DITRIBUTION NETWORK CONNECTION PRICING FRAMEWORK AND METHODOLOGY: COMPARATIVE ANALYSIS ON CONNECTION CHARGES OF UTILITY COMPANIES IN MALAYSIA

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ABSTRACT: *The purpose of this review is to identify any deficiency of Sarawak Energy Berhad (SEB) connection charges (CC) guidelines to deal with the customers' ever increasing energy demand and supply connection. The review involves a peer review of the company CC guidelines and comparison of its guidelines with another two utilities within the same region. The study revealed a few areas in SEB CC guidelines can be further improved. Many improvement options can be adopted from other more successful utilities such as TNB. However, the key challenge of the improvement is to strike the right balance between the amount of upfront investment and the ability to fulfill key pricing objectives acceptable to both the company and the connecting customers*

Keywords: Connection charges, capacity charges, economic efficiency, investment efficiency

1. INTRODUCTION

Complaints on issues and matters related to connection charges to electricity supply have been very common throughout the world for electricity supply utility companies as this involves dollars and cents that customers have to pay to get connected to the distribution of the electrical network. Some of the common issues raised are mostly related to the pricing, technical issue or the related application process and procedures, which has a direct impact to the connecting customers directly and indirectly.

This paper will provide an overview of Sarawak Energy Berhad (SEB) connection charges policy, as well as comparing the connection charges policy with other two utility companies around the region. Sarawak Energy Berhad (SEB), a utility company in the south east region, responsible for the generation, transmission and distribution of electricity for the state and is wholly owned by the government [2]. Shortcomings in the connection charge when dealing with the current supply, demand patterns were identified and to find areas for improvement. This is necessary to ensure that the connection charges imposed on the customers are reasonably charged. This is to ensure that customers are not over-charged nor under-charged that may cost SEB on the return of investment [1].

2. PROPOSED RESEARCH

The study was undertaken via reviewing and understanding connection charges policy of three utility companies operating in Malaysia and to identify the salient features of their policies, which may be used as the fundamental component when formulating a new connection charges framework for SEB. The study is carried out in Sarawak, Malaysia.

3. COMPARATIVE ANALYSIS RESULTS

Figure 1 shows the supply connection of a customer from the distribution intake substation for the three utility companies under study. It is also the typical connection frame work model used for computation of the connection charges and the policies.

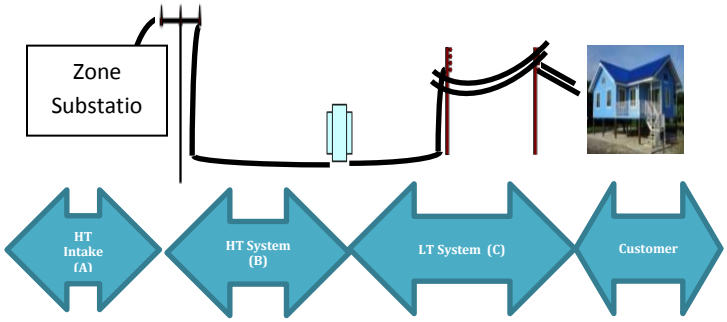

Figure 1. Typical distribution network connection frame work model for computation of connection charges

It is made up of the following chargeable sectors:

- ***Development of HT intake (33KV substation)***
  Covers the development of major distribution substation, typically at 33KV and with voltage transformation to 11KV before distributing to various customers as indicated in Figure 1 as "A".
- ***Development of HT system***
  Covers the development of HT system which includes the underground cables, overhead lines, transformers and all related accessories as indicated in Figure 1 as "B".
- ***Development of LT system***
  Covers the development of LT system which includes the underground cables, overhead lines and all related accessories as indicated in Figure 1 as "B".

Besides Sarawak Energy Berhad (SEB), two (2) other utility companies' connection charges, namely Tenaga Nasional Berhad (TNB) and Sabah Electricity Supply Berhad (SESB) were chosen for this study. Overview of the company financial and system performance are summarized in Table 1, extracted from relevant companies annual reports.

Table 1. Company financial and system performance for SEB, TNB and SESB

Item	SEB [3,6]	TNB [4]	SESB [5]
Total Customer	593,000	8,600,000	535,686
Service Covered Area (KM^2)	124,450	130,596	72,500
Profit before tax (RM, Mil)	336.2	6571.0	13.9
Maximum Demand (MW)	2,288 [6]	16,901 [6]	908 [6]
System Performance (SAIDI 2015)	144 [6]	55 [6]	234 [6]
Average demand density (KW/km^2)	18.38	129.41	12.52
Average customer demand (KW/Cust)	3.8	1.96	1.69
Customer Density (No Cust/km^2)	4.8	65.9	7.4

Table 2, 3 and 4 summarized the key components of current charging methodology of SEB, TNB and SESB respectively as per extracted from their connection charges guidelines.

