



## **Transformation of Electricity Supply Industry in Malaysia: An Overview**

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**Abstract:** The global trend in the electricity market has driven Malaysia to restructure its industry to be more dependable, open, competitive, and long-term. Furthermore, vertically integrated entities' centralized power purchasing units have been chastised for failing to provide a level playing field for generation sector players vying to sell power to a single buyer. This paper attempts to study the evolution of the Malaysian Electricity Supply Industry (MESI), which has gone through several stages of change, evolving from a largely single entity to a multi-player industry, especially in the generation field. This case study covered electricity market in Malaysia. Electricity Market model also discusses and introduced a number of electricity market model that is designed to be suited with its local condition through evolvement and transition of the Electricity Supply Industry (ESI). Besides that, Renewable Energy Market in the Malaysian context is also discussed.

**Keywords:** Electricity, Transformation, Malaysia

### **1. Introduction**

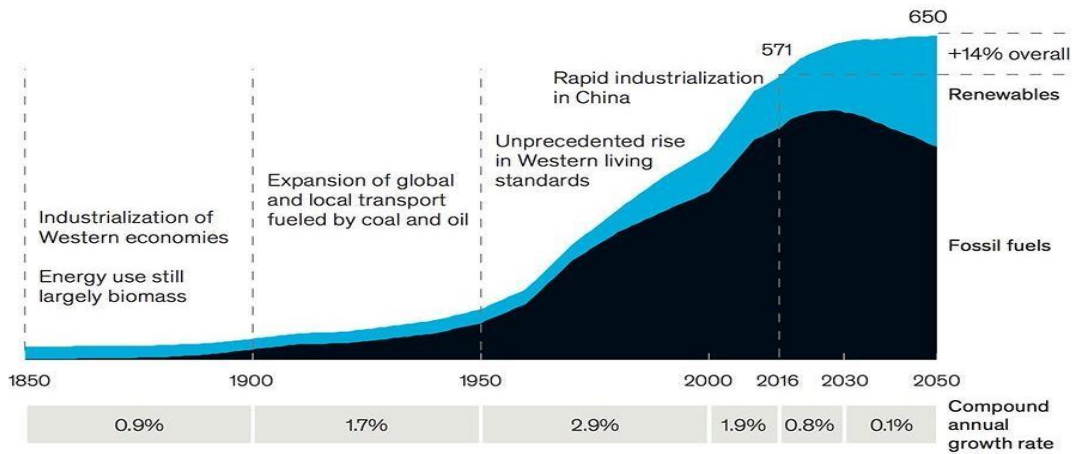
Energy has an important role to play in the economy. No production is possible without energy. On the same note, the production of energy is always needed to be concerned when planning to expand any other industries. An Energy Economist is to research ways that energy has been used in the past, the rate of current consumption, areas that use the highest quantity of the product, the future consumption rate, the cost of production, and its use in other areas and countries. Economic growth depends critically on access to reliable energy. In addition of the exponential growth of the world population, the energy demand is skyrocketing as well.

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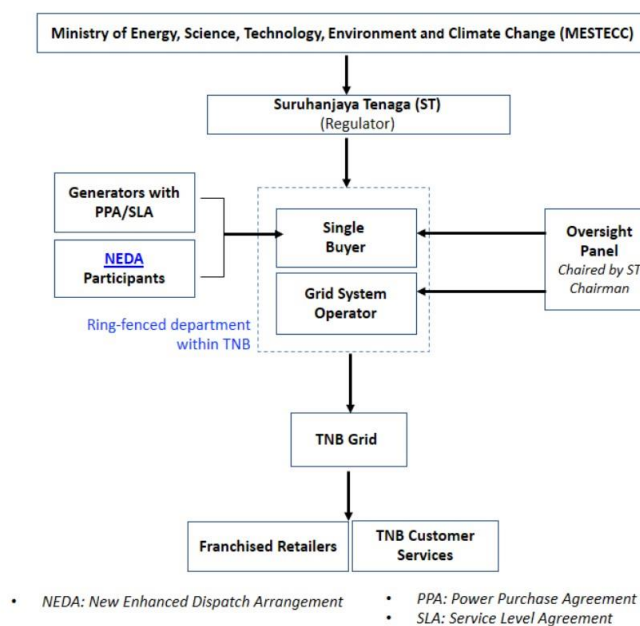


