A REVIEW OF TARIFF EFFICIENCY MECHANISMS FOR MALAYSIAN ELECTRICITY DISTRIBUTION FIRM

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ABSTRACT: *The Malaysian electricity market is highly regulated. Electricity tariffs for the different consumer groups are distributed by the Tenaga Nasional Berhad (TNB) based on a Base Tariff rate as stipulated by the regulatory agency, the Energy Commission (EC). This paper discusses the mechanism in which the Base Tariff is disbursed to the three main consumer groups which are i) Industries, ii) Commercial and iii) Residential. This disbursement requires a more accurate and justifiable mechanism that lead to the need to redesign the technique. This can be done through a Tariff Optimization Modelling which advocates a constrained optimization technique.*

Keywords: Electricity, Base Tariff, ICPT, Efficiency, Optimization

1. INTRODUCTION

The Malaysian electricity industry is highly regulated. Currently, Malaysian Energy Commission (EC) has been given the mandate to regulate and set electricity tariffs for the nation for every three years. The tariff setting is generally based on the costs provided by Tenaga Nasional Berhad (TNB), the main electricity distributor for the country. The tariffs are then set based on the allowable rate of return, which in turn will be the basis for tariff setting calculation for various customer groups through its increasing block rate method. In addition, to set more structured electricity tariff, the utility firms are given an Incentive-Based Regulation (IBR) [i] in their tariff setting. The introduction of IBR mechanisms and its objectives for tariff setting is to promote the financial, operational and cost efficiency as highlighted in the electricity tariff regulatory implementation guidelines (RIGs)[ii] by EC. There are eleven RIGs under the electricity tariff are as follows:

RIG 1: Define business entity, their functions and the flow of funds between business entities.

RIG 2: Define the tariff setting framework for each business entity (price or revenue regulation, regulatory term).

RIG 3: Establish revenue requirement principles for each business entity (building block model) & establish incentive framework: clear principles for treating variances in forecasts (both cost and consumption).

RIG 4: Establish return requirement for each business entity.

RIG 5: Establish detail operating cost, capital cost, asset and consumption templates for each business entity.

RIG 6: Establish incentive framework for operational performance.

RIG 7: Establish cost allocation principles (to allocate common costs).

RIG 8: Establish imbalance cost-pass-through mechanism.

RIG 9: Establish tariff design principles.

RIG 10: Establish regulatory accounts process: specify timing, reconciliation to audited accounts and explanation of variances.

RIG 11: Establish a process for revenue requirements and tariffs for each business entity.

Thus, the IBR under RIGs mechanism is to strengthen the economic regulatory framework for regulating TNB, tariff setting mechanism and principles for tariff design, incentive mechanisms to promote efficiency and service standards, the process of tariff reviews and creation of regulatory accounts and its annual review process (EC, 2016) [1]. Therefore, this IBR framework encourages best-practices and operational efficiency as well as ensures a fair and efficient tariff for the customers (TNB, 2017) [2].

By considering to the issues discussed on the tariff setting, this study is motivated to review on the current tariff design and highlights some optimize efficiently design the end-user tariff to different customer categories with the main objective of recovering the forecast revenue requirement as approved under IBR to minimize and maximize the cost and profit respectively. As the principal entity in the electricity distribution industry of the country, TNB and other utilities proposed that an optimum tariff setting incorporating business (i.e, economic competitiveness, energy efficiency), environmental (i.e, green initiatives, renewal energy, energy saving) and welfare (i.e, tariff subsidy) of the people and industries are developed. This attributes of tariff efficiency are consistent with the Bonbright principles which will be discussed further in the next section. This is particularly critical if the tariff setting is to remain competitive, act as the catalyst to nation building and win the race to become a developed country by 2020.

This paper is organized as follows. Section 2 reviews the current practice of tariff mechanisms in Malaysia. In the following section, this paper discusses the mechanism of electricity tariff related to energy price, subsidy and other determinants. Next, in section 4 presents the proposed model; optimization, constraints and sensitivity analysis. Finally, section 6 concludes the paper.