Item	Description
HT Intake (33KV substation)	Case to case basis. No clear guidelines on the charging methodology
HT System	Covers the: - Connection to existing HT network - Extension of HT network - Installation of HT transformer Housing and shop houses development: - Capacity charge of RM500/KVA + Actual HT costs (if more than 1km from the nearest HT connection point) Single residential, commercial and industrial premise: - Capacity charge of RM500/KVA + Actual HT charge for HT cost that exceed 300% of the capacity charge + Actual HT costs (if more than 1km from the nearest HT connection point) Government and temporary supply: - Estimated project actual cost
LT System	Estimated actual project cost
Salient feature	Key Features: - A fixed RM500 / KVA capacity chare imposed on all customers regardless of if HT development is required - Subsidy (up to 300% of capacity charge paid) on HT development cost for single premise customers and unlimited subsidy cap (Differences between total HT project cost and capacity charge paid) for development projects - Inconsistency in charging HT intake (33KV substation) construction

Table 2. Key components of current charging methodology of SEB as per extracted from their connection charges guidelines [7].

Item	Description
HT Intake (33KV substation)	Shared HT intake: - Shall be funded by the company Dedicated HT intake: - The developer is to pay for the construction of the substation Infrastructure development area: - The company and the developer shall share the cost of developing the infrastructure on a 50-50 basis. If the electricity sales collected within the 3 years achieves 25% of the total project cost, the full amount paid shall be refunded to the developer.
HT System	Covers the: - Connection to existing HT network - Extension of HT network - Installation of HT transformer For individual customers, if there is a requirement to augment >6.6kV & <132kV, the connection charge is 50% of the project costs. For customers that are not "individual" customers, if <6km from nearest available supply (that could meet demand), the charge is based on Schedule 1 (differs by MD, metering type and whether land for substation donated or needs to be purchased) [8] For customers that are not "individual" customers, if >6km from nearest available supply (that could meet demand), the customer charge includes the cost for sizing cable to meet requested load in excess of 6km.
LT System	For individual (domestic) customer, the extension of mains/and or service (limited to 3 poles) is as per Schedule 3 [8]: - No charge for 1 phase (OH) connection - RM 750 for 3 phase OH connection - RM 1700 for 3 phase UG

	connection For individual customers requiring > 3 poles the connection charge is 50% of the **additional project cost** (i.e., cost greater than 3 poles) ***PLUS*** charge from schedule 3 (outlined above)
Salient feature	Key Features: - It effectively operates a reimbursement scheme where development occurs in an Infrastructure Development Area - 50% of the HT project cost is imposed on all customers within a radius 6KM, it is based on the assumption that the company will invest partially on the network that can be used by other customers. - Transparency in the charging whereby all customers (except for those outside 6KM radius) will be able to estimate the connection cost through the schedule of rates

Table 3. Key components of current charging methodology of TNB [8] as per extracted from their connection charges guidelines.

Item	Description
HT Intake (33KV substation)	Fully dedicated supply system - Calculation based on Rate of Recovery within 3 years (33.33% pa) Supply scheme to be part of shared network - Project Cost (Materials, Labour) plus Development Charge (10% of Project Cost) plus Processing Fee (RM100)
HT System	Standard Scheme within 6km - Project Cost * 0.5 + Development Charge (10% of Project Cost) plus Processing Fee (RM100) + *Disaggregation costs (If HT system requires upgrading) + Project cost for >6km (If >6km from point of connection) *Shall be imposed, which is the proportionate project cost of the upgraded system, based on the applied load.
LT System	Domestic application (single phase) and no additional poles required - Free <1km: - Project Cost * 0.5 >1km: - Project Cost for <1km * 0.5 + Project Cost for >1km
Salient feature	Key Features: - Domestic single phase connections requiring no additional poles is free - All 11kV asset project costs with 6km of the existing network are discounted by 50%, in effect, 50% of the costs of constructing the 11kV network are now borne by Sabah Electricity, and therefore, recovered from tariffs - The full cost of developing the 11kV network, beyond 6km from the existing network, are borne by the connecting customer - It operates a true-up mechanism for HT intake development, whereby, a customer's connection charge reflects an estimate of the difference between the revenue that will be generated from that customer, and the costs of connecting that customer to the network

Table 4. Key components of current charging methodology of SESB [9] as per extracted from their guidelines

Based on the comparison of the cc guidelines between SEB, SESB and TNB, it is found that there may be some areas for improvement in SEB connection charges guidelines to suit the ever increasing energy usage demand.

a) Charges for Development of 33KV System

Dealing with charges on developing 33KV intake substation, SEB deals with it on case-to-case basis and is not clearly stated in the current connection charges guidelines and customers are normally charged the full project cost similar to SESB. This is obviously a concern for the developer as the first customer who comes first will have to contribute to the 33KV construction cost whereas the later customer will ride on the spare capacity of the substation for free. Unlike TNB, all cost incurred on development of 33KV shared asset shall be borne by the company, or customers to pay the full cost if the substation is dedicated. This is made possible as TNB has a higher economic efficiency rates whereby their average tariff price is higher than both SEB and SESB respectively.