**Figure 1: Global primary energy demand, millions of Tera joules [1]**

The energy market is a scheme where energy is being traded between suppliers and manufacturers before the energy is being sold again to end consumers with a marked-up price. As the energy industry is encouraged by the innovation of a more environmentally friendly production, energy markets are also in the middle of a revolution all around the world. In this report, information on the recent energy scenario on the energy market focusing on the electricity market model in Malaysia, the monopoly in the electricity market, renewable energy growth in the Malaysian market, and the competitive market in this industry are reviewed and further discussed.

## 2. Electricity Market Model

Evolvement and transition of the Electricity Supply Industry (ESI) had introduced a number of electricity market model that is designed to be suited to its local condition [2]. Malaysian Electricity Supply Industry (MESI) especially has undergone several reforms to meet the industry objectives. The objectives are to deliver a secure and stable electricity supply at economically competitive tariffs while at the same maintaining environmental sustainability and ensuring consumer loyalty by fulfilling customer preference [6]. In 2010, MESI reform took place which results in the implementation of competitive bidding for the new generation, Single Buyer Framework, and Incentive-Based Regulation (IBR). This reform aimed to enhance transparency and provide a competitive environment in the power sector.



**Figure 2: Current MESI Structure [6]**

In the context of the electricity market, there are four models used for market arrangements which are the Single Buyer Model, Pool Market Model Trading, Bilateral Contract, and Multilateral/Hybrid model [3]. Currently, MESI operates as a Single Buyer Model as indicated in **Figure 2** and is ring-fenced to enhance transparency and accountability [4]. Under this model, the electricity is purchased by a Single Buyer either based on PPA/SLA or based on an offer for NED participants. Long-term supply is procured through competitive bidding or in some cases, through direct bidding. In the meantime, daily unit commitment and dispatch schedule are carried out through the least-cost option, taking into account generator outages and system constraints [6]. Increasing population leads to increasing demand. Therefore, Independent Power Producers (IPP) has been introduced to help TNB to solve the electricity shortage issue and to enlarge the electricity reserve margin.

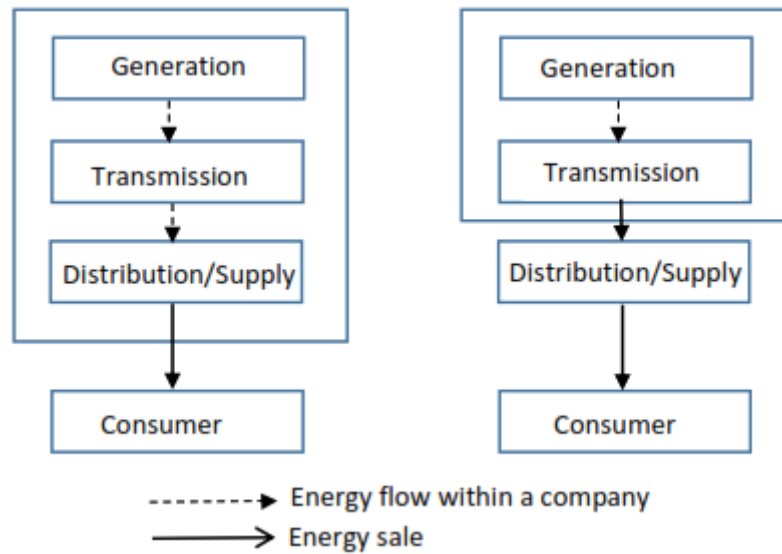
Next, for Pool Market Model Trading. The model is one of the most preferred electricity market models implemented in many developing countries [5]. In the model, generators are located according to their bidding price. Thus, a cheaper generator will have a higher chance to be selected to meet the electricity demand. The pricing issue has always been attentive in the energy-only market because generators are paid solely based on the volume of electricity produced. It will be resulting in the expensive generator will receive zero revenue during low electricity demand. Besides, the pool model would also have some issues like price fluctuation and market power exercises. Therefore, the Hybrid Model (HM 1) and Hybrid Model (HM 2) were developed by researchers to overcome the pool model issues.