2. CURRENT PRACTICE

A review on what is happening globally has seen electricity market reforms already taken place in the UK, Norway, Alberta (Canada) and California (USA). The reform, however, leads to the introduction of a competitive generation market that of itself, has failed to deliver reliable service at low and stable prices. The market reform failures are attributed to market power abuse by few dominant sellers (especially at times of transmission congestion), poor market design that invites strategic bidding by suppliers, the lack of customer response to price spikes, capacity shortage caused by demand growth not matched by new capacity, and thin trading of forward and futures contracts that are critical for price discovery and risk management. The policy implication is that an electric market reform can be extremely risky, and may lead to a disastrous outcome [3]. Thus, it is imprudent to implement such a reform in countries with limited sites for a new generation and no indigenous fuels (e.g., Israel and Hong Kong). According to Woo, Lloyd & Tishler [3], these countries should, therefore, consider introducing performance-based regulation, also known as IBR as a direction that Malaysia is currently going, that can immediately benefit electricity consumers in terms of lower prices, more stable prices, improved reliability, more choices, while encouraging the electric sector to pursue efficient operation and investment.

Early in the year 2014, the IBR system took effect to facilitate in mitigating the threat posed by unpredictable fuel costs (EC, 2014) [4]. This IBR system resulted in a more consistent and transparent means of determining the electricity tariffs applied to the residence, commercial and industrial consumers throughout Peninsular Malaysia. In terms of electricity tariff regulations, in developing an improved mechanism to determine the electricity tariff rate, the EC takes into consideration the interests of the consumer and balanced them against the needs of the utility. However, the current tariff calculation depends on the type of customer (residential or retail commercial) and billing charges based on different rates and units of measurement.

Furthermore, IBR is an improvement over the cost plus model as it enables tracking of efficiencies and costs which applies to natural monopoly parts of the power sector such as transmission and distribution networks (Tariff Optimization Workshop, TNB- Uniten, 6 October, 2017) [2]. Mohd Zamin & Ibrahim [5] claimed that IBR becomes an economic regulation tool that seeks to balance the needs of both utility and customers by driving down costs, promoting efficiencies while ensuring that the utility receives a fair rate of return. Therefore, IBR is a tariff setting mechanism which provides a systematic incentive for a utility to lower the cost through improved efficiency [6]. Through this IBR tariff setting framework, it allows electricity distribution firm to recover its true cost of services, while imbalance cost pass-through mechanism allows the full recovery of fuel and generation specific costs as carried out in other jurisdictions [5]. To support the IBR's goals and objectives, single buyer department of TNB planning acts as the off-taker and optimizes generation costs based on efficient dispatch of generation. Furthermore, responsibilities of fuel management, generation plant-up and load forecasting also lie within single buyer department. Therefore, it can lead to optimal operations by the system operator, efficient fuel and energy procurement and successful implementation of imbalance cost pass-through which is translated into huge financial savings for TNB [5, 7]. The implementation of incentive regulation concepts is more complex and more challenging than may first meet the eye. This has important implications for regulatory resources devoted to information collection, monitoring, and dynamic regulatory adjustments [8].

TNB Electricity tariff in Peninsular Malaysia is based on the IBR principle. This is a mechanism for the electricity tariff determination that focuses on a more efficient gain as well as providing a more structured process of tariff evaluation. It is also an effective tool employed globally for designing tariffs which is consistent with what was recommended by James C. Bonbright through 10 principles[iii] that embedded into 5 core principles namely; economic efficiency, equity, revenue adequacy and stability, bill stability and customer satisfaction [9]. In addition, according to Totten (u.d) [10], principles of public utility rates by Bonbright are covered in seven important scopes include rate attributes in terms of its simplicity, understandability, public acceptability as well as the feasibility of application and interpretation. Followed by effectiveness of yielding total revenue requirements, revenue (and cash flow) stability from year to year, stability of rates themselves, minimal unexpected changes that are seriously adverse to existing customers, fairness in apportioning cost of service among different consumers, avoidance of "undue discrimination" and efficiency in promoting efficient use of energy and competing products and services. These elements were illustrated in figure 1 and 2.

