt crisis with financial impact spreading to other Eurozone countries, and an earthquake in Japan, all leading to higher oil price. The same goes for the LNG CIF trend that follows closely with MFO price trend.

Consequently, gas prices to the power sector, Gas Malaysia Sdn. Bhd. and Petronas Gas Berhad were increased to RM13.70/mmBtu, RM14.05/mmBtu and RM18.35/mmBtu respectively in June 2011. Also, in line with subsidy rationalisation effort, the Government decided that the price will be increased by RM3.00/mmBtu for every six months until it reaches market price. Impact of prices volatility to electricity tariff can then be moderated while consumers will have enough time for consumption adjustment.

For coal pricing, a mechanism known as Applicable Coal Price (ACP) was introduced beginning year 2011 to set common coal prices to be used in coal-fired power plants. The ACP, set every three months or on quarterly basis, is based on the forward looking weighted average delivery prices (CIF) of all bituminous and sub-bituminous coals for delivery in each quarter. In the future, ACP will be used as reference for coal price in electricity tariff review process. As of 4th Quarter 2012, ACP stood at RM15.10/mmBtu or US$107.29 per tonne, mainly attributed by softening of demand in seaborne market. However, it is still higher than the benchmark price of US$85 per tonne used for tariff review in June 2011.

Figure 18 : Average fuel price trend in RM/mmBtu for the energy sector



Fuel Mix Study

Attaining supply security, affordable tariff and with minimum impact to the environment are the objectives set in National Energy Policy. Costs increase especially for fuel component require reassessment of fuel mix policy to ensure all the objectives are met. In order to formulate policy on fuel mix, a study was conducted by Ministry of Energy, Green Technology and Water and MyPower Corporation.

The study aims at identifying and addressing the fuel mix options and fuel security risk. Recommendations from the study are used to develop long term generation development plan. Areas covered by the study are as follows:

- Security, sufficiency, efficiency, cost-effectiveness, sustainability and quality of supply
- Subsidy rationalization on elements in the electricity supply chain
- Efficient utilization of energy
- Minimizing negative environmental impacts
- 7 parameters of Energy Security (ES) were identified as proposed framework to be adopted for long term generation development plan together with determining factors such as availability, accessibility, affordability and acceptability of the fuel

Figure 19: Proposed framework for electricity supply security and fuel mix

#	Parameter	Where We Are Today	Proposed Targets	Strategic Actions
ES1	Global reserves-to-production ratios for gas, coal and oil.	Gas - 60 years Coal - 120 years	Check that coal, gas and oil are able to maintain global R/P ratio > 60 yrs during planning horizon	• Current R/P ratios adequate for coal and gas • Need to monitor R/P ratios for domestic gas
ES2	Power sector reserve margin	LOLE<1 day Reserve margin = 32%	LOLE<=1 day	• Continue use as benchmark in JPPPET plant-up planning • Equivalent to about 22% reserve margin benchmark to developing economies

#	Parameter	Where We Are Today	Proposed Targets	Strategic Actions
ES3	HHI for fuel mix (i.e. gas, coal, oil, hydro) for the power sector	HHI=0.48	HHI<=0.5 by 2020 HHI<=0.4 by 2025	• Apply as benchmark in JPPPET plant-up planning
ES4	HHI for fuel suppliers (country of origin) for the power sector	HHI=0.6 (Coal) HHI=0.5 (Domestic Gas)	HHI<=0.5 (for coal)	• Encourage utility to diversify sources of coal as soon as practicable via pass-through mechanism
ES5	Net energy import dependence (NEID) for gas, coal and oil for the power sector	NEID (Coal) =100% NEID (Gas) = 80%	NEID ratio drive ES4 HHI • When NEID -ve : HHI not relevant • When NEID +ve : HHI <0.5	• Net import dependent fuels will require diversification of source
ES6	Gas, coal and oil stocks available to power sector	Gas = Negative Reserve Coal = 45 days	Gas = Reserve margin of 15% Coal = 90 day by 2018	• Encourage investment to build stocks and capacity • Cost pass through critical to incentivise investment
ES7	CO_2 emissions intensity for the power sector	0.64t/MWh	Today=<0.7t/MWh 2020 onwards=<0.62t/MWh 2025 onwards=<0.52t/MWh	• Apply as benchmark in JPPPET planning • Encourage RE & EE, Sarawak import and/or Nuclear

HHI : Herfindhal Hirschman Index

LOLE : Loss of Load Equivalent

Natural Gas Supply Management

Over the years, the indigenous gas production declined due to maturing fields whereas demand for the fuel is steadily rising especially from industrial users. In December 2010, during scheduled major maintenance in several offshore facilities that caused drop in gas production, fire broke out in one of the major platforms, further aggravated the already tight supply to power sector.

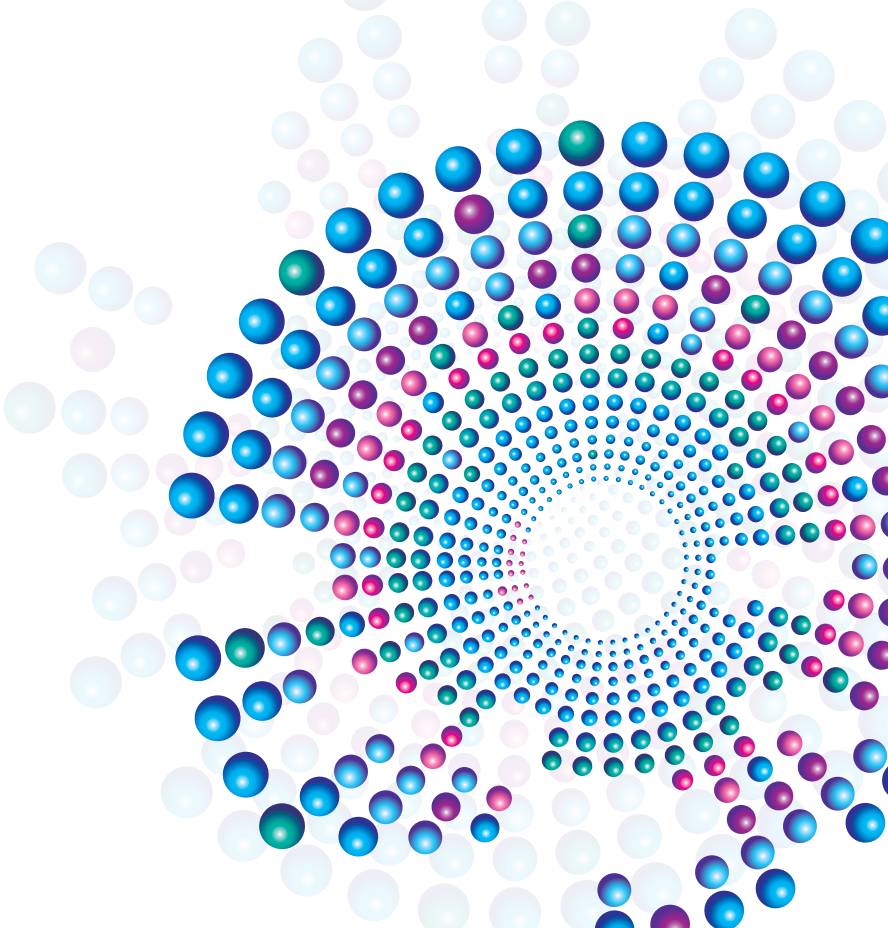
Although consumers did not suffer even a blip to their electricity, the incident served as a warning to all parties involved. While several initiatives were already introduced in order to sustain domestic gas production, most notably being the exploration of new fields, gas shortage situation is expected to recur as no new source is available prior to operation of RGT in Melaka.

To overcome it, the Government formed the National Gas Task Force (NGTF) comprises of Performance Management Delivery Unit (PEMANDU), EPU, Ministry of International Trade and Industry (MITI), Malaysian Investment Development Authority (MIDA), KeTTHA, ST, PETRONAS, TNB, and Gas Malaysia Berhad (GMB) after the December 2010 incident. Initially, the objective was to coordinate overall gas supply operation and delivery of distillate fuel to power stations as extensive and lengthy repair works were required on the damaged platform. However, due to prolonged gas shortage situation, role and formation of the NGTF remained so as to monitor the natural gas production and supply in the country with the objectives as follows:

- Monitor to ensure gas supply across the network is not affecting consumers and businesses;
- Monitor performance of distribution and supply network – anticipate potential issues and problems;
- Ensure activities committed by PETRONAS, TNB and relevant stakeholders are carried out;
- React rapidly and make quick on-the-spot executive decisions when gas supply is at detrimental levels;
- Develop contingency plans in the event of planned shutdowns;
- Lead/spearhead national gas crisis war room when triggered; and
- Develop and approve a communications plan when and if required

Supply shortage was at its worst in 2011. TNB had to incur additional fuel cost of RM3.07 billion resulting from unexpected usage of distillate and oil. To lessen the utility's burden, fuel cost sharing mechanism was agreed upon between Government, PETRONAS and TNB. The mechanism is expected to continue until commencement of RGT operation in June 2013.

Transmission Network Capability



TRANSMISSION NETWORK CAPABILITY

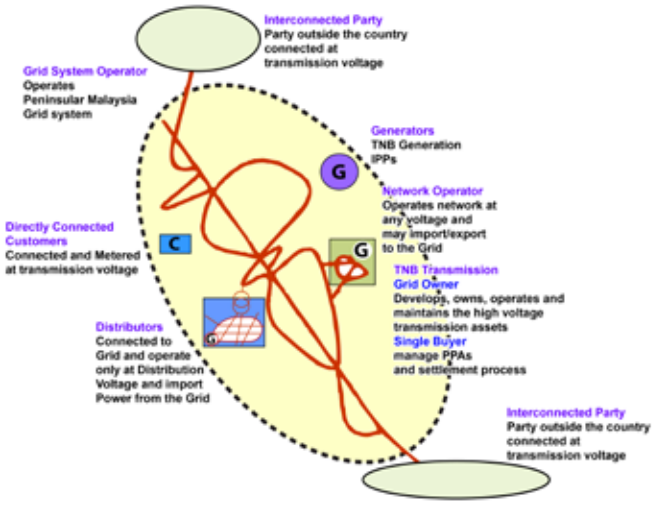
Introduction

Transmission networks which form a Grid System in Peninsular Malaysia consists of 500kV, 275kV and 132kV system voltage levels. TNB owns and operates the Grid System and it's called the Grid Owner. The Grid Owner is entrusted to plan and develop the Grid System in order to maintain adequate grid capacity. The key requirements of these networks are based on Malaysian Grid Code (MGC) and Transmission System Reliability Standard (TSRS).