Hybrid Model (HM 1) combines pure pool market and pro-rata base load which consist of two properties, baseload demand and peak load demand [7]. For baseload demand, the baseload allows all generators to get their revenue regardless of the current demand and energy bid price. The Pro-rata basis approach is used to divide the baseload fairly to all power producers. Using this model, portions of supply obtained by each generator will be proportional to its installed capacity. However, Hybrid Model 2 (HM 2), has categorized electricity demand into high demand areas and low demand areas [6]. Both of the areas are determined from the daily electricity demand curve constructed using the demand forecasting data. Both HM 1 and HM 2 did not take account of the efficiency and electricity price offered by generators in the baseload sharing.

### 3. Natural Monopoly in Electricity Energy Market

A natural monopoly is meaning, an industry where a single company can manufacture products to supply the market at a lower per-unit cost than two or more companies [8]. For further explanation, natural monopoly generally describes as a scenario where one company may realize economically that it can produce the market's desired output at an average cost that is lower than two companies could with a smaller-scale process. More precisely it is defined as the efficiency of a single company compared to the efficiency of other companies in the industry being the controller of an important resource or holding a patent on a particular product [9]. Usually, a natural monopoly would have very high fixed costs, which means it is impossible to have more than one business producing the product. Industries often cited for natural monopolies for example are the telecommunication industry, electricity, and water supply.

The Malaysian Electricity Supply Industry (MESI) has remained a controlled monopoly for many years. TNB is a vertically integrated national electricity utility and regulates the generation, transmission, and distribution of electricity, including retail, to its 9.2 million customers [10]. Although, the introduction of competitive bidding and IPPs allows for a level playing field in the generation market only, there is no competition in other fields, as the other part of the electricity industry is entirely dominated by the TNB from transmission to distribution and retail.



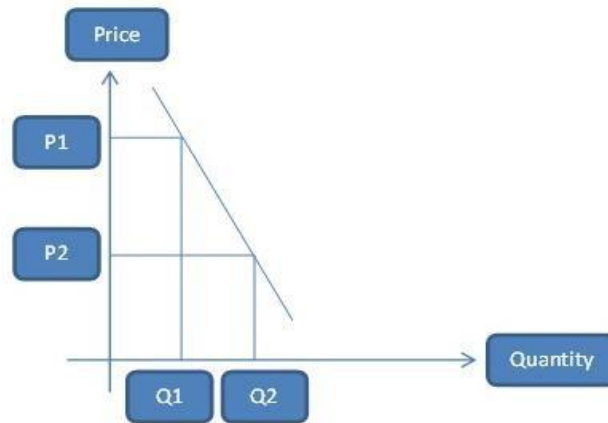
**Figure 3: TNB vertically integrated**

**Figure 3** indicates how TNB completely monopoly utilities that fully own from generation (GenCo), transmission (TransCo and GridCo), and distribution (DistCo) prior to deregulation [11]. In this situation, TNB supplies the entire demand to consumers. Monopolies are the reason why competition is not supposed to work well in these industries. Some features of a natural monopoly, due to economies of scale, include:

- 1) High fixed coast;
- 2) Decreasing long-run average cost;
- 3) Subadditivity of its cost function.

