Defining Toll Fee of Wheeling Renewable with Reference to a Gas Pipeline in Indonesia

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Abstract: Indonesia has a huge number of renewable energy sources (RE) however; the utilization of these is currently very low. The main challenge of power production is its alignment with consumption levels; supply should equal demand at all times. There is a strong initiative from corporations with high energy demand, compared to other sectors, to apply a renewable portfolio standard for their energy input, e.g. 15% of their energy consumption requirement must come from a renewable energy source. To support this initiative, the utilization of power wheeling will help large factories on industrial estates to source firm and steady renewables from remote sites. The wheeling renewable via PLN’s transmission line has been regulated under the Ministry Decree in 2015 however; the tariff or toll fee has not yet been defined. The potential project to apply wheeling renewable will obtain power supply from a geothermal power plant, with power demand from the scattered factories under one company. This is the concept driving the application of power wheeling in the effort to push the growth of renewable energy in Indonesia. Given that the capacity of PLN’s transmission line are normally large and less congested compared to distribution line, the wheeling renewable can accommodate the scattered factories locations which then results in the cheaper toll fee of the wheeling renewable. Defining the best toll fee is the main topic of this paper with comparison of the toll fee of the gas pipeline infrastructure in Indonesia, so that it can be applied massively to achieve COP21’s commitment.

1. Introduction
Indonesia is a vast archipelago comprised of more than 17,000 islands, with over 250 million inhabitants. More than half of inhabitants concentrate in Java Island while the rest spread across Sumatra, Sulawesi, Kalimantan, Nusa Tenggara and Maluku, Papua, and other smaller islands whereas also abundant energy resources are located. The Government of Indonesia (GoI) through PLN, the state-owned electricity company that is vertically integrated and holds a monopoly over transmission and distribution is responsible for meeting increased electricity demands of its consumers.
With a high number of populations, household has been a major consumer of PLN’s amongst three other basic tariff categories on consumer types namely industrial, business and others (public). Per PLN’s data, from 2013-2015, average market share measured by electricity sales for household is 42% followed by industry as the second largest market share of 33%. In 2015 electricity sales for household reached 88,682 GWh, industry 64,078 GWh, business 36,978 GWh and 13,106 GWh for others (public) [1]. Industry has always been focus on GoI, in 2015 The President of Republic of Indonesia issued Government Regulation No. 14 Year 2015 concerning Master Plan of National Industry Development year 2015-2033 with its firm vision of “Indonesia as a strong industrial country”.

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This target would be hard to achieve if energy as one of important backbones for industrial growth cannot be met as needed.

2. Electricity Supply
Supply of electricity has been a domain of GoI. Electricity Law No. 30 Year 2009 stipulates that “power supplies shall be under the control of the state, which supplies shall be provided by the Government and the regional governments under the principle of regional autonomy”. Supply-demand balance is varying geographically across the country. The generating capacities in Sumatera and East Indonesia (including the smaller islands with smaller electricity systems) are barely sufficient to meet the increasing demand. While Java and Bali are served by generating capacities that are bigger than those are in the rest of other parts of Indonesia combined to meet the power requirement that is mostly supplied by coal-based power generation. Nevertheless, the growth of industry that still concentrates in Java is driving increased electricity consumption. Companies and manufactures are demanding more sustain supply of power from PLN for their production. Alas, PLN’s regular maintenance, such as repair at the sub-station, transmission and or distribution lines, major overhaul plus unpredicted event of disruptions or force major could cause reliability of its system where would end up in worse cases with the shutting down of power generations without providing back up with the same amount of power for consumers. To overcome this, some of manufactures install diesel gen-sets at their facilities to prevent the shortage.

Having stable power supply is key for manufactures. With the growth of their production and simultaneously with their environment awareness to take steps toward reducing the environmental impact, manufactures are no longer seeking for power from conventional supplies. They demand of renewable energy is also slowly building up to contribute in their energy mix and to create cleaner productions. Therefore, manufactures are looking for another option to get the power aside from PLN. A few started to install solar PV at their facilities. A small number of them begin to consider getting renewable energy from independent power producers (IPPs) via power wheeling.

3. Electricity Plan

3.1. Implementation
Besides governing power supplies that has to be provided by government, the Electricity Law also allows private sector to take similar part in certain conditions. Electricity Law Num. 30 of 2009 has signalled that PLN is no longer the sole provider of power generation, the private sector who own and manage industrial zones are permitted to build and operate a power plant, along with its transmission lines, for that area.