Malaysian Grid Code (MGC)

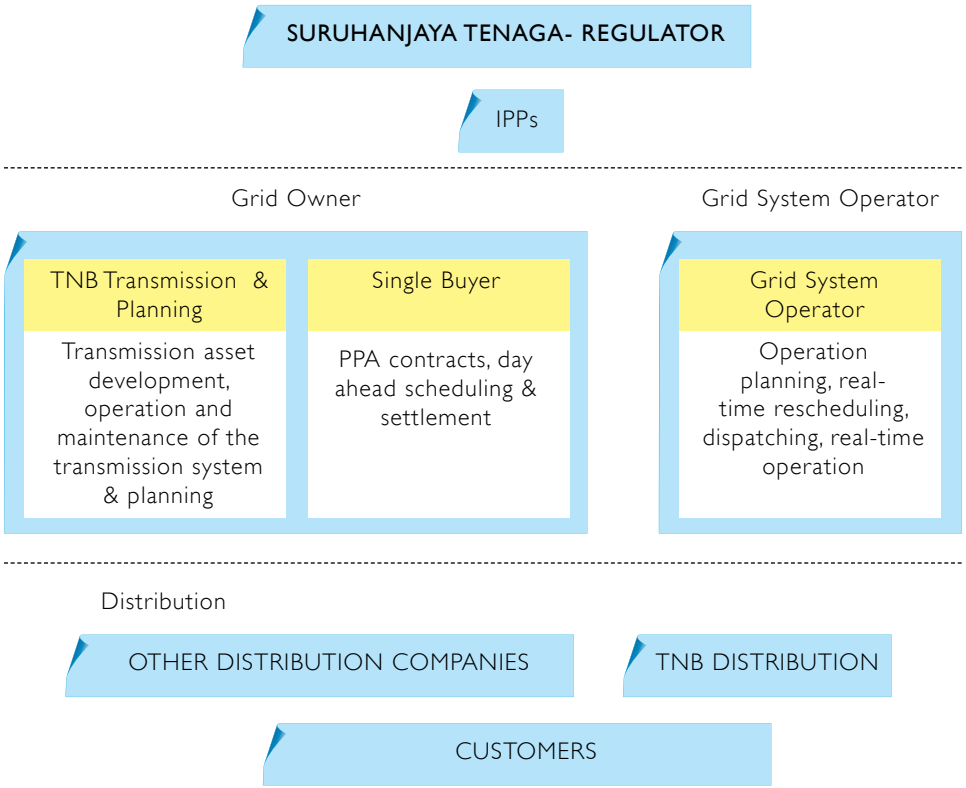
Reliable and economic operation of the grid system of Peninsular Malaysia requires close coordination between Grid Owner, System Operator and users of the Grid System. This in turn calls for clear definition of role and responsibilities of all parties and of the processes and procedures to be followed in planning, connecting, operating, dispatching, metering and safe operation of the Grid System. The MGC is an important regulatory instrument much needed to coordinate various activities to ensure secure, reliable and safe electricity supply. The following figure illustrates how the various parties identified in the Grid Code are connected or associated with Grid System.

Figure 20: Parties in the Grid Code



The MGC is a set of technical regulations used by utility companies such as TNB and IPPs in the Peninsular Malaysia that serves as the main guidelines in electricity supply operation to ensure the electricity supply in Peninsular Malaysia remains reliable. The Peninsular Malaysia electricity supply industry structure in terms of functions as used in the MGC are illustrated in following figures:-

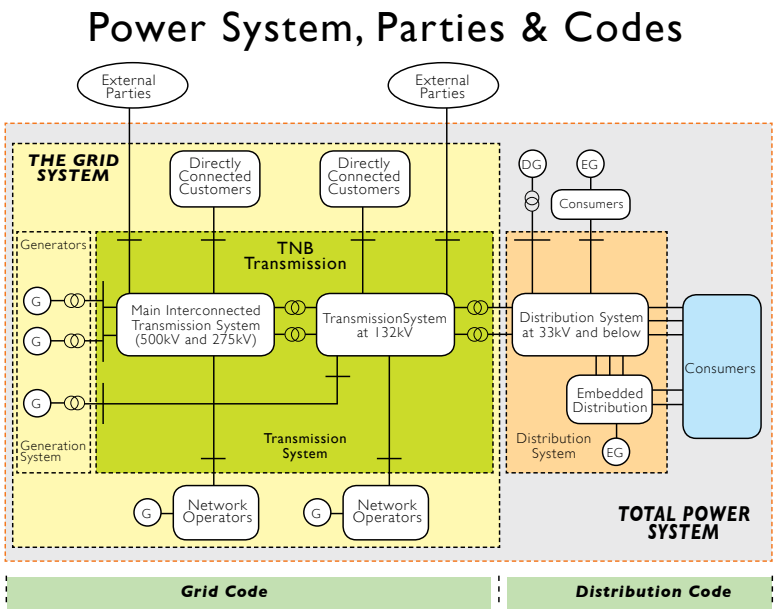
Figure 21: Electricity supply industry structure in the Malaysian Grid Code



Malaysian Distribution Code (MDC)

The Distribution System is that part of the system that operates below 66kV (33kV,22kV, 11kV, 6.6kV and 400Volt). Malaysian Distribution Code (MDC) is used to set the regulations and technical requirements that need to be met by all party involved in the planning, managing and maintaining the Distribution Systems to ensure security, safety and reliability at all time. The structure of the Power System, connected Parties and applicable codes are shown as follows:-

Figure 22: Structure of power system, parties and codes



These two codes highlight in details the roles and responsibilities of parties involved in managing or using the system. Since the enforcements of The Codes in 2011, ST as the regulatory body chairs the two important standing committees (MGC and MDC committees) to oversee the implementation of The Codes.

Existing Network

The existing transmission networks in Peninsular Malaysia consists of 500kV, 275kV and 132kV voltage levels. TNB is responsible for the operation of the networks. These networks are made available to connect all generation stations to the energy consumers. With the highest peak demand in the system for the year was 15,826 MW recorded on 20th June 2012 and the total installed capacity in Peninsula stands at 21,749MW, TNB is committed to make sure that existing network can cater for power transmission requirements for today and future expansion .

These networks are divided into four regions i.e. Northern Area (Perak, Pulau Pinang, Kedah and Perlis), Central Area (Selangor, Federal Territory of Kuala Lumpur and Putrajaya), Eastern Area (Pahang, Terengganu and Kelantan), Southern Area (Johor, Melaka and Negeri Sembilan) which can be shown in the diagram in the next page. The major load centers are in the West Coast where majority of thermal power plants are located. Presently, Bukit Tarek and Lenggeng are the main network gateway for power transfer from Northern and Southern regions to the major load center.

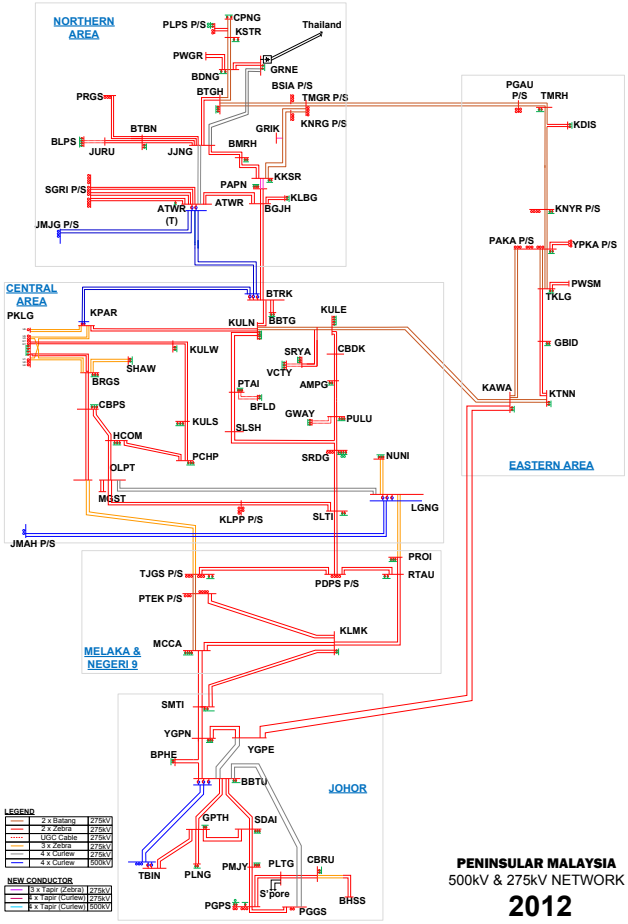
In order to enhance system stability and security, the Grid System is also connected to Singapore and Thailand via several interconnector as listed below:-

- 275kV HVAC (450MW) link with Singapore
- 300kV HVDC link (300MW) Gurun-Khlong Ngae link with Thailand
- 132kV AC interconnection Chuping-Sadao (80MW) link with Thailand

Existing Network in Peninsular Malaysia

Figure 23: Peninsular Malaysia national grid map

Figure 24: Single line diagram for existing network



Major Transmission Projects Under Construction

Transmission network development can be classified into two main categories. They are either related to generation plant-ups or associated with load growth and system development. Transmission developments required to facilitate connection of new generations into the system are identified by taking into account the maximum generation capacity per site as well as the minimum transmission reinforcement required to evacuate the power. Transmission reinforcements required to strengthen the backbone of transmission network in order to meet the demand growth are also part of network development.