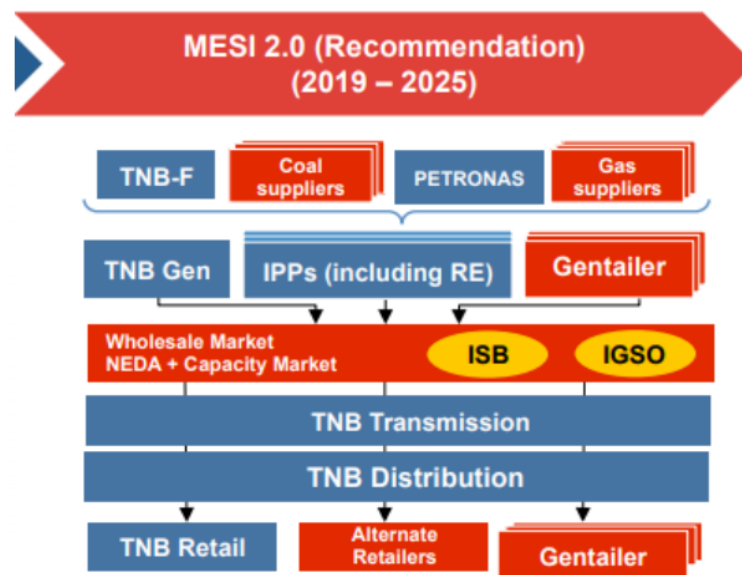
In Malaysia, TNB is the only company which supplies electricity to end-user such as industry and household. In the concept of monopoly, TNB lies in the ability of the company to control the price of its product or services. This company remains the only electricity supplier direct to the consumer because it would require a company to spend a large amount of capital in order to start such a monopoly business. In the electricity industry, huge capital needs to invest in the start-up of power plants with a high electrical capacity of megawatts. Moreover, to keep the production cost from increasing, a single company should be in this industry. If there were more than one company in the electricity industry, it will contribute to a higher price in coal. The supplier of coal has a choice to sell the coal at a higher price because coal is a scarce resource and selling the high price will contribute to the increase in production cost.

TNB company act as a monopoly market because the production cost will be reduced when there is no competition and provide the best price to the user. **Figure 4** shows the demand curve for electricity [12]. There is a steep demand curve since the demand for energy is relatively inelastic. The change in the price of electricity will not influence the demand for electricity. The consumer cannot find any substitution because TNB is the only electricity distributor in the country if the price of electricity was increased.



**Figure 4: Demand curve of electricity under a monopoly market**

Recently in MESI 1.0 and after deregulation, the monopoly concept for TNB was applied in transmission, distribution, and retail electricity to end-user. Transmission and distribution will remain a monopoly in MESI 2.0 because it will be a problem to direct the cable to each household that chooses the different supplier and indirectly will increase the production cost to the supplier. So, in order to resolve these issues, the government has given the license to TNB to operate these parts of the business. **Figure 5** shows the recommendation for the electricity market in MESI 2.0 where the TNB will remain monopoly for transmission and distribution business [13].

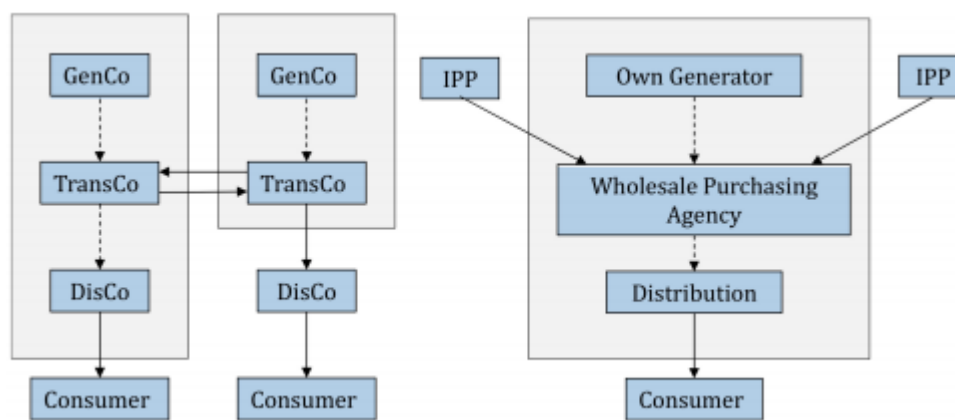


**Figure 5: Recommendation MESI 2.0**

#### 4. Competitive in Electricity Energy Market

Competitive markets will emerge in certain circumstances. Among them is profit with a free market formed when profits provide sufficient incentives for entrepreneurs to enter the market. Profits are earned when producers earn with total income more than production costs. There are two types of profits that need to be considered, namely supernormal and normal. For super normal profits is in accordance with the views of the public on the benefits when total revenues exceed total costs, but the idea is unique for the common benefit of the economy and downgraded by employers when total revenue equals total cost. The total economic cost of production includes the minimum remuneration for all factors of production to continue to provide - a reward to entrepreneurs is normal profit. Supernormal profits are the best as the initial incentive or incentive to firms to innovate.