Therefore, the calculation of the tariff for access to the distribution network should be based on energy flows, delivery capacity, and costs for the entire distribution system in the base year. Economic efficiency pricing could maximize the net economic benefits of the electricity generators. It will also influence production efficiency when output is produced at the lowest feasible average cost, both in the short run or the long run, in addition to the allocative efficiency achieved when the price of output reflects the true marginal cost of production (i.e. Price=Marginal cost). This means, the initial investment of capital is diffused over an increasing number of units of output, and therefore, the marginal cost of producing good or service decreases as production increases when the industry is experiencing increasing economies of scales.

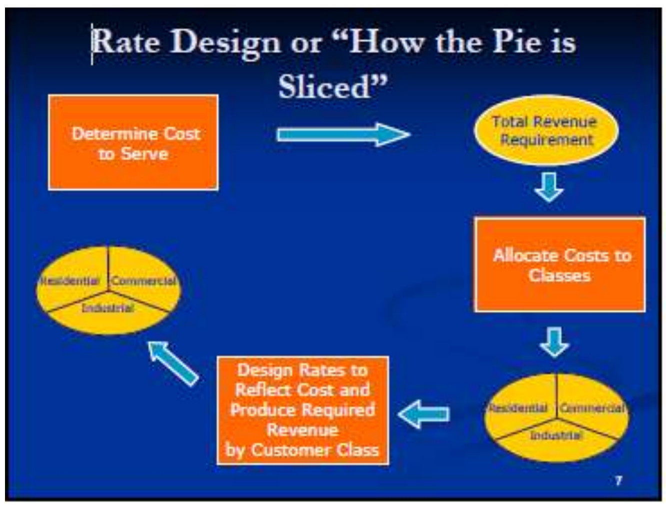

Figure 1: Rate Design to Electricity Customers

Source: Jess Totten, Director, Public Utility Commission of Texas Briefing for the NARUC/INE Partnership [10]

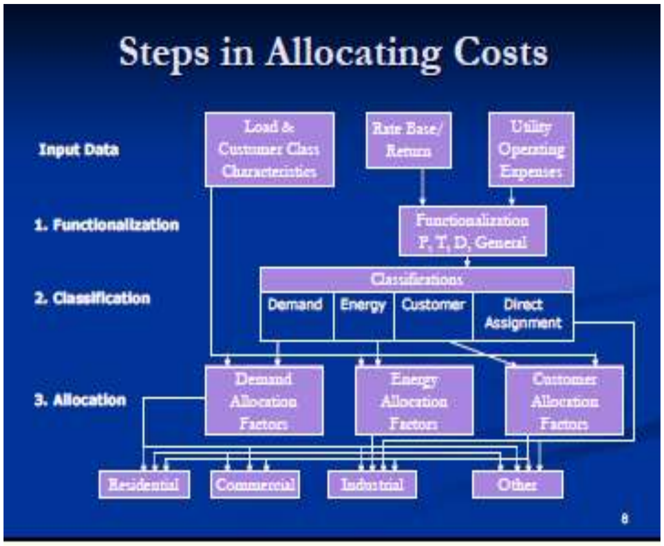

Figure 2: Steps in Allocating Costs under Rate Design to Electricity Customers

Source: Jess Totten, Director, Public Utility Commission of Texas Briefing for the NARUC/INE Partnership [10]

Thus, all these elements should be considered in determining the electricity tariff rates. Currently, there are two elements need to be considered for efficient cost computations in measuring average selling price which is embedded into base tariff and Imbalance Cost Pass-Through (ICPT) for the tariff. In the base tariff, the cost capital expenditure (CAPEX) and operating expenditure (OPEX) are need to be considered whereby these cost separation are recovered by different entities which can be classified into two parts, (1) the tariff of transmission, distribution, grid system operation and single buyer operation, and (2) the tariff of single buyer generation. This cost is important to determine the base tariff setting which is reviewed once every 3 years.