With an average demand density of 129.41kw/km^2, 7 times higher than SEB and 10 times higher than SESB, and customer density of 65.9 customers/km^2, 15 times higher than SEB and 9 times higher than SESB, TNB yields a higher investment efficiency rate, as with the same amount of investment for infrastructure development, it shall be able to cover more customers on the same area of coverage.

b) Different customers make different contribution to shared HT System Development (11KV and below)

For charges on HT system development, TNB and SESB use similar charging methodology where the customers will only be charged for HT system development if there is a need to augment or construct HT infrastructure to service the customers. In this regards, the customer shall be charged on 50-50 basis. This is subjected to the HT development work is

less than 6KM from the existing system and based on assumption that the system shall be used for connecting other customers in the future.

As for SEB, a standard charge of RM500/KVA is imposed to ALL customers requesting for connection to the system regardless of whether any HT network augmentation is required.

It creates unfairness of charging whereby for small customers that does not require any augmentation to the upstream system or requires no dedicated HT assets, would also have to contribute RM500/KVA. On the other hand, a development which requires connection to the existing HT network and extension of HT network up to 1km dedicated to their development would also pay the same. This indirectly cause the cross subsidy between customers whereby the small customers would subsidy the big customers.

c) Different customer categories of same applied load contribute to different capacity charge

In general, housing/show houses developers are receiving higher subsidy than single premise, industrial and residential customer. For example, assume a housing development and an industrial customer place exactly the same load on the system (and they require exactly the same HT assets to be constructed to serve that load). If the industrial customer breaches the 300% subsidy threshold, then it bears the full HT costs above that threshold, yet in the same circumstances, the housing development would not (Unlimited subsidy)

d) Economic deficiency: manipulation of KVA applied for

The 300% subsidy rule introduced in SEB connection charges guidelines may encourage some industrial and commercial customers to arbitrarily increase their "required" nominated electrical load (KVA) to reduce their connection charges. This will eventually increase SEB's contribution whilst at the same time leading to the development of oversized asset in the distribution system thus reduction in asset utilization factor.

e) Inconsistent treatment of HT/LT assets (Shared and dedicated assets)

HT assets, regardless of whether developed to serve a single development (dedicated) or multiple developments (Shared) are covered by the RM500/KVA (+ additional cost funded by SEB) whereas all LT assets are treated as dedicated assets (and all funded directly by the connecting customer) thus inconsistency in the charging of shared/dedicated asset.

It is believed that there are still rooms for improvement on SEB connection charges policy since it has been in practice since 2008. Due to the change of customer expectation and electricity usage pattern, the charging policy needs to be constantly reviewed in order to ensure that it suits the customer supply connection requirement and yet still able to provide a reasonable economic efficiency and investment efficiency rate to the company.

Way forward, the revision exercise shall comprise and revolve around the following fundamental principles:

- be easy to understand and be able to be consistently applied across all offices,
- lead to fair connection charges, and
- Lead to the least-cost means of providing electricity services to end customers.

To operationalize these issues, a number of components of connection charging methodology are proposed to be included in the future charging policy:

- Differentiation of dedicated and shared assets
- Fairness and equity – Customers require similar assets should impose similar costs, avoiding cross subsidy between customers
- Transparency of charging via introduction of schedule of rate for the commonly used scope of work.

Following the above fundamental principle as the frame work, additional work needs to be carried out via:

- Case study to determine and to verify the deficiency of the current connection charges policy
- Engagement with various stakeholders (internal and external) to understand the grievances and issues faced by them when practicing the policy
- Questionnaires with various stakeholders to understand their needs and "wish to have list"
- Financial modeling and financial impact study on the current connection charges policy to determine the current and future financial position of continuing to practice the current policy
- Continue benchmarking study with other utility companies in other regions

4. CONCLUSION

This review study found a few areas in SEB CC guidelines can be further improved and have formulated a few key fundamental principles of the connection guidelines that is currently practiced in other utility companies widely. Many other network connection pricing frameworks are available to be adopted but it is important to address the key challenge in the revision exercise that is to strike the right balance between the amount of upfront investment and the ability to fulfill key pricing objectives acceptable to both the company and the connecting customers.

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