Republic of Indonesia
Ministry of Energy and Mineral Resources (MEMR)
PT PLN (Persero)

Data Collection Survey on New Power Supply Scheme by Using Power Wheeling in Indonesia

Final Report

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Japan International Cooperation Agency (JICA)
Tokyo Electric Power Company Holdings, Inc.
Tokyo Electric Power Services Co., Ltd.

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Abbreviations

ABR	Adequate Business Return
AER	Australian Energy Regulator
AS	Ancillary Service
CAPEX	Capital Expenditure
ENTSO-E	European Network of Transmission System Operators for Electricity
ESCJ	Electric Power System Council of Japan
FERC	Federal Energy Regulatory Commission
GEMA	Gas and Electricity Market Authority
HV	High Voltage
HVWOE	High Voltage Wheeling Operation Expense
IPP	Independent Power Producer
ISO	Independent System Operator
JICA	Japan International Cooperation Agency
JEPX	Japan Electric Power Exchange
LRMC	Long-Run Marginal Cost
LV	Low Voltage
LVWOE	Low Voltage Wheeling Operation Expense
MEMR	Ministry of Energy and Mineral Resources
MPE	Ministry of Petroleum and Energy
MV	Medium Voltage
MVWOE	Medium Voltage Wheeling Operation Expense
NEM	National Electricity Market
NERC	North American Electric Reliability Corporation
NVE	Norwegian Water Resources and Energy Directorate
ODA	Official Development Assistance
OFGEM	Office of Gas and Electricity Markets
OPEX	Operating Expenditure
PUC	Public Utilities Commission
RAV	Regulatory Asset Value
RIIO	Revenue set with Incentives for delivering Innovation and Outputs
ROR	Rate of Return
RPI	Retail Prices Index
RTO	Regional Transmission Organization
SAIDI	System Average Interruption Duration Index
SOP	Standard Operation Procedure
TOTEX	Total Expenditure
WACC	Weighted Average Cost of Capital

Chapter 1 Introduction

1.1 Background to the Survey

The Indonesian government released its 35,000MW Power Plants Project in May 2015 to develop new power sources up to 35GW by 2019, aiming to cope with the anticipated steep increase in electricity demand. In particular, the government plans to increase private investments in the power generation sector, and 25,000MW of the 35,000MW power supply is assigned to independent power producers usually funded by private companies. This private sector investment policy aims to harness private investors' ambitions in the power generation sector to compensate for the shortage in the network expansion budget of PT.PLN (Persero), which is the public utility funded by the government. The government also revised the accounting rules of its power transmission company, PT.PLN (Persero), hereinafter PLN, to include newly-built IPPs' assets on its balance sheet, and this enables the government to provide various types of private investment opportunities in the power generation sector. To utilize such private investments in the power generation sector, new introduction schemes must be thoroughly studied in addition to conventional IPP schemes.

On the electricity demand side, industrial high-voltage customers and large-scale customers are now demanding high electricity supply quality, complaining about the current inferior power supply quality: unreliable power supply, low supply voltage, and the revised electricity tariff's raised in 2014, are identified as their business risks. In particular, the rectification of the low power electricity supply quality is quite important for the government, because it has become a critical issue to be solved in order to maintain a proper investment environment in Indonesia's market, and consequently the key to Indonesia's continued economic growth.

The current electricity law (Law No. 30/2009) still prioritizes PLN's supplying of customers, but also allows other private entities to provide generation, transmission, distribution, and electricity sales services. In addition, the law enables PLN to lease part of its transmission and distribution system to other private utilities. Such regulations provide ample opportunities for private investors to enter all sectors in Indonesia's electricity supply business.

Facing the current challenges both on the supply and demand sides of the electricity network, and based on current regulatory structures open to public investment, the Ministry of Energy and Mineral Resources (hereinafter MEMR) issued a ministerial regulation in January 2015 to allow the introduction of a power wheeling scheme for high-voltage customers by partially opening the Indonesian transmission and distribution network (ref. ministerial regulation No. 1./2015 of Ministry of Energy and Mineral Resources). MEMR explains that this power wheeling scheme does not de-regulate the Indonesian power network completely, and it is limited to supply contracts for large-scale high-voltage customers, such as manufacturing factories in industrial areas.