Besides that, under the electricity tariff review, ICPT is an additional tariff adjustment to reflect uncontrollable fuel cost and other generation costs. The cost components comprise of, (1) actual versus forecast cost of fuel and other generation costs for the preceding 6-month period and, (2) piped gas price increase of MYR1.50/mmBtu for the next 6-month period (EC, 2016 [1]; TNB Handbook for forum slide, 2016 [11]). These costs which reside in the electricity supply industry are then accounted for in the tariff calculation under the IBR framework. Hence, the IBR method promotes efficiency gains that will be shared among the consumers, investors, government and the utility company.

3. OTHER CONSIDERATIONS IN DESIGNING END-USE TARIFF FROM MALAYSIA ELECTRICITY SUPPLY INDUSTRY (MESI) PERSPECTIVE

Highlighted from the current practice of tariff setting mechanisms, there are probably other considerations in designing end-user tariff from Malaysia Electricity Supply Industry (MESI) perspective and macro as well as microeconomic perspectives. In this paper, several suggestions are point out such as the issue of gas price subsidy and initiatives from our government planned to gradually reduce the subsidy. Moreover, other types of subsidy also need to be considered, for instance, the changes of government policy, government services tax (GST) exemption, MYR20 subsidy for eligible customers, lifeline band, cross-subsidy among consumer groups and discounts to selected customers. Besides the subsidy, setting for the tariff maybe to promote the renewable energy program such as feed-in- tariff (FiT).

With respect to tariff subsidy, an RM20 subsidy on monthly electric bills is provided by the Government to all eligible residential customers. This rebate has been offered since 1 October 2008. This rebate is offered to residential customers whose, electricity bills amounted to RM20 or less. The amount includes any applicable discounts. Outstanding amounts, late payment charges or any other charges are excluded from this RM20 bill total. Residential customers who have a monthly reading of 0kwh a month, e.g. vacant premises, are not eligible for this rebate. This subsidy rationalization has been implemented since 2010 by the Performance Management and Delivery Unit (PEMANDU) through its subsidy laboratories and public engagement initiatives. Under tariff rationalizations, the average electricity tariff in Peninsular Malaysia was raised from 14.89 per cent or 4.99 sen per kilowatt-hour (kWh) to 38.53 sen/kWh, which was effectively on 1st of January 2014. This tariff revision was due to the increase in gas price and it is consistent with the Government's policy to reduce the gas subsidy in stages until it reaches market price [12]. Additionally, the subsidy tariff rationalizations, as per the 2014 Budget, a Government Service Tax (GST) will be imposed (has been imposed at the time this paper is written) on all consumers with effect from April 2015. However, domestic consumers using 1-200 kWh per month will not be subjected to the GST. The reason behind the tariff subsidy rationalization is that the government cannot continue to subsidize increasing fuel prices; especially gas prices (see *Figure 3*). The total value of the gas subsidy reached about MYR20.1 billion in 2011 representing a dramatic increase of 171% since 2005. Of the total, 56% or MYR11.6 billion went to power generation, while the remaining 44% or MYR8.5 billion is for the non-power sector, which includes industries, commercial and residential users. The country also needs to move from blanket to targeted subsidies as it tends to result in an inefficient allocation of resources, and therefore, impose less distortion on the economy.

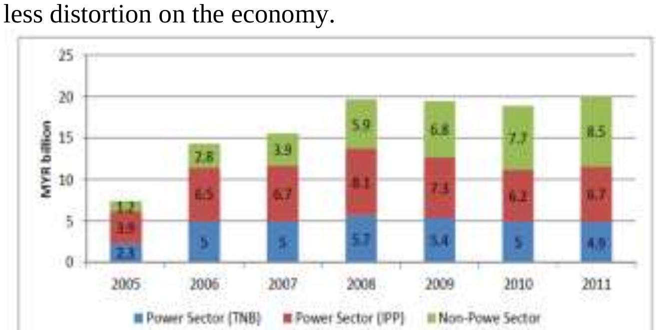

Figure 3: Malaysia Gas Subsidy Allocation

Source: Ilias, Lankanathan, and Poh [13]