Investors who generate electricity for their own use rather than for sale to PLN are known as Private Power Utilities (PPUs). A PPU can generate, transmit and distribute electricity for their own use or to their own consumer base (such as Industrial Zone) after getting necessary permits and license to do so. PT Cikarang Listrindo Tbk is a private power company that provides energy to industrial and residential consumers in Indonesia under the exclusive license [2]. The Company's plants utilize gas turbines that run-on gas or liquid fuel. The license valid for 30 years which has begun since 11 December 2006 as the sole IPP supplying electricity to its tenants of five industrial estates in the Cikarang area which are not served by PLN.

This situation limits manufactures to freely choose source of renewable energy power that they want to have. Because some of them may have a condition where

- They have several facilities located in different areas;
- They are PLN’s consumer and only intend to mix their source energy and has no intention to cut 100% power from PLN;
- They plan to their operation with 100% renewable energy source but PLN cannot provide;

3.2. Power Wheeling and Current Regulation
In such cases, power wheeling can be an option for these off-takers. Power wheeling, refers to the practice of a utility that owns a transmission network taking in and passing along electricity produced
by another utility or generator. Consequently, besides the availability of electricity, transmission and distribution lines must present to enact power wheeling. Ministry of Energy and Mineral Resources Regulation No. 01 year 2015 regulates Electricity Supply Cooperation and Joint Utilization of Power Grid. Ideally this should enable companies or manufactures to get electricity supply not solely from PLN but also from IPPs by utilizing the existing transmission and distribution lines.

Unlike any other countries who have successfully implementing power wheeling, there are still a few challenges that need to be addressed by the Regulator and PLN as the owner and operator of transmission and distribution grids, such as:

- The regulation that exists now which only allows power wheeling for IPPs that will supply the power to their own facilities not third parties’. And they cannot supply power to PLN’s existing consumers should be reviewed in order to grow private sector interests as well to boost the development of RE;
- The “toll fee” for the usage of transmission and distribution grids and its electricity losses;
- The reliability of the grids;
- Electricity tariff that private sectors pay to IPPs should be competitive with PLN’s, in particular, if it comes from renewable energy, and
- The permit for IPPs to have other markets besides PLN should not be impeded.

Private sector who will utilize power wheeling must pay a leasing cost and a reliability cost to PLN which will step in to ensure electricity supply if IPP has a problem.

3.3. Renewable for Electricity Indonesia

With lower demand situation, nowadays, PLN’s total power generation capacity is forecast to grow from 50.9 GW in 2015 to 93.6 GW in 2024. Under the assumption that adjustment in the capacity expansion plan from the lower load growth, is limited to deferment of thermal projects, the existing scenario has a 19% share of renewable energy by 2024, assuming all hydro and geothermal projects in the 2015 power supply business plan are implemented according to the plan. To reach the Government target of 25% by 2025, or 24% by 2024, would require an additional 22.3 TWh of renewable energy capacity which would be met by a combination of additional wind, PV, small hydro and geothermal of the total 3,935 MW. Only the geothermal capacity is assumed to have a full capacity credit and would displace coal.

3.4. Transmission and Distribution CAPEX

Transmission CAPEX from the 2015 power supply business plan divided by two phases, the expenditures in the years 2015-2018 are dominated by the completion of the 500kV system, at around $4 billion per year, then fall sharply to around $1 billion by 2021 and thereafter. At the first phase, the transmission CAPEX per kW is $1,300 while the distribution CAPEX per kW is $460, resulting the total transmission and distribution CAPEX per kW at $1,760 [3].

4. Toll Fee Determination in Gas Transmission Pipeline

In order to support the need to expand its pipeline network to raise gas penetration rates and cut oil dependency, Government of Indonesia has introduced the concept of open access to gas pipelines [4]. Through the regulatory agency, BPH Migas, that was established on 30 December 2002 has function to assume state oil and gas company Pertamina’s regulatory roles in relation to downstream activities (Articles 46 and 47 of Law No.22). BPH Migas is charged with assuring sufficient natural gas and domestic fuel supplies and the safe operation of refining, storage, transportation and distribution of gas and petroleum products via business licences.