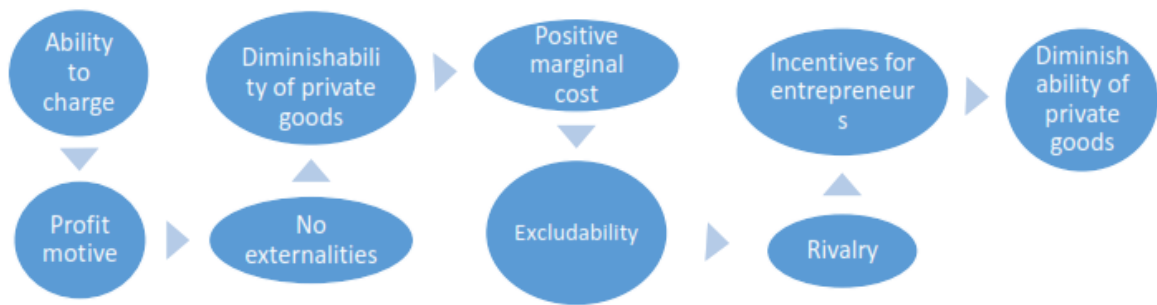
More competition in the electric supply industry by Tenaga Nasional Berhad (TNB) with proposed under the Malaysia Energy Supply Industry 2.0 (Mesi 2.0) programme. The utility company fully gives cooperation to the Malaysia Programme Office for Power Electricity Reform (MyPower), the tasked by the energy, science, technology, environmental, and climate change ministry to drive Mesi 2.0. Have several IPPs competing in the generation sector and more contribute to powering the nation by Electric Power Supply Industry 2018 (Cepsi 2018). By a monopoly must have a misperception that incurring more cost. For example, see the statistics as a given index with an average interruption duration supplies are at an advanced country status. A system for the transmission channels is in under a minute, even better than some developed countries [16]. Developing and emerging countries are determined from international investors, because state-owned enterprises are usually unable to support planned expansion investment levels on their own. Competition between these sectors may lead to inefficient investment due to duplication of transmission and distribution systems. State-owned power companies can and in many cases can compete with private companies. Figure 6 shows the monopoly and purchasing and explained what the best market structure and power generation technology combination in the oligopoly power market model is, the purpose is to minimize market power.



**Figure 6: Monopoly and Purchasing models**

For competition for the free market will only be formed when consumers must compete for profit. To get good seat users must make reservations in advance or get there early. The need to compete for profit from goods or services. This is the principle of competition and is related to the principle of decline. With the positive marginal cost of supplying goods made the private and small cost for the use of resources that produce the marginal cost to enter the market more and more users, more products are produced and continue to be made marginal cost [14].

The ability to charge when the deteriorating situation, competition, Severability, rejection and have a positive marginal cost, the market is likely to be formed to charge for the product and the buyer can accept or reject the price. Bids for goods or services, and to the accepted or rejected by the seller and the ability to charge at the point of use is central to the formation of the market. The market is also said to be efficient when not influenced by parties who are not directly involved in the market [15]. This means that during the production of goods, and during the use of disposal after use does not leave a positive or negative effect. Positive impacts and negative effects are called negative externalities or external costs. Positive externalities related to customer benefits. When the external form, the free market may not work effectively.



**Figure 7: Flow the Competitive Market**

### 5. Renewable Energy Growth Market in Malaysia

Malaysia adopted Renewable Energy (RE) as the fifth fuel strategy in the year 2001 Mixed Energy under the National Energy Policy. The intention was to provide RE capital with 500 MW of grid-on electricity in 2019 [17]. National Biofuel Policy 2006, National Green Technology Policy 2009, and National Renewable Energy Policy 2010 are the initiative policies from the Government of Malaysia (GoM) to promote RE [18]. This subtopic explains the programmes introduced by the GoM to increase the renewable energy growth market in Malaysia.

New Enhanced Dispatch Arrangement (NEDA) was officially introduced in June 2017 and the regulations were revised in May 2019 to add ‘solar power developer’ as a new group of NEDA participants [19]. Since 2016, the Energy Commission (EC) of Malaysia has initiated a competitive bidding process for Large Scale Solar (LSS), providing a total of 434 MW for Peninsular Malaysia with a leveled tariff ranging from 39.95 to 44.95 sen/kWh. The second round of LSS bidding by EC proposes a total of 563 MW and an expected 500 MW for the third round of bidding in 2019 [20]. The government announced the third LSS power project tender (LSS3) which equivalent to 500MW in February 2019. More than 100 tenders were submitted for the venture, with bid prices ranging from RM 0.17 to RM 0.58 per kilowatt-hour. The commission has chosen five firms to manage the project. Online operations are scheduled to launch by 2021 [20].

Sustainable Energy Development Authority (SEDA) is an agency under the Ministry of Energy, Science, Technology, Environment & Climate Change (MESTEC) responsible to control and integrate the operation of the feed-in tariff system required by Renewable Energy Act 2011 (Act 725). SEDA has approved 108 MW Net Energy Metering (NEM) at the end of November 2019 [21]. Table 1 shows the cumulative NEM approved from the year 2016 until 2019 and it shows the approved quota to implement NEM from the year 2016 to 2019 increased by 18%. The overall accepted quota reflects an optimistic improvement of 7.8 times relative to the previous three years and is only at a rate of 13.86 MW intake. Table 2 shows the approved NEM by the category, the highest approved NEM quota is for industrial (69%) followed by commercial, domestic, and agriculture category.

**Table 1: The Cumulative NEM approved from 2016 to 2019**

Year	Approved quota (MW)
2016	0.01
2017	2.33
2018	11.53
2019	94.14
<b>Total</b>	<b>108</b>

**Table 2: The approved NEM quota according to the category**

Category	Approved capacity (MW)
Domestic	7.67
Commercial	25.18
Industrial	75.01
agriculture	0.13
<b>Total</b>	<b>108</b>

SEDA Malaysia launched an e-bidding system for biogas in the 4<sup>th</sup> quarter of 2018 while small hydro energy was applied in 2019 applications under the Feed-in-Tariff (FiT). For the first e-bidding of Biogas in the fourth quarter of 2018, the average efficiency was RM0.4055/kWh and the second in July 2019 was RM 0.4058/kWh, respectively. This price is slightly less than the effective cost provided before e-bidding which is RM 0.4669/kWh [21]. The Malaysian Feed-in Tariff (FiT) program enables Distribution Licensees (DLs) to purchase power generated from renewable energy from Feed-in Approval Holders (FIAH) and sets the FiT rate [22]. In the last eight years, FiT has effectively driven Malaysia's RE policy. 10,269 FiT implementations have been commercially operational in Malaysia as of November 2019, with a gross installed RE power of 614.93 MW [21].

## 6. Conclusion

In a conclusion, Electricity Supply Industry (ESI) in Malaysia have gone through some transformation to fit its current condition of energy demand and to meet industry objectives and finally introducing those market models. Single Buyer Model, Pool Market Model Trading, Bilateral Contract and Multilateral or also known as Hybrid Model are the four models used in market arrangement. Each model has pros and cons. In order to overcome this problem, each country have their own preference of model to be implemented. The increasing demand is overcome by introducing Independent Power Producers (IPP). Meanwhile Hybrid Model (HM 1) and Hybrid Model (HM 2) were developed by researchers to overcome the pool model issues. A natural monopoly exists when the average costs of a certain product continuously fall as the company gets larger. In the energy industry, natural monopoly happens to electric companies. This infrastructure is characterized by high investment costs, which makes that it is not efficient to have more than one infrastructure. Therefore, TNB will remain dominant in the transmission and distribution of electricity in Malaysia to avoid any failure in the market.

Ministry of Energy, Green Technology and Water, Energy Commission, and the Malaysia Energy Centre are the agencies under the Malaysian government that are responsible for the energy policy of the country. According to the data uploaded on Energy Commission official website, Malaysia's energy sources in the earlier years are crude oil, petroleum, natural gas, hydropower, and coal and coke before more energy sources are found [23].

These renewable sources ensure the diversifying energy supply and reducing dependence on imported fuels as well as creating economic development in the country. National Biofuel Policy 2006, National Green Technology Policy 2009, and National Renewable Energy Policy 2010 also an initiative from the Government of Malaysia (GoM) to promote renewable energy in this country and The Malaysian Feed-in Tariff (FiT) program ensure renewable energy is bought at a mandated price from the generators.



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