Generally, there are three price mechanisms that have been used to guide and control Malaysian energy prices, which are automatic price mechanism (APM), IBR policy and FiT. The retail prices for petroleum products in Malaysia is based on the APM since 1983, which means the government sets the price at a certain level. The main objective of APM is to stabilize the price of petrol and diesel in the country to a certain extent via a variable sales tax and subsidy scheme [14]. The fit is a government policy created to encourage the adoption of renewable energy (RE) as well as the increment in RE investment. It was designed to attract renewable energy technologies, particularly solar photovoltaic (PV), wind power and tidal power to market. In the case of photovoltaic technology, the optimal subsidy estimation method according to Chou, Nguyen, Yu & Phan [15] and Jeon, Lee & Shin [16] is more accurate and flexible thereby help policymakers to optimize their subsidy allocation and therefore reduces subsidy inefficiencies.

As regards to the electricity tariff subsidy, Malaysian national oil corporation, (PETRONAS), subsidizes gas via the mechanism of importing 32% of gas demand from Indonesia, Thailand, and Vietnam and supplying TNB with a price which is approximately 25% of the imported cost [17]. Figure 4 shows the electricity consumers are the beneficiaries of the controlled gas price set by the Government which is much lower than the market price. However, the independent power producers (IPP) and TNB profits are indifferent to the gas price, as this is a pass-through cost. IPPs do not benefit from any gas subsidies. As for liquid natural gas (LNG), it is all purchased at international market prices.

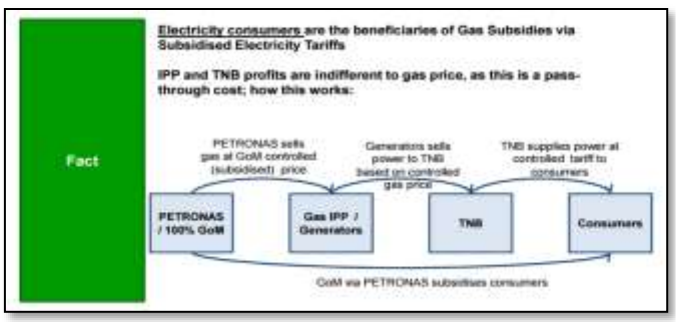

Figure 4: Malaysia Subsidies Electricity Tariff Framework
Source: Energy Commission [18]

4. PROPOSED FOR THE TARIFF EFFICIENCY APPROACH

Tariff/Price optimization model is proposed to determine how different types of customers (i.e; Residential, Commercial, Industrial, etc) will respond to different tariff/prices for electricity. It uses to determine the tariff/prices that will help the utility company to determine a fair tariff while meeting its desired objectives. The data used in tariff/price optimization includes operating costs, inventories and historical tariff/prices and sales. Specifically, the price optimization model illustrates how electricity/demand varies at different tariff levels, taking into account costs and inventory levels in order to develop a reasonable tariff setting. This tariff model is also used to evaluate the pricing for different segments of customers by simulating how targeted customers will be charged to respond to different cost pricing. In order to develop a functional model, it is necessary to test the model on only one segment of customers at one point in time. This would enable us to precisely estimate how customers in different market segments would respond to different tariff/prices offered through different channels. Given this information, determining the tariff/prices that best meeting the electricity company' goals and satisfy the social needs can be formulated within a constrained optimization process (See Figure 5). The optimization is determined by the underlying structure of the pricing problem.

One of the principles of tariff optimization determination is that economic regulation will act as a substitute for the market in situations where natural monopoly characteristic of industries, as in the case of network utilities. Regulators are expected to exert pressure on the utility to improve its working to a level at which it would have performed in a competitive market. This model assumes the ability of the regulators to mimic such market conditions. Even the partial achievement of such conditions, as demonstrated by experience in U.K, requires substantial effort by the regulatory authorities towards articulating a long-term agenda, defining targets and milestones and designing and implementing the strategy. Where a clear mandate to restructure the market is not available, as, in India, pricing strategy is the principal tool available to simulate those conditions [19].