However, the ministerial regulation and relevant documents do not yet cover a tariff system for wheeling charges, standard procedures for acquiring licenses for power wheeling, technical requirements for interconnection to the Indonesian network, or necessary dispute resolution procedures. Thus, a standard operation procedure and calculation rules for wheeling charge tariffs that are designed to be fair, transparent, and open to the public are indispensable. The calculation rules for wheeling charges must be developed based on a study of other countries' wheeling charge systems and their applicability to Indonesia's current power network and its operation practices. For the realization of the wheeling system, relevant technical requirements and operational procedures are also to be studied.

1.2 Purpose of the Survey

- The Survey proposes a method of developing a practical and feasible wheeling charge system by referring to foreign countries' wheeling charge systems and technical and operational practices in Indonesia's power system network. In particular, a calculation scheme for high-voltage customers and standard operational procedure for wheeling charge contracts will be proposed.

- The Survey also proposes necessary ODA projects on the actual operation and management of the wheeling charge system developed.

1.3 Work Flow of the Survey

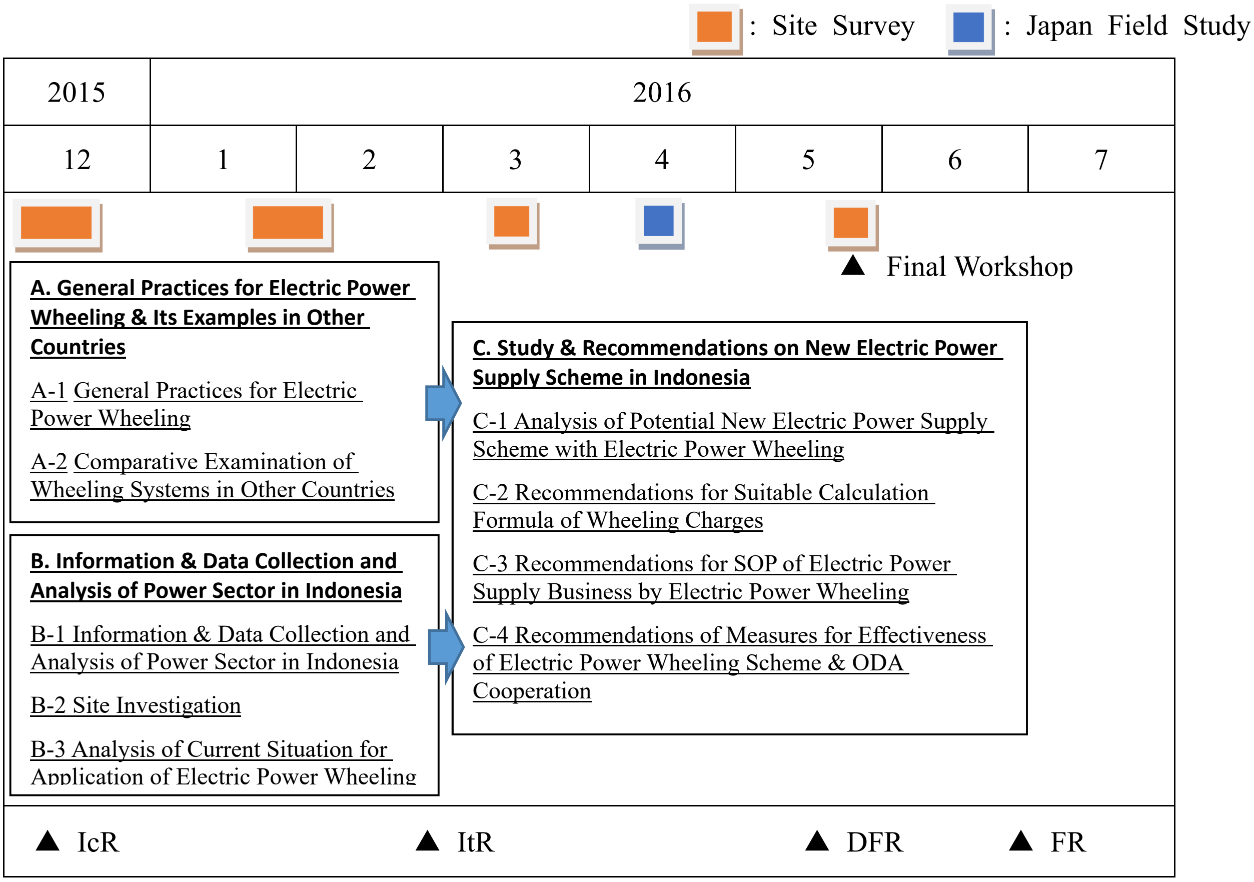


Figure 1-1 Work Flow Diagram

A General Practices for Electric Power Wheeling & Its Examples in Other Countries

A-1 General Practices for Electric Power Wheeling

- Review of General Methodology of Electric Power Wheeling Corresponding with Power Market Opening Stages

A-2 Comparative Examination of Electric Power Wheeling Systems in Other Countries

- Comparison of Electric Power Wheeling in both Developed & Developing Countries
- Study of Electric Power Wheeling Scheme to be introduced in Indonesia

B Information & Data Collection and Analysis of Power Sector in Indonesia

B-1 Information & Data Collection and Analysis of Power Sector in Indonesia

- Current Situation of Power Sector in Indonesia
- Information related to Power Sector Policies in Indonesian Government
- Legal Basis for Electric Power Wheeling

- Current Application & Available Scheme on Existing Law System

B-2 Site Investigation