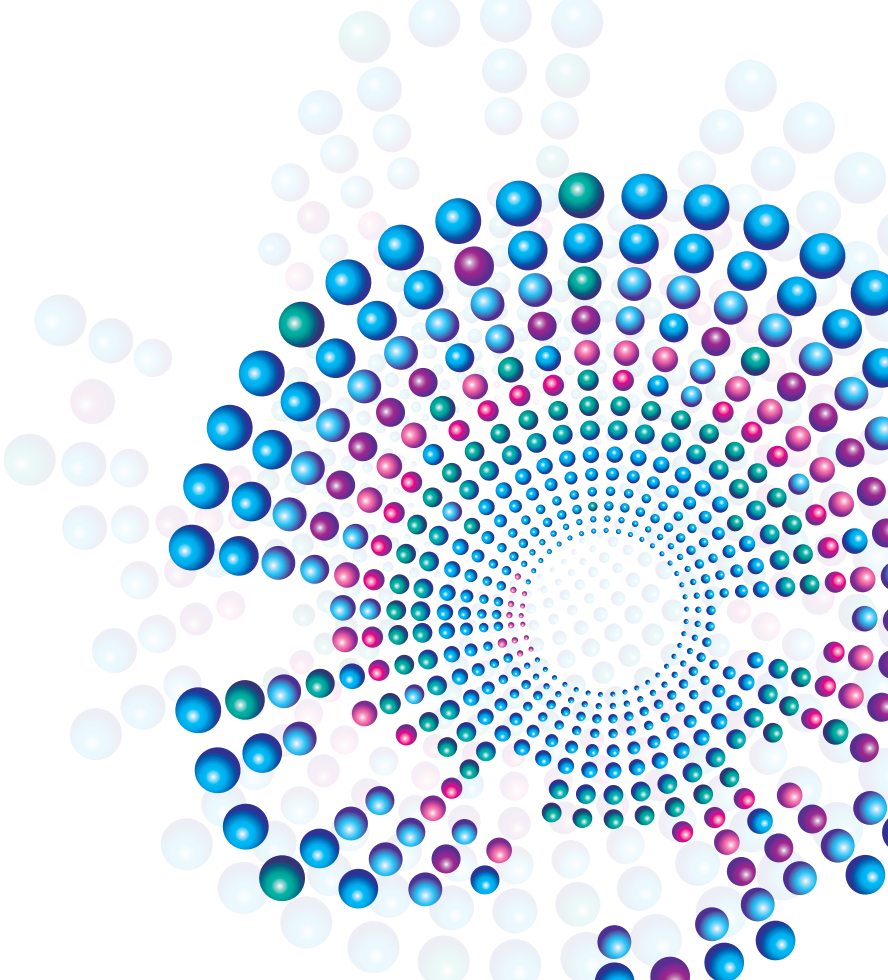
Table 11: Ongoing transmission projects associated with generation plant-up

No.	Description	Completion Date
1	Hulu Terengganu Hydro • Hulu Terengganu 275kV substation • 275kV OH Lines from Hulu Terengganu Single-circuit Loop in/out (LILO) into Kenyir- Tanah Merah 275kV OHL	2015
2	Janamanjung Coal Unit 4 • Ext 2 x 500kV AIS 1-1/2 Breaker Diameter & Ancillaries, and associated works at Manjung 500kV substation • Double- circuit 20km 500kV OH Lines from Manjung to Point A (a point between ATWR – BTRK 500kV OH Lines where the new 500kV lines are looped in/out of one ATWR-BTRK circuit) • Extension at Air Tawar 500kV substation to add new 1 x 750MVA 500/275kV interbus transformer	2015
3	Ulu Jelai Hydro • Ulu Jelai 275kV substation • Tapah 275kV substation (provision for future 500kV substation) • 275kV substation at Bentong South (provisions for future 500kV substation) • Double circuit 93kM 275kV lines (1000MVA) from Ulu Jelai to Tapah • Double circuit LILO from Tapah into Batu Gajah- Bukit Tarek 275kV OHL • Double circuit 500kV lines from Tapah to Bentong South (energized at 275kV)	2016
4	Tg. Bin Coal Unit 4 • Ext 2 x 500kV AIS 1-1/2 Breaker Diameter & Ancillaries, asssociated works at Tg. Bin 500kV substation • Installation of 1 x 750MVA 500/275kV XGT (3- single phase auto transformers) and associated works at Tg.Bin • 63km 500kV Single circuit Tg. Bin to Bukit Batu (Quad-curlew) • Line termination and associated works at Bukit Batu 500kV	2016

Table 12: Selected major ongoing transmission projects associated with system development / reinforcement

No.	Description	Completion Date
1	PMU 275/132kV Sg. Mati • 2 x 240 MVA interbus transformers • 275kV OH Lines Kelemak- Sg. Mati • PMU Kelemak 275kV extension	2012
2	PMU 275kV/ 132kV Puchong Perdana GIS • 2 x 240MVA interbus transformers • 275kV OH Lines Olak Lempit – Puchong Perdana	2013
3	PMU 275/132kV Shah Alam Seksyen 18 • 3 x 240MVA interbus transformers • Double- circuit loop in/ out 275kV OH Lines CBPS – Olak Lempit	2013
4	Central Area Reinforcement • 275kV Bukit Tarik – Chubadak • 275kV OH Lines Port Klang- Bukit Rajah	2013
5	PMU Pantai Remis 275kV Switching Station • 275kV DC LILO from Segari – Ayer Tawar	2013
6	275kV OH Lines Segari – Bukit Merah • Extension/ Upgrading Bays at PMU Bukit Merah and Segari • Reconfiguration at PMU Ayer Tawar 275kV	2013
7	PMU 275/132kV Subang Jaya Town Centre • 3 x 240MVA interbus transformers • Double –circuit loop in/out 275kV OH Lines KL West-KL South	2014
8	Establishment of PMU 275/132/33 kV Ebor GIS • 2 x 240MVA interbus transformer • Associated transmission lines	2014
9	Transmission development associated with the 1,000MW Coal-Fired Unit at Manjung by 2015 • DC 500kV OHL Janamanjung – Point A • DC 500 kV OHL Point A-Tapah • SC LILO 500kV OHL from Ayer Tawar to Bkt Tarek into Manjung • Other related transmission works	2015
10	Establishment of PMU 275kV Bentong South (AIS) • 2 x 240MVA interbus transformers • Associated transmission lines	2015

Transmission Network Outlook



TRANSMISSION NETWORK OUTLOOK

Transmission Development Plan

A study on the transmission development plan for Peninsular Malaysia is carried out annually by TNB. The planning is discussed in the Transmission Development Planning Working Group (TDPWG) which is chaired by ST. The study looks at the transmission requirements in the next ten years and produce a 10-year Transmission Development Plan (10-YTDP). The plan is to ensure that the transmission system in Peninsular Malaysia will be adequate and secure under normal operating conditions as well as under (N-1) contingency conditions, in compliance with the License Conditions, TSRS and MGC requirements. Major assumptions used in the study are the latest demand forecast and also the recommended generation development plan. PSS/E and DSA Power Tools software are used to carry out the system simulation studies.

On-going transmission projects have achieved various stages of implementation. For example new transmission projects to cater for load growth in the next ten years (2012 to 2022) were identified in the study. In this study, all ongoing and approved transmission projects are reassessed with regards to the need to ensure system adequacy and security in line with the latest electricity demand forecast. Some of the firm projects associated with the generation plant up (2013-2017) are as follows:-

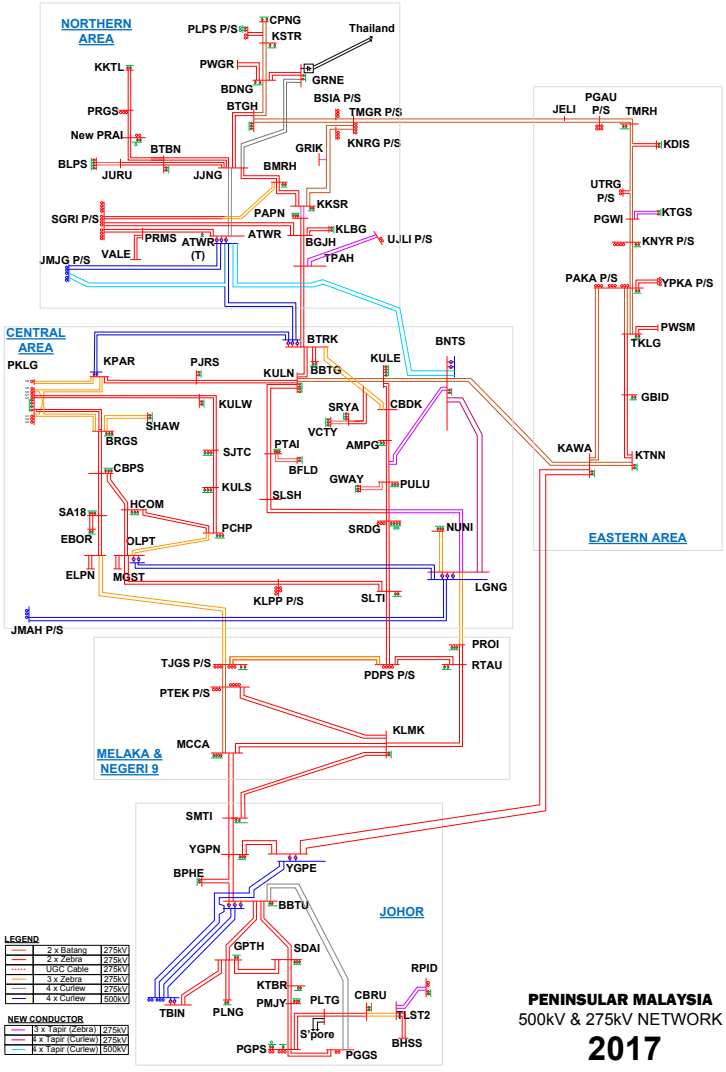
Table 13: Firm projects associated with the generation plant-up programme