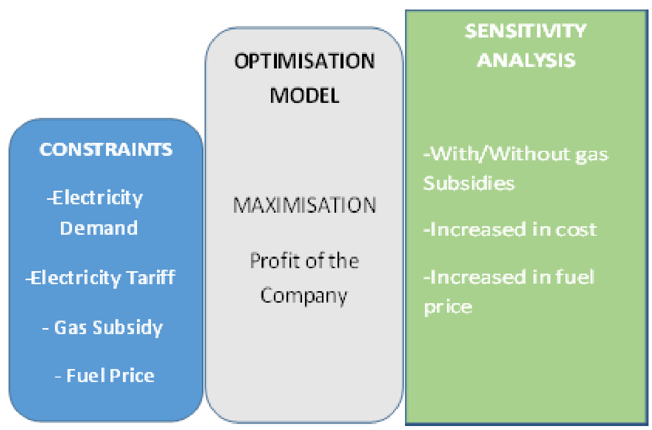

Figure 5: Schematic representation of Tariff Optimization Model
Source: Author

5. CONCLUSIONS

Many electricity distribution companies nowadays are putting an effort to improve its disbursement of the Base Tariff that is both efficient and justifiable to especially three consumer groups, i.e; residential, commercial and industrial. Difficulties of such disbursement have become more challenging when subsidies have to be incorporated in the final set tariffs. It is best that an efficient and justifiable method of Constrained Optimization by taking into account the marginal costs of distribution to the different consumer groups is developed. It was supported by Wang & Lee [20] and Tower [21] who found that the association between electricity tariff and revenue among distribution firms can be identified in three ways; (1) the optimum-welfare tariff is higher than the maximum-revenue tariff when the upstream firm adopts uniform input pricing and if the number of foreign competitors is sufficiently large. (2) the maximum-revenue tariff is higher than the optimum-welfare tariff when domestic upstream monopolist adopts discriminatory input pricing, and (3) the optimum-welfare tariff will exceed the maximum-revenue tariff if the sizes of domestic and foreign firms become more unequally distributed when foreign upstream monopolist adopts discriminatory input pricing. Therefore, it is the aim of this project to design an optimal tariff setting framework that might probably use by electricity distribution companies. This framework will be translated into a simulation model and system to enable quick computation of tariff given changes in business parameters. While the model still needs to be tested, the model can be used by TNB, and possibly other country' electricity distribution companies for future tariff negotiations, bearing in mind the needs of the nation and the company.

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[i] IBR framework in Peninsular Malaysia is governed by the Regulatory Implementation Giudelines (RIGs) by EC in January 2012.

[ii] RIGs have been registered under Electricity Supply Act 1990 on 4th May 2016.

[iii] 10 Bonbright Principles are; (1) Effective in yielding total revenue requirements under the fair-return standard without any socially undesirable level of product quality and safety., (2) Revenue stability and predictability with a minimum of unexpected changes that are seriously adverse to utility companies., (3) Stability and predictability of the rates themselves, with a minimum of unexpected changes that are seriously adverse to utility customers and that are intended to provide historical continuity. (4) Static efficiency, i.e; discouraging wasteful use of electricity in the aggregate as well as by time of use. (5) Reflect all present and future private and social costs in the provision of electricity, i.e; the internalization of all externalities. (6) Fairness in the allocation of costs among customers so that equals are treated equally. (7) Avoidance of undue discrimination in rate relationships so as to be, if possible, compensatory (free of subsidies). (8) Dynamic efficiency in promoting innovation and responding to changing demand-supply patterns. (9) Simplicity, certainty, the convenience of

payment, the economy in collection, understandability, public acceptability and feasibility of application. (10) Freedom from controversies as to proper interpretation.