- Current Operational Situations of Power Transmission & Distribution System and Power Supply-Demand Balance

- Current Specified Power Supply Scheme in Indonesia

B-3 Analysis of Current Situation for Application of Electric Power Wheeling

- Study of Suitable Electric Power Wheeling System in Indonesia

- Clarification of Required Laws, Technical Requirements & Operating System

- Study of Mid & Long Term Possibility of Completely Liberalized Market for Developing its Simple Roadmap

C Study & Recommendations on New Electric Power Supply Scheme in Indonesia

C-1 Analysis of Potential New Electric Power Supply Scheme by Electric Power Wheeling

- Analysis of Potential for Application of Electric Power Wheeling to High Voltage Power Consumers

- Examination of Utilization of New Electric Power Supply Scheme in Specified Areas such as West Java & North Sumatra

- Interviews with Japanese Companies interested in Electric Power Wheeling

C-2 Recommendations for Suitable Numerical Calculation Formula for Wheeling Charges

- Recommendation for Numerical Calculation Formula for Wheeling Charges

- Recommendations for Incentives for Investment in Electric Power Wheeling Business in Tight Electricity Supply and Demand Areas

- Case Study of Java-Bali System and/or Sumatra System

C-3 Recommendations: SOP of Electric Power Supply Business with Electric Power Wheeling

- Recommendation for Draft SOP of Electric Power Wheeling Business

- Sample of Electric Power Wheeling Contract

C-4 Recommendations: Effectiveness of Electric Power Wheeling Scheme & ODA Cooperation

- Recommendation: Schemes for Effective Electric Power Wheeling

- Recommendation for Possible ODA Co-operations

1.4 Invitation to Japan

Toward the purpose of the study, the aim of the Japan visit is to deepen understanding of the wheeling system for its introduction in Indonesia in the future. A summary of the contents is as below.

- Explanation of the current wheeling system that has been operating in Japan
- Site visit to an industrial park that utilizes the wheeling system
- Site visit to underground substations that support the power supply business in the city
- Discussion with our employees and institutions to perform the actual operation

The Japan visit schedule and the invitees are as follows.