No.	Region	Distribution Identified Projects (2016-2020)	Required Date
1	Northern	Prai Combined-Cycle Plant : 1,000 to 1,400MW • New Kuala Letil (KKTL) 275/132kV 2 x 240MVA AIS substation • Double circuit 275kV line (683 MVA/cct) KKTL to Prai GIS (PGRS)	2016
		• 2 nos. 275/132kV 240MVA terminated at SKS Prai (SKSP) • New Prai 275/132kV 2 x 240MVA GIS substation • Double circuit 275kV line/interconnector (683MVA/cct) • Double circuit 275kV line (683MVA /cct) • Double circuit 275kV line (683MVA/cct) New Prai to Bukit Tambun (BTBN)	

No.	Region	Distribution Identified Projects (2016-2020)	Required Date
2	Southern	Pengerang COGEN Plant (PCP): 400MW • New 275/132kV substations • Associated 275kV OH lines • Associated 132kV OH Lines	2016
3	Central	CBPS Combined- Cycle Plant : 350MW • Replacement at existing spare overhead line bay (SB1) at Connaught Bridge 275kV (CBPS 275) into generator Bay	2015
4	Northern, Central , Southern	Coal Plants: 3 x 1000MW (assumed at Manjung, Jimah and Tg. Bin) • Extension of 500kV substations at the power plants • Associated 500kV substations • Associated 500kV OH lines	2017

After taking into account all the assumptions made and in order to cater the forecasted demand, outcome of the study can be seen through the single line diagram in figure 25 which shows the future networks in 2017.

Figure 25: Future network for year 2017



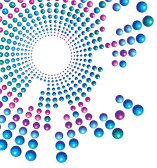
With the introduction of International Competitive Bidding by the Government, it has posed a new challenge to plan transmission network expansion. Bidders are allowed to propose any location of new green field site for power generation which does not necessarily guaranteed an optimum location in the network.

To help mitigate this risk and still meeting reliability standards, ST has introduced nodal points concept in the latest tender. Nodal points are termination points of the new interconnection facilities for the new generation plants to be connected to Grid System. Several nodal points have been identified after assessment made

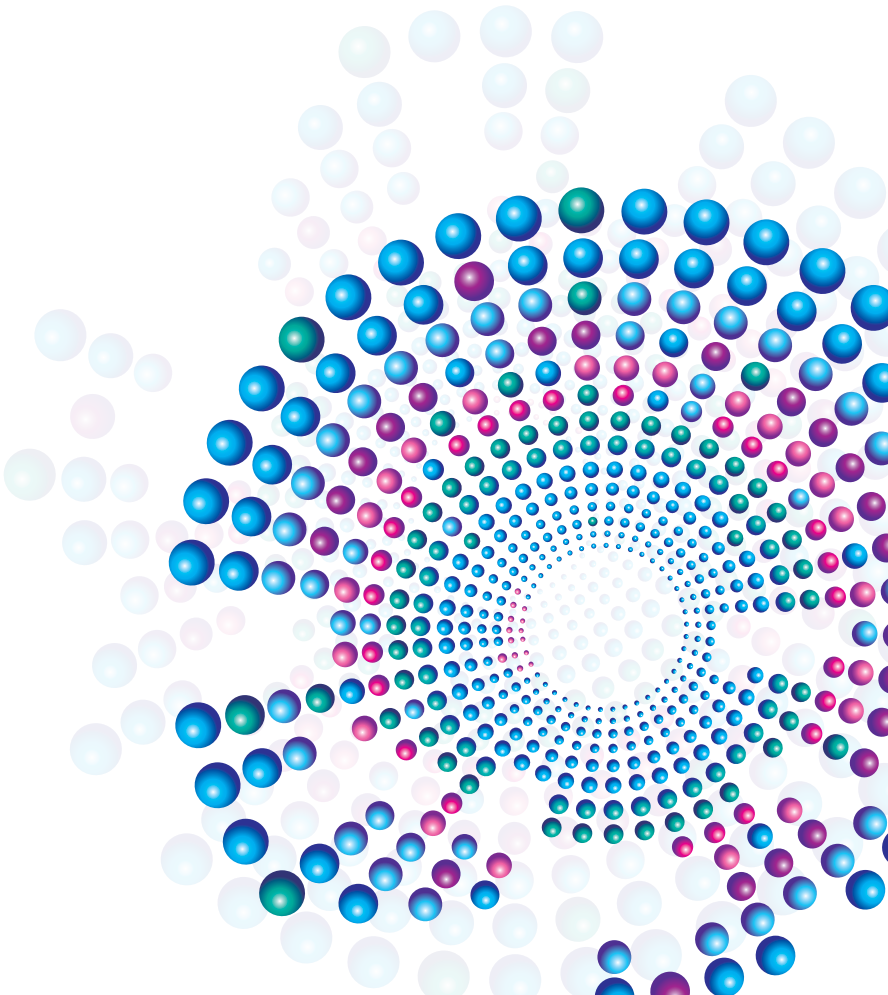
on the adequacy of main transmission network to reliably support major inter-regions power transfers and between generation and demand centres. Figure 26 below shows the snap-short taken from Grid System Operator website (www.gso.org.my/System-Data) on the 20th December 2012 at 1220 hours, which illustrates inter-regional transfer and regional demand and supply balance.

To strengthen the National Grid backbone and support new generation according to the least-cost expansion plan, new 500 kV transmission line projects are being developed to reinforce existing 500 kV main trunk transmission lines. These initiatives will increase power transfer capability between regions and opening up more access for new generations to be connected along this "highway" where previously were constraint by its non-optimum location. The ultimate aim is to promote and develop new generation and connecting it with transmission network with load centres in the most cost efficient manner.

Figure 26: Snap-shot of inter-regional transfer and regional demand/supply balance



Competitive Bidding



COMPETITIVE BIDDING

The Generation Development Plan which outlines requirement for new capacity is determined by JPPPET. Fuel mix, demand forecast, generation technology and fuel prices are among factors considered and evaluated before any decision on new capacity. Following Government's decision for future generation capacity requirement to be met through the competitive bidding process, ST is mandated to execute the process beginning year 2010. The lead time for power plant development requires 4 to 7 years as it involves, among others the bidding process itself, environmental impact assessment (EIA), site identification and investigation, power plant construction, associated transmission network construction, authorities approvals and financing due diligence.

Restricted Bidding for the 1,000MW Coal Fired Capacity

The restricted bidding for a 1,000MW coal-fired capacity was conducted as replacement capacity for the cancellation of 2,000MW power transfer through submarine cables from Bakun Hydroelectric Project to Peninsular Malaysia. The submarine cables were slated for operation in two stages in 2015 and 2016, each cable with power transfer capacity of 1,000MW. To avoid potential brownouts as a result of projected capacity shortfall, Government instructed ST to conduct restricted bidding among existing coal fired power stations (brownfield) with Scheduled COD on 1st March 2016. The bidding process right up to project award took 12 months to complete.

Earlier, 1,010 MW coal-fired capacity was awarded to TNB Janamanjung Sdn. Bhd. (TNBJ), an IPP wholly-owned by TNB for commercial operation on 31st March 2015. In terms of implementation, TNBJ is required to strictly adhere to all regulatory requirements as imposed by relevant authorities while at the same time must be able to offer competitive tariff for the benefit of consumers. As benchmark, tariff offered by TNBJ has to match or better the tariff obtained through restricted bidding.

The brownfield development was opted due to time constraint as greenfield development requires longer time to allow for site identification and assessment and transmission line survey and acquisition. As one of the 1,000MW capacity was already awarded to TNBJ, only Jimah Energy Ventures Sdn. Bhd. and Tanjung Bin Power Sdn. Bhd. were invited to the bidding process to minimise completion risk.

Tanjung Bin Energy Sdn. Bhd., a subsidiary of Malakoff Corporation Berhad won the bid. The plant is currently under construction in Pontian, Johor and will be commissioned on 1st March 2016.

International Competitive Bidding for the New Combined Cycle Gas Turbine Power Plant in Prai, Pulau Pinang

Electricity supply industry in the country reached another landmark with implementation of international competitive bidding for the new combined cycle gas turbine power plant (Track 1). The plant will be located on a site previously occupied by Stesen Janakuasa Prai, which was decommissioned in 2005. The plant will be connected to the grid system upon completion in March 2016.

In line with established international practice, "Notice for the Pre-Qualification of Prospective Bidders for the Development of a Combined Cycle Gas Turbine Power Plant" or Expression of Interest was published in major dailies in December 2011 . A total of 47 companies registered their interest to participate in the pre-qualification process from which 18 submissions were received. Upon shortlisting, a total of 9 consortia and sole bidders have been invited to submit their bids as follows:-

Table 14: Shortlisted bidders for Track 1

No.	Shortlisted Bidders
1.	1Malaysia Development Bhd and Hyundai Engineering & Construction Co Ltd.
2.	Pendekar Power Sdn Bhd
3.	Mastika Lagenda Sdn Bhd
4.	Tenaga Nasional Berhad
5.	YTL Power International Berhad and Marubeni Corporation
6.	CI Holdings Berhad, Teknologi Tenaga Perlis Consortium Sdn Bhd and Daelim Industrial Co Ltd
7.	Mitsui & Co. Ltd and Amcorp Power Sdn Bhd
8.	Sime Darby Power Sdn Bhd
9.	Malakoff Corporation Berhad, Petronas Power Sdn Bhd and Mitsubishi Corporation

All shortlisted bidders were then required to sign an Integrity Pact, an instrument introduced by the Malaysian Anti-Corruption Commission to promote integrity and transparency in the procurement, eradicate corruption and assist in the implementation of a more efficient procurement transaction.

The Track 1 exercise was successfully conducted whereby TNB was announced as the winner. In meeting all the mandatory requirements with lowest levelised tariff, TNB was offered to build, operate and own the CCGT facility with capacity of 1,071.43 MW for 21 years. The facility, utilising latest CCGT technology with plant efficiency of 60%, will be ready for commercial operation from 1st March 2016.