Toll fee for gas pipeline must consider the economics of pipeline owner and interest of the shippers and consumers. In order to calculate the toll fee, BPH Migas follows the following steps:
- Determine the base parameters
- Base Asset Value = 151 US$ mio
- Capital Loan = 18 US$ mio
- Equity Loan = 133 US$ mio
- Length of Project = 8 years
- Risk Free Rate = 2.55%
- Mature Equity Market Premium = 5.26%
- Indonesia Country Risk Premium = 3.7%
- Beta = 1.018
- Cost of Equity = 11.67%
- Incentive IRR on Equity = 0%
- Loan Capital Interest = 6.67%
- Corporate Income Tax = 25%
- Cost of Debt = 5%
- WACC (Capital Loan/Base Asset Value) * Cost of Debt + Equity Loan/Base Asset Value) * Cost of Equity = 10.89%
- Inflation rate in USA = 2%

- Operational Parameters
- Volume Forecasting and Volume Annual Gas Flow in mmscfd
- Gas Losses
- Operational Cost
- Income Calculation and Levy to BPHMigas (3%)
- Depreciation Calculation
- Cost of Service Calculation

Grissik-Duri pipeline (Duri line) is the milestone for onshore Indonesian gas transmission which has been completed in 2001. It is 536 km long with 28 inch diameter pipeline from Grissik to Duri pipeline. There are facilities along Grissik to Duri pipeline, i.e. 22 Sectional Valves, 5 Pig Trap Stations, and 2 Compressor Stations which located at Sakernan and Belilas, with total capacity of 430 mmscfd.

Following the previous calculation steps, BPH Migas through the BPH Migas Regulation No. 01/2015 decided that the tariff transportation of natural gas for Duri line which defined as total Cost of Service divided by Annual Gas Flow shall be 0.466 US$/mscf, equivalent to 0.49 US$/MMBtu. This amount of toll fee provides an IRR to the owner of gas pipeline at 11%.

According to PGN (a state owned gas company), the toll fee for South Sumatera- West Java line (SSWJ I with 400km length that built in 2007, has been regulated by BPH Migas to be 1.55 $/mscf while for SSWJ II with 600 km length is 1.47 $/mscf.

5. Converting Toll Fee of Gas to Electricity
If we take the reference of pipeline gas tariff calculation above, we can either count the conversion of 1 kWh to mmbtu directly for power wheeling toll fee on an open access transmission system. It is known that 1 kWh equal to 0.0034 MMBtu, so the toll fee in gas pipelines by 0466 US$/mscf will generate power wheeling rates at 0.17 US cents/kWh.

Meanwhile, if we calculate the total investment required for the construction of transmission and distribution principle using rate of return regulation of an electricity transmission company, then it is computed in three steps [5] as below:
Estimate the amount of electricity (kWh) the transmission system will be delivering over a given year.

Estimate how much it will cost the transmission company to transmit that quantity of kWh.

Divide the second number by the first to compute a transmission price in cents/kWh.

In setting prices for the transmission industry, policymakers must take into account special technological circumstances of electricity transmission: load balancing, line losses, loop flow, and user-specific lines. Transmission and distribution CAPEX per kW is known in the above at $1,760. Assuming that the transmission and distribution will be utilized for 20 years, then the cost of transmission and distribution which will be assumed as a power wheeling charge is as follow:

\[
\frac{1,760,000}{20 \text{ years} \times 365 \text{ days} \times 24 \text{ hours}} = 10\$/\text{MWh}.
\]

Further, from the data compiled by the Project Management Office of 35GW of Government of Indonesia, the evaluation of transmission CAPEX and distribution CAPEX are as follows:

- 2016: 1285 $/kW and 457 $/kW
- 2017: 1111 $/kW and 455 $/kW
- 2018: 927 $/kW and 406 $/kW
- 2019: 607 $/kW and 401 $/kW
- 2020: 271 $/kW and 370 $/kW
- 2021: 186 $/kW and 333 $/kW
- 2022: 159 $/kW and 313 $/kW
- 2023: 123 $/kW and 278 $/kW
- 2024: 33 $/kW and 231 $/kW

Respectively above numbers reflected to a power wheeling charge as described in Figure 1 below:

![Figure 1. Indicative Toll Fee for Power Wheeling has range between 0.2 – 0.6 cents $/kWh as a baseline](image)

The best approach to define the toll fee for renewable wheeling in Indonesia to have competitiveness with the gas transmission pipeline from Figure 1 is at 0.6 cents $/kWh.

### 6. Conclusion

Indicative Toll Fee for Power Wheeling has a range between 0.2 - 0.6 cents $ / kWh as a baseline can be used by the Government of Indonesia as a prefix to the implementation of power wheeling, for example, for a 5 MW geothermal IPP for later evaluation if required. If this approach is successful, this could be a pioneer in introducing the application of power wheeling in the effort to push the growth of renewables in Indonesia and expectantly could be followed by other companies or manufactures. In addition, the geothermal power plant company will have a new perspective to explore the development of small-scale geothermal projects (3/5/10 MW scale) which will also increase the exploration activities.
The increased number of geothermal power to be used to provide electricity for factories manufacture in Indonesia will support the utilization of renewable energy so that Indonesia’s commitments in COP21 can be met.

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