Date/Time					Form	Agenda	Company/body in charge
Day 1	4/10 (Sun)	6:45	~	16:25		Travel to Japan	
Day 2	4/11 (Mon)	9:15				Meet in the Hotel lobby	
		9:30	~	10:30	Lecture	Orientation, Overview of TEPCO	TEPCO
		10:30	~	11:30	Lecture	Introduction to the Grid Code and Grid Service	TEPCO
		13:30	~	15:00	Visit	Visit to Retailing Company	Tepco Customer Service
Day 3	4/12 (Tue)	9:15				Meet in the Hotel lobby	
		9:30	~	11:00	Visit	Visit to Load Dispatching Center	TEPCO
		11:00	~	12:30	Lecture	Wheeling System, Electricity Deregulation Introduction to Japan's Wheeling System	TEPCO
		13:30	~	16:00	Meeting	Project Discussion with JICA Survey Team	TEPCO
Day 4	4/13 (Wed)	9:45				Meet in the Hotel lobby	
		10:00	~	18:00	Visit	Visit to Kawasaki Zero Emission Industrial Park	City of Kawasaki
Day 5	4/14 (Thu)	9:15				Meet in the Hotel lobby	
		9:30	~	11:30	Meeting	Project Discussion with JICA Survey Team	TEPCO
		13:30	~	15:00	Visit	Visit to Underground Substation	TEPCO
		15:00	~	16:00	Visit	Visit to Smart Meter Operation Center	TEPCO
Day 6	4/15 (Fri)	8:20				Meet in the Hotel lobby	
		9:00	~	11:00	Visit	Visit to TEPCO Call Center	TEPCO
		11:00	~	12:00	Meeting	Discussion on Business in the future	TEPCO
		13:30	~	14:30	Meeting	Project Discussion with JICA Survey Team	TEPCO
		15:30	~	16:30	Meeting	Wrap-up Meeting	JICA/TEPCO
Day 7	4/16 (Sat)	10:50	~	16:35		Back to Indonesia	

Figure 1-2 Japan Visit Schedule

SL.no	Name	Organization / Position	
1	Pamudji Slamet	Head of Legal	Ministry of Energy and Mineral Resources Directorate General of Electricity (DGE)
2	Afrizal, ST, M.Sc, M.Ec.Dev	Deputy Director of Business Regulation and Supervision	Ministry of Energy and Mineral Resources Directorate General of Electricity (DGE)
3	David Firnando Silalahi	Head Section of Electricity Tariff and Subsidy	Ministry of Energy and Mineral Resources Directorate General of Electricity (DGE)
4	Fahmy El Amruzi Dalimi	Head of Electricity Business Transaction and Partnerships Division	PT PLN(Persero) Head Office
5	Benny Marbun	Head of Commercial Division	PT PLN(Persero) Head Office

Figure 1-3 Japan Visit Participants

By visiting Japan, they will be able to understand the background to and intentions for the wheeling systems and the grid release in Japan. From the viewpoint of power liberalization, they will be able to understand the similarities and differences compared to the Indonesian power sector. The Japan visit program has become a very meaningful part of the present survey project. The following shows pictures of lectures Appendix1 shows discussions at the invite program.

Figure 1-4 Japan Visit Program

Chapter 2 Cases of Power Wheeling in Other Countries

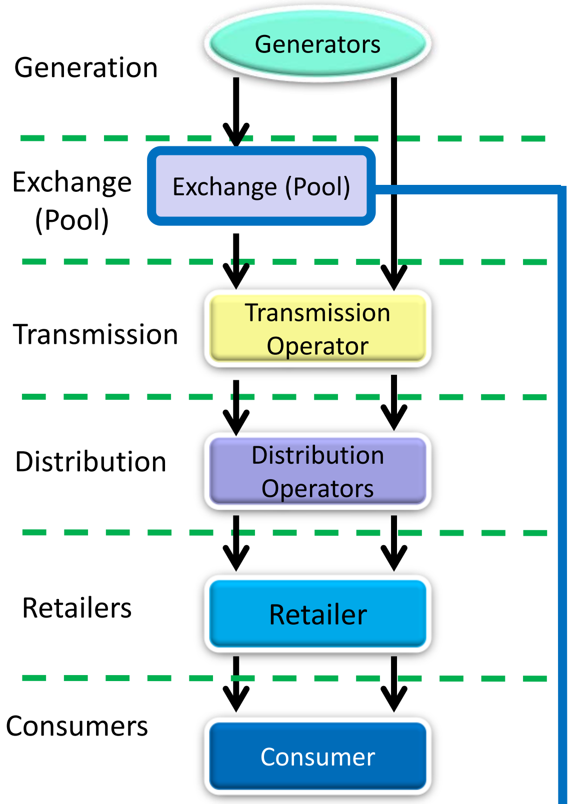
2.1 Case Studies

5 countries – Norway, Germany, Great Britain, Australia and the United States – are analyzed in this section. These countries have been chosen to illustrate what the Indonesian power wheeling sector could become in future should the sector reforms take place.