Restricted Tender Among Pre-Qualified First Generation Independent Power Producers and Tenaga Nasional Berhad

The restricted tender, also known as Track 2, is a restricted invitation for bids from qualified participants to bid for renewal of existing facilities on extension terms of either 5 or 10 years. The PPA for the first generation IPPs and SLA for TNB power plants will expire in 2014-2017. However, studies have shown that these facilities still have considerable remaining life beyond PPA/SLA expiry period and thus the operation can be extended further without incurring much additional capital expenditures.

The objectives of Track 2 are to secure required capacity at the lowest levelised system cost, to minimise completion risk and to secure immediate measurable benefit to consumers via voluntary reduction in existing commercial rates. The proposal was to secure up to 2,250MW from total of 6,320MW existing capacity that comes with new standardised power purchase agreement terms.

To ensure lowest system cost in meeting future demand, the bidding process for Track 2 was run simultaneously with Track 1. Also, in line with subsidy rationalisation exercise, tariff offered by the bidders is based on the projected gas market price of RM42.24/GJ. The successful bidders are then require to sign the new, improved PPA with commercial and technical terms as agreed upon by ST.

The bidders listing for 2nd Track bidding is as follows:-

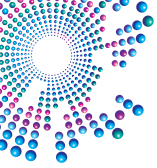
Table 15: Qualified participants for Track 2

Qualified Participants	Existing Facility (Existing Site)	Existing Capacity (MW)
YTL Power Generation Sdn. Bhd.	Paka, Terengganu	780
YTL Power Generation Sdn. Bhd.	Pasir Gudang, Johor	390
Genting Sanyen Power Sdn. Bhd.	Kuala Langat, Selangor	720
Segari Energy Ventures Sdn. Bhd.	Lumut, Perak	1,303
Port Dickson Power Sdn. Bhd.	Tanjung Gemuk,Port Dickson	436
Powertek Berhad	Teluk Gong, Melaka	434
Tenaga Nasional Berhad	S.J. Jambatan Connaught (Open Cycle)	478
Tenaga Nasional Berhad	SJ.Sultan Ismail, Paka	999
Tenaga Nasional Berhad	S.J. Sultan Iskandar, Pasir Gudang (Combined Cycle)	249
Tenaga Nasional Berhad	S.J. Sultan Iskandar, Pasir Gudang (Open Cycle)	205
Tenaga Nasional Berhad	S.J. Putrajaya (Unit 1, 2 and 3)	326

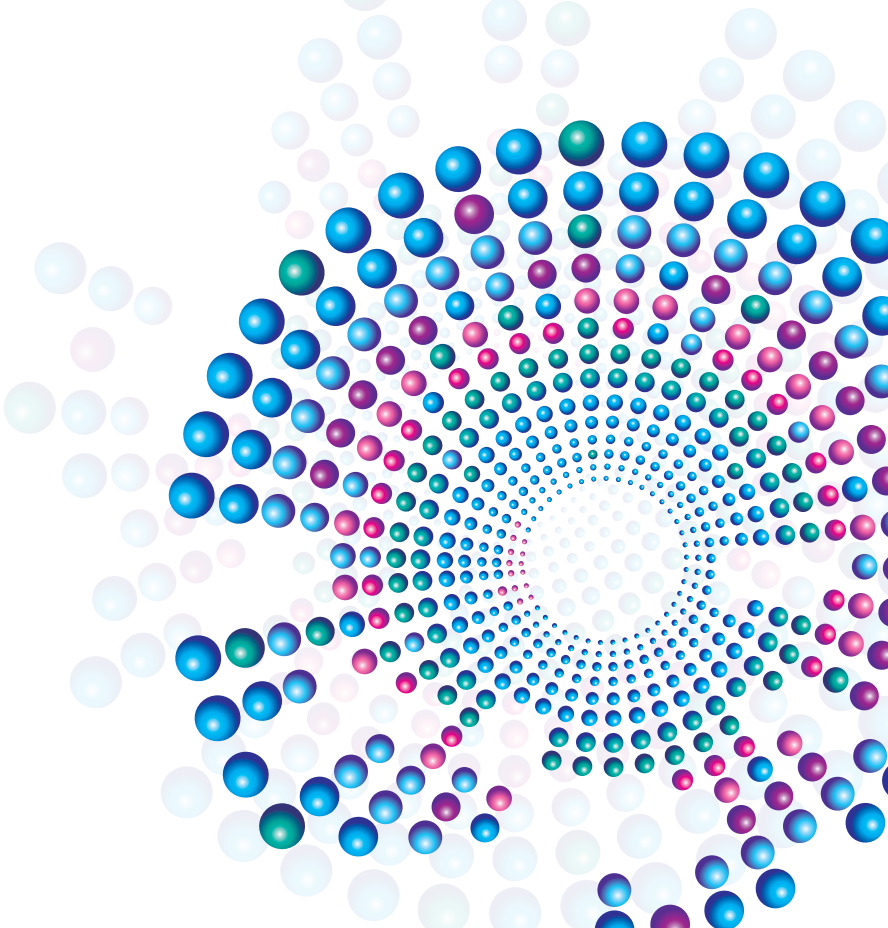
Announcement of successful bidders for Track 1 and Track 2 was made on the 9th October 2012, approximately 9 months after the notice of Expression of Interest for Track 1.

Genting Sanyen Power Sdn. Bhd. and Segari Energy Ventures Sdn. Bhd., each with capacity of 675MW and 1,303MW respectively were offered 10 years extension term. TNB Pasir Gudang with revised capacity of 275MW was offered the 5 years extension term. The result shown that the existing facilities are still competitive and capable in terms of offering reliable intermediate capacity for the system.

The competitive bidding exercises demonstrates the commitment of Government in providing lowest cost of electricity supply to the consumers while at the same time ensuring transparency in procurement process through open tender practice.



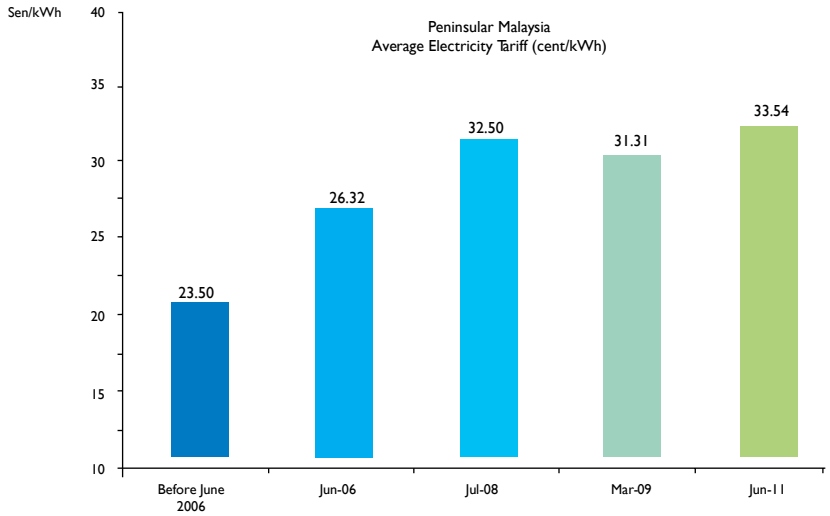
Electricity Tariff Setting Mechanism



ELECTRICITY TARIFF SETTING MECHANISM

As regulator, ST is responsible to ensure the electricity tariff is at reasonable prices and affordable to consumers. At the same time, the utility has to remain viable and incentivise to operate efficiently. Since June 2006, four tariff revisions were implemented in Peninsular Malaysia due to fuel prices and base tariff reviews as depicted in figure below.

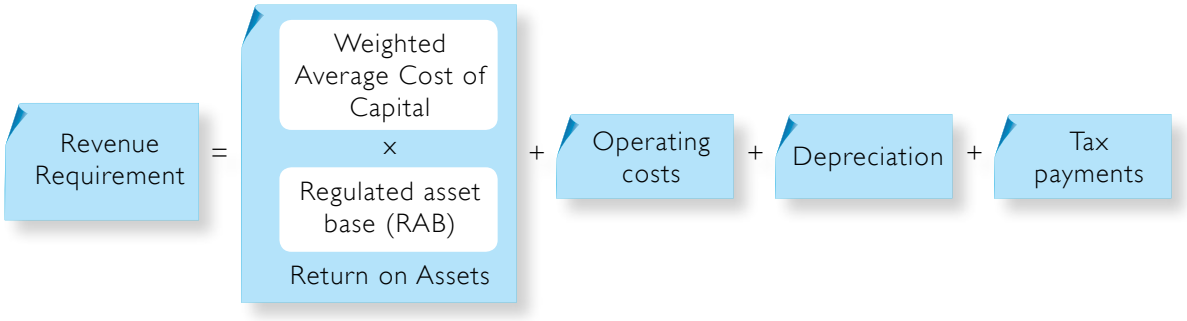
Figure 27 : Average electricity tariff in Peninsular Malaysia



The current tariff was revised on 1st June 2011 with an average rate increase of 7.12% or 2.23sen/kWh, from 31.31 sen/kWh to 33.54 sen/kWh. The rate was raised to pass through the impact of gas price adjustments to the power sector from RM10.70/mmBtu to RM13.70/mmBtu. At the same time, TNB base tariff revised by 2% or 0.63sen/kWh from the current average tariff at that time. The revision for base tariff is to cater for the increase in the cost of supplying electricity. This will include an increase in capital expenditure in generation, transmission and distribution activities, increase in cost of raw materials for electricity supply equipment and maintenance costs, as well as an increase in the consumer price index.