2.1.1 Sector Overview

In all 5 countries chosen for this case study, electricity value chain is similar in that they all have 4 distinct value chains – generation, transmission, distribution and retail, and in between generation and transmission, all countries have exchanges or power ”pools” wherein generated energy is pooled and then wheeled to retailers through transmission and distribution networks.

The below illustrates the simplified value chain as applicable to the 5 countries. The exchange (pool) is somewhat detailed in this diagram as it is not covered elsewhere in this report.



Exchange (Pool)

Country	Market	Description
Norway	Nord Pool	Power market authorized in 12 countries including Norway, Sweden, Austria, Denmark and Finland
Germany	EEX	EEX (European Energy Exchange) is the power market authorized in 9 countries including Germany, France, Belgium and Switzerland
UK	BETTA	Integrated wholesale power market for England, Wales and Scotland managed by National Grid, created under British Electricity Trading and Transmission Agreement (BETTA). BETTA integrates exchanges such as APX Group, Nasdaq OMX and N2EX. Balancing Mechanism Unit (BMU) that deals with imbalances, is also created under BETTA
Australia	NEM	NEM (National Electricity Market) is the wholesale electricity market that interconnects five regional market jurisdictions (Queensland, New South Wales, Victoria, South Australia and Tasmania). Western Australia and Northern Territory are not connected to the NEM
US (PJM)	PJM	PJM Interconnection coordinates the movement of wholesale electricity in 14 states including Illinois, Maryland, Michigan, New Jersey, Ohio, and Pennsylvania.

Figure 2-1 Simplified Electricity Value Chain

2.1.1.1 Norway

2.1.1.1.1 Deregulations in Perspective [1]

Before deregulation, the electricity sector was mainly owned and operated by the public sector.

In the 1980s, households and other consumers that were paying relatively high electricity rates in comparison to large consumers became increasingly dissatisfied (they were also dissatisfied with the rate disparities among regions.) In response to this, with the aim of converging nationwide electricity rates into certain levels, the government introduced a policy to liberalize the wholesale and retail market by effectuating the “Energy Act” bill.

This Energy Act bill was passed into law in October 1990 and became enforced in January 1991.

The Energy Act obligates all electricity sellers and transmission/distribution operators to obtain the respective license. In addition, legal separations are required between transmission/distribution and generation/retail sales.

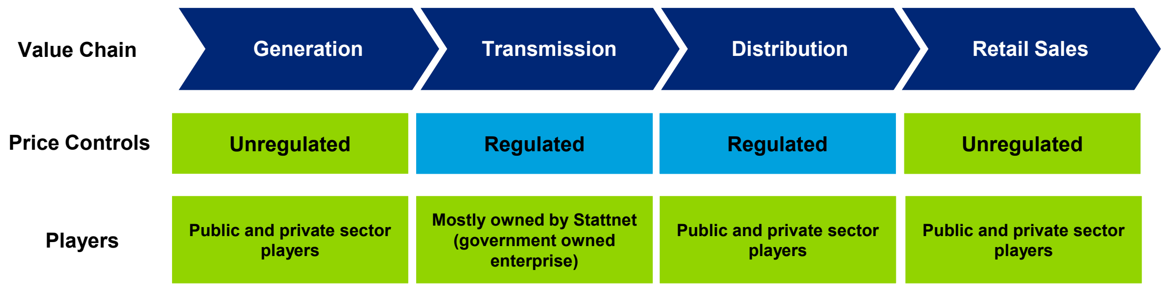
2.1.1.1.2 Price Controls and Players

Prices for transmission and distribution are regulated, whereas prices for generation are unregulated.

As of 2011, there were 183 generation business operators, and 90% of the generation capacity was owned by the public sector.

The transmission network is monopolized nationally by Statnett, a state owned company, and the distribution network is regionally monopolized and owned and operated mainly by local municipalities. Various players from private companies to local municipalities etc. exist in the retail market.

The below summarizes the price controls and main players in the electricity value chain.



Source: Prepared by DTFA by referring to “Overseas electric business Part I (the first volume) year 2014”, Japan Electric Power Information Center, Inc.

Figure 2-2 Price Controls and Players

2.1.1.1.3 Regulatory Bodies[2]

The Norwegian Water Resources and Energy Directorate (NVE) is the supervisory authority for electricity business operators except for the import/export of electricity which is supervised by the Ministry of Petroleum and Energy (MPE) under which NVE belongs.

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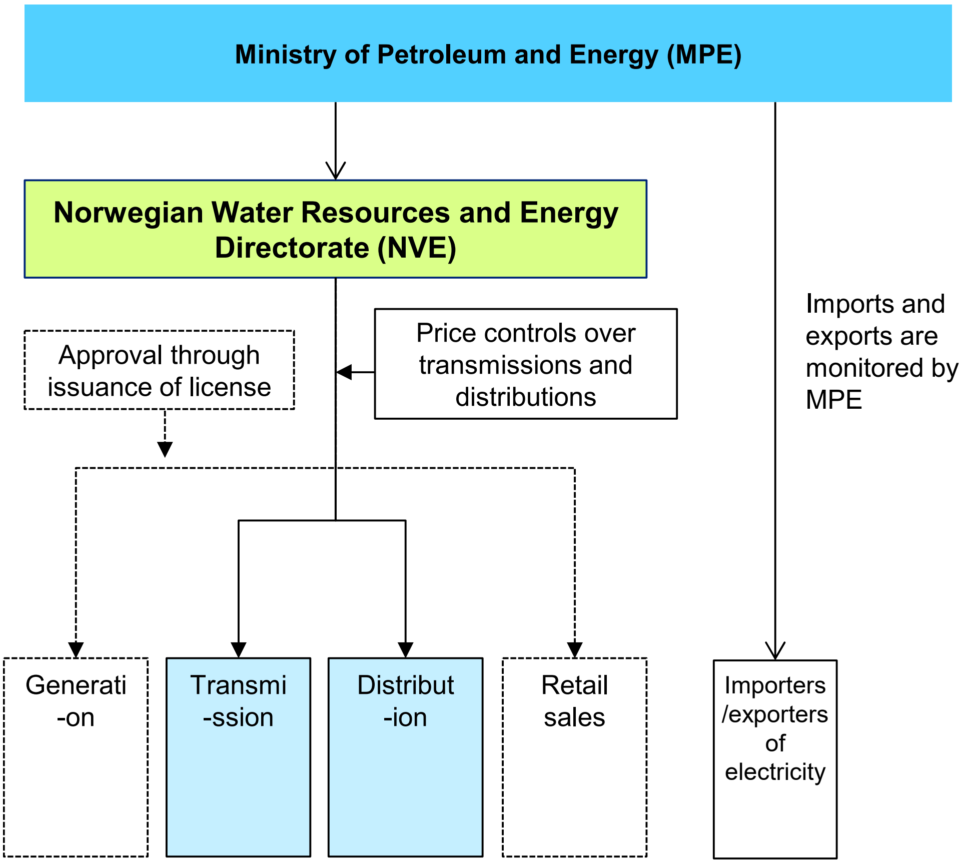
1 “Overseas electric business Part I (the first volume) year 2014”, Japan Electric Power Information Center, Inc.
2 “Overseas electric business Part I (the first volume) year 2014”, Japan Electric Power Information Center, Inc.

Transmission prices and distribution prices are controlled by NVE.



Source: Prepared by DTFA in reference to "Overseas electric business Part I (the first volume) year 2014", Japan Electric Power Information Center, Inc.