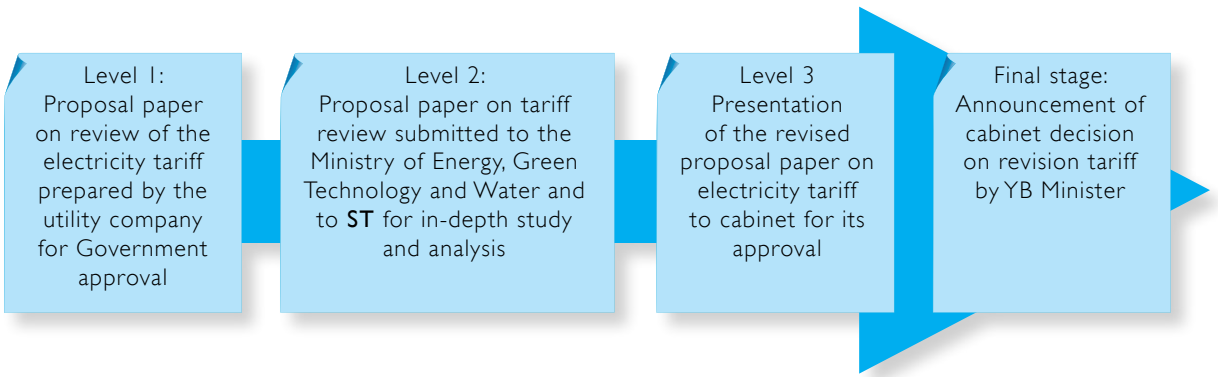
This is the second time of tariff adjustments involving the base tariff revision of TNB since June 2006. Prior to this, in July 2008 and March 2009, the tariff revision only involves a change in gas prices alone in the electricity generation sector.

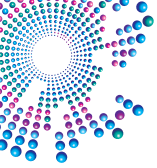
Figure 28: Base tariff formula



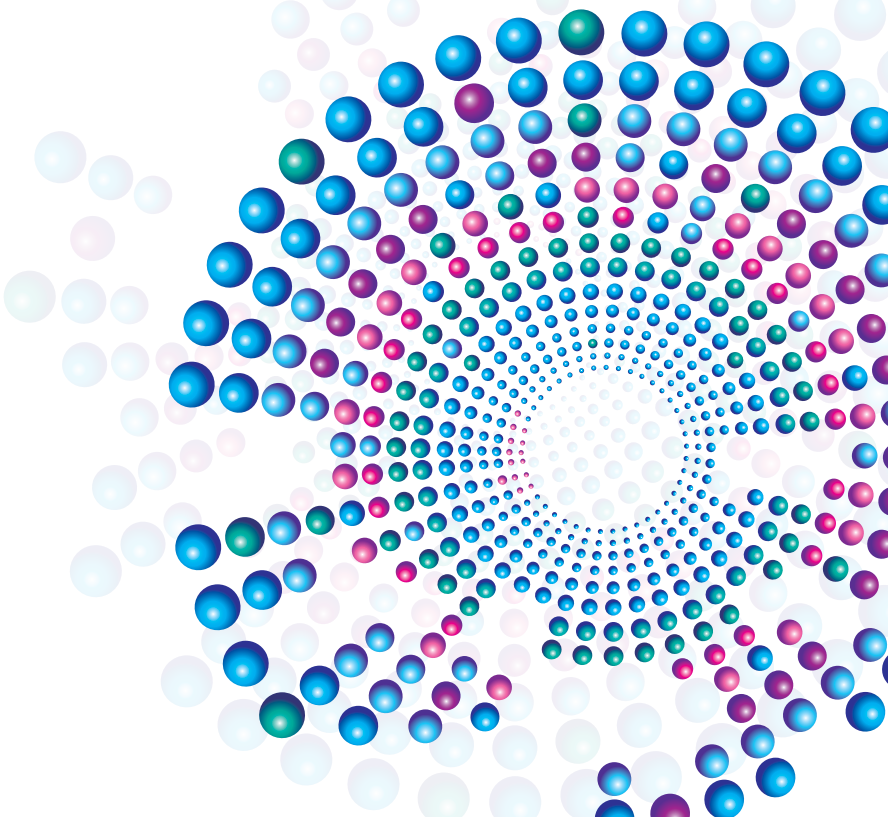
The process of electricity tariff revision is done in stages as follows:-

Figure 29: Electricity tariff review process





Incentive-Based Regulation Mechanism



INCENTIVE-BASED REGULATION MECHANISM

A New Policy for Electricity Tariff Determination

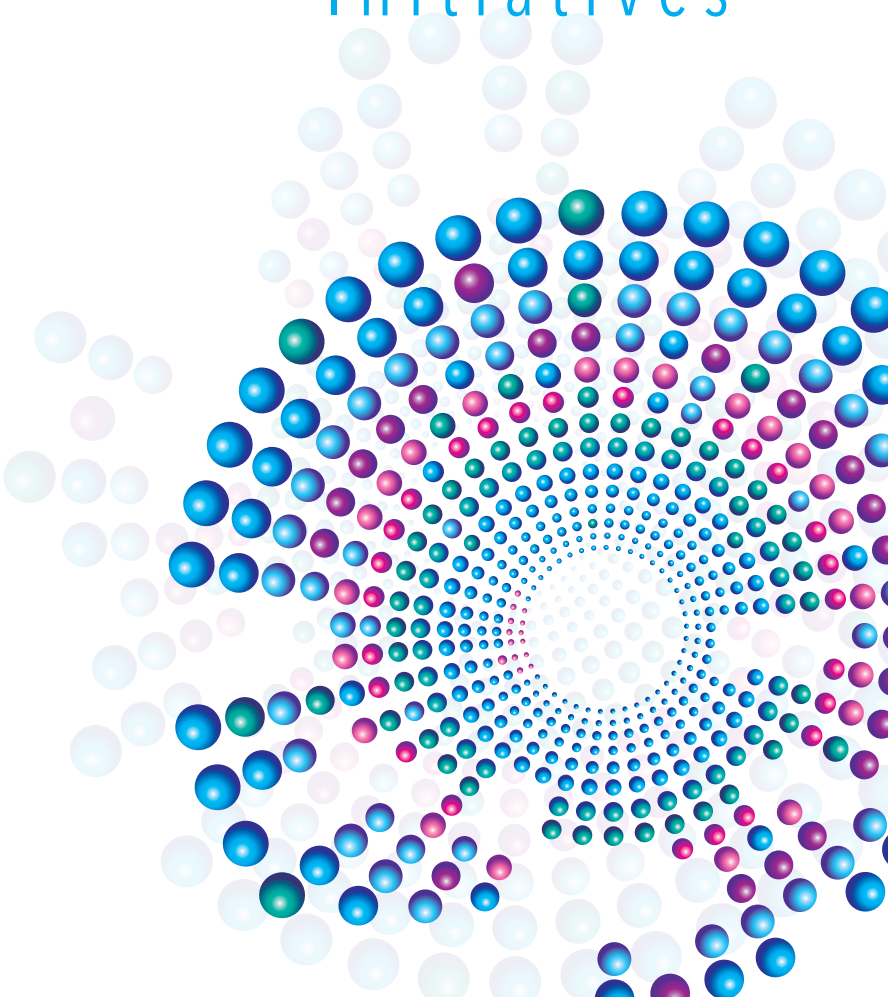
Beginning 2012, ST is embarking on the Incentive-Based Regulation (IBR) mechanism in electricity tariff determination. This mechanism is not new in relation to the best practices of economic regulation around the world. It enhances regulatory governance and adopting a more effective and consultative decision making process that creating transparency and certainty in the industry. For this purpose, the ST formulated eleven (11) guidelines known as the Regulatory Implementation Guidelines (RIGs), as a framework for the IBR implementation. The main objectives of the IBR are to develop:

i. Economic regulatory framework to regulate the utility;
ii. Tariff setting framework, the principles of tariff design and tariff review process;
iii. Incentive mechanism to promote efficiency and service standards; and
iv. Format regulatory accounts and an annual review process.

In essence, the IBR framework is designed to incentivise the utility to reduce costs and improve service levels, rather than leaving the task to the regulator to determine the levels of efficiency. **The main components of the IBR are:**

i. Determination of the regulatory period to ensure that the tariff revision is carried out periodically and consistently;
ii. Determination of the regulated and non-regulated business for the utility and the separation of accounts;
iii. Determination of financial performance and technical efficiency targets of the utility;
iv. Implementation of the imbalance cost pass-through mechanism to enable the recovery of actual fuel related and other generation specific costs and;
v. Implementation of efficiency sharing mechanism to provide the utility a continuous and sustained incentive to pursue cost efficiencies in every regulatory term.

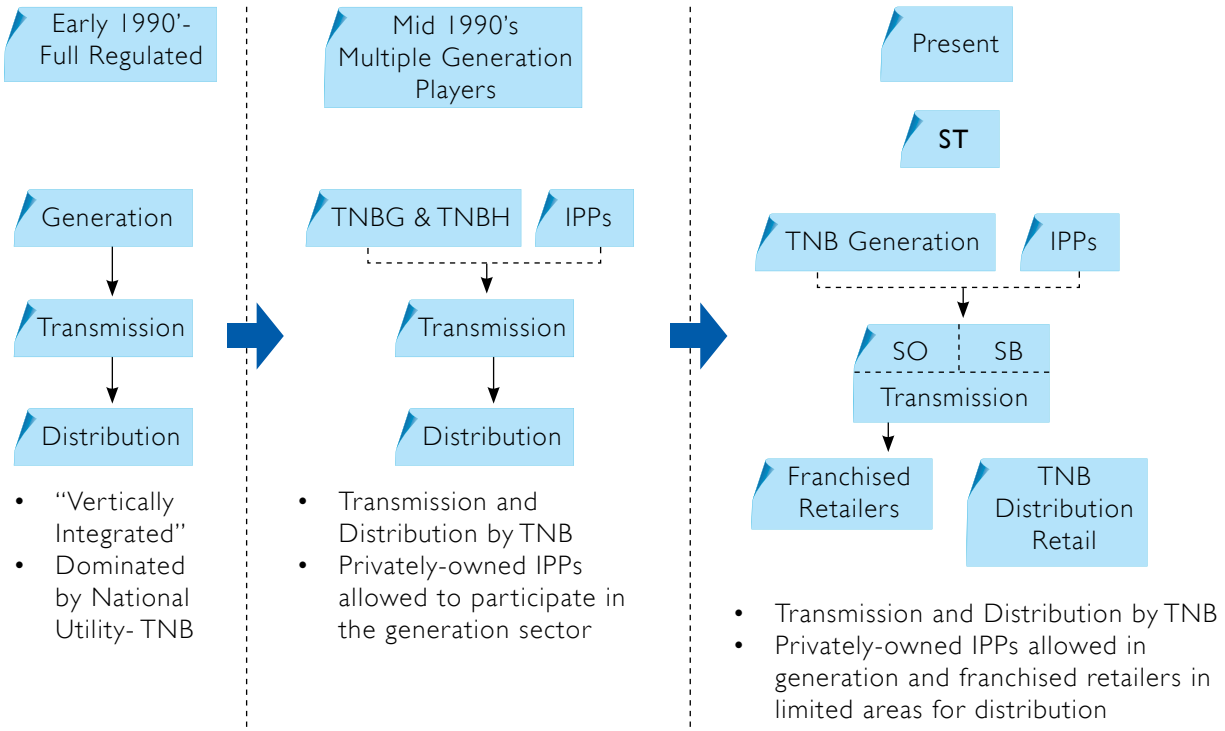
Industry Reform Initiatives



INDUSTRY REFORM INITIATIVES

The energy sector in Malaysia has undergone significant changes over the last two decades. In the electricity supply industry, privatization of the national utility as well as the introduction of independent power producers were among the earlier and major reforms introduced by the Government in 1990s. This initiative was aimed to ensure the nation's electricity supply industry remains resilient and vibrant to power the country rapid economic growth.

Figure 30: Changes of ESI structure in Malaysia



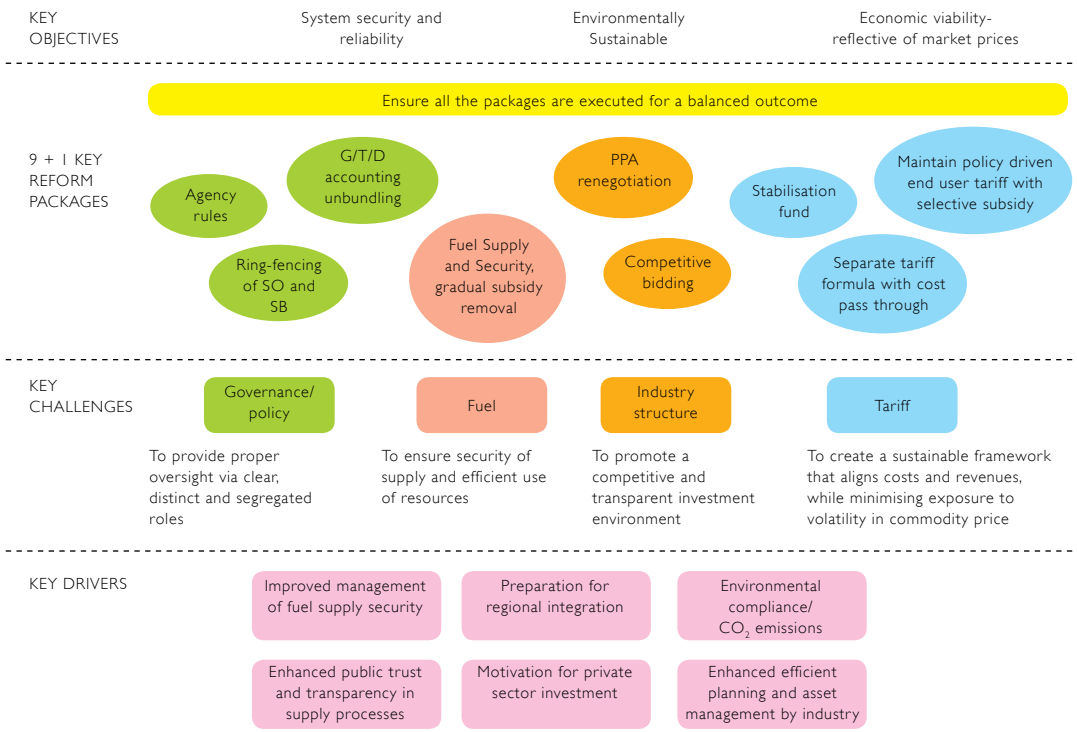
Another reforming period is planned through a programme termed as the Malaysia Electricity Supply Industry Reformation (MESI Reform). The programme is spearheaded by the Ministry of Energy, Green Technology and Water with the assistance of the Suruhanjaya Tenaga and MyPower Corporation, an agency that is tasked to look into various areas to be reformed as preparation towards a more efficient and liberalised market structure.

The objective of MESI Reform is to enhance the performance of the industry in terms of its efficiency, transparency, competitiveness and credibility of the market structure and governance. Ultimately, MESI

Reform initiatives will ensure long term electricity system security and supply quality as well as manageable and sustainable tariffs for the benefits of the country. In meeting these objectives, a gradual but yet holistic approach is employed for a more effective and stable transition. This approach takes into consideration the stakeholders' views, focussing on fixing key issues and "no-regret" moves as well as the idea of simulation/ dry-run of some of the outcomes in order to establish a stable foundation for market reform.

There are four key challenges currently being addressed for reform which includes governance/policy, industry structure, tariff and fuel.

Figure 31 : Malaysia ESI reform

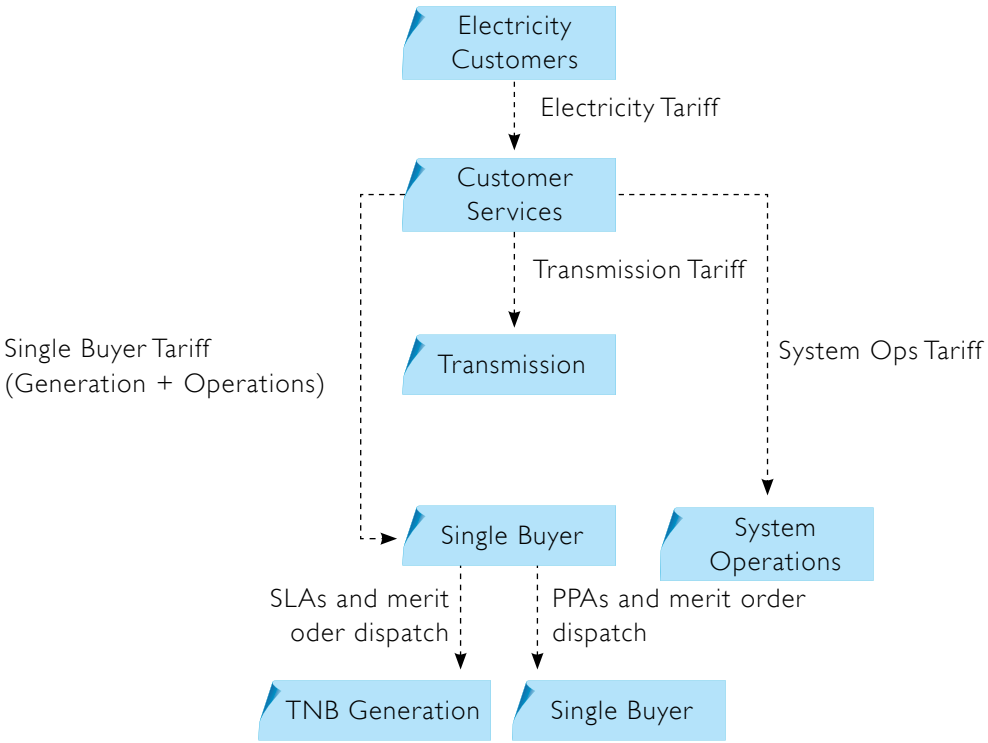


Nine(9) holistic reform packages are identified to address the four challenges. The 9 packages is embraced by the 10th package which is to ensure that all of the other packages are executed for a balanced outcome to all parties. These packages are specially designed for Malaysia's electricity market reform and have so far being implemented, and to date, with progress made at various stages.

Governance / Policy

The capacity planting up programme starting from the year 2015 and beyond are to be administered by ST. In addition, ST is also responsible to publish the long term capacity projection for public review in order to attract private and external investment into the country.

Figure 32: Position of single buyer and system operator in the managed market model



Ring-fencing of single buyer and system operator will be implemented to create operational separation between key elements of the electricity sector's supply chain. In order to have transparency and non-discriminatory processes of electricity dispatch and procurement, a clear set of Single Buyer and System Operator rules and framework are being established and implemented.

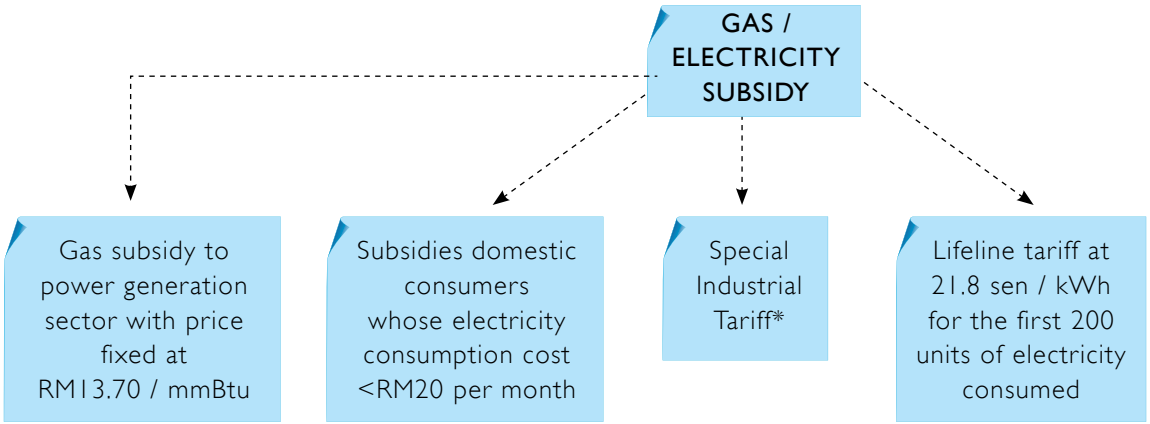
The unbundling of accounts for the national utility activities according to divisions is performed under the Incentive Based Regulation (IBR) regime and is aimed to determine the cost per unit of each division so as to create transparency in the tariff and pricing rationale. These accounts are submitted to ST to reflect the forecasted revenue requirement to covers its capital and operational expenditure, as well as its regulator return.

Tariff

Separation of divisional tariff with automatic adjustments for fuel cost pass-through to consumer is to be implemented in the country to address the operational and financial efficiencies as well as reducing the significant fuel risk faced by the national utility. In addition, this initiative which is performed under the IBR regime sets the revenue requirement with certainty of return for the utility so as to improve the utility financial performance. The IBR is expected to change the way electricity tariff is set and revised in the future.

In its efforts to ease the burden of low-income consumers, the Government gave assistance in terms of gas and electricity subsidy.

Figure 33 : Gas and electricity subsidy provided by the Government

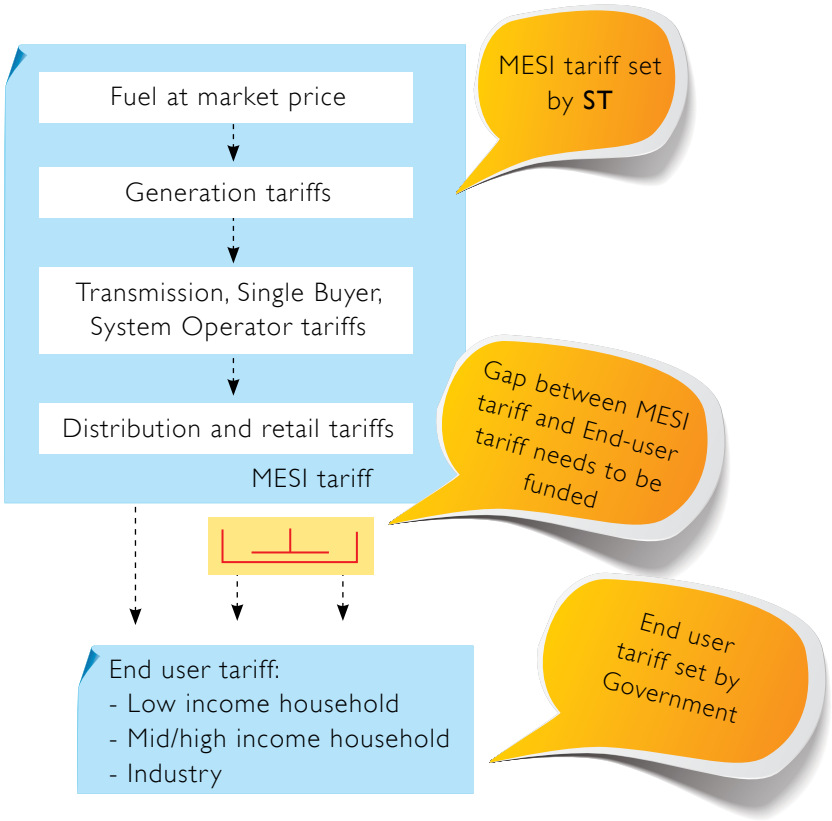


* To be phased out by 2015

This policy-driven end user tariff is maintained with several other additional selective subsidisation to be determined further. To support this, a study is conducted to define principles and develop processes to formulate a new electricity tariff structure including the development of end-user tariffs.

In addition, the study also establish and structure the framework for a stabilisation fund – a temporary buffer between Cost of Supply and the end-user tariff. The fund is aimed to provide support for selected consumer segments, while ensuring that such tariff adjustments are coordinated to address the gap between required revenues and allowed revenues based on approved end-user tariffs. This will primarily be to cushion the increase in fuel prices when fuel cost pass-through mechanism is implemented.

Figure 34 : A 'shock absorber' mechanism to cushion the impact of end-user tariff



Industry Structure

The procurement of new generation capacity is conducted through an International Competitive Bidding process with the objective to have an optimised plant up costs to the system. This task of selecting new capacity which is mandated to be under the jurisdiction of ST will fulfil the supply requirement for the years 2015 and beyond.

In addition, the PPA of first generation IPPs which expires between 2015 and 2016 are also extended for 5 to 10 years through the bidding process.

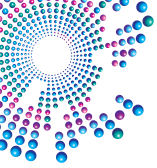
The Government noted the importance that the private sector and external investor places on the openness and transparency of investment rules and trading regimes of the electricity supply industry. As such, the Government recently increased the foreign equity participation up to 49% for electricity generation project to attract such private and external investment into the country.

A study is also conducted to look into the implementation of an appropriate competitive industry structure and market design and arrangements to improve the ESI efficiency.

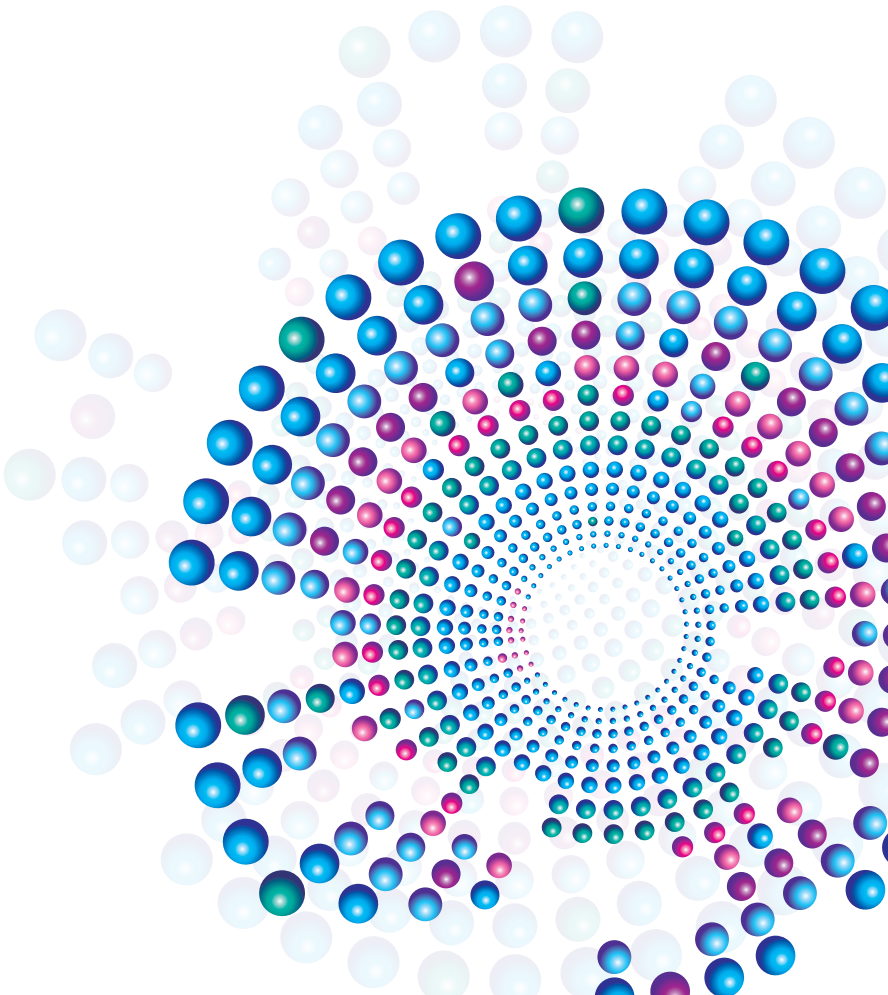
Fuel Supply and Security

Seven (7) parameters which addresses fuel security risks are currently grouped into 4 perspectives - availability, accessibility, affordability and acceptability and are considered for the country's future power development planning process. These parameters are translated to targets and strategic action plans, among others, as follows:

- At Loss Of Load Equivalant, LOLE<=1 day, the equivalent reserve margin is about 22 percent;
- Herfindahl-Hirschman Index (HHI) is used as the country's fuel diversity index with value <= 0.5 for year 2020 and <= 0.4 for year 2025;
- Monitoring of reserve-to-production ratios for domestics domestic gas;
- Diversification of coal source due to high dependence on imported coal;
- Increased coal and gas available stock through encouraging utility to invest on building stocks and capacity; and
- Encourage renewable energy and energy efficiency, Sarawak import energy and nuclear power development as means to reduced CO_2 intensity.



Closure



CLOSURE

The success of Electricity Supply Industry is measured by its ability to provide continuous, reliable and affordable electricity to the consumers. The priority is to maintain and improve from where it stands now, which does not get any tougher than during this uncertain global economic climate.

In terms of continuous and reliable supply of electricity, much rests with the ability to secure fuel supply. Source diversification needs to be pursued as the system still dependant on two major fuels. LNG regassification terminals will provide both flexibility and supply security for gas-based plants. Inaugural coal shipment from Russia on the other hand bodes well with the desire to reduce dependency to particular coal terminals. As supply exploration continues, it is expected that the supply diversity will improve in the coming years.

The projected long term energy outlook demands for transmission and distribution network upgrades. Investment in this high capex assets is expected as new and bigger generation capacities will be built in the future.

The success of smart grid pilot projects, if replicated elsewhere, requires significant investment that may entails changes in relevant codes and standards governing the industry. In this respect, provisions in Grid and Distribution Codes will be reviewed from time to time to address any additional requirements.

As the backbone of the economic activities, final electricity prices still need to be kept at reasonable level in order to maintain affordable end-tariff to consumers. While tariff revision across all consumer categories have to be realised, implication of the exercise will be studied in detail. It is still probable for the targeted consumer groups to be given specific consideration in view of its direct impact to the disposable income. Another option is to have price moderation through fuel stabilisation mechanism that minimise tariff fluctuation and allow for consumption pattern adjustment.

The call for MESI Reform is driven by the need to reinvigorate the industry to be more resilient to challenges, for better transparency and to foster competition. The process will be long and still require further deliberation as the implication of any one action is potentially far-reaching to the society. It is our hope that the progress of reform initiatives can be captured in the next edition, and a new MESI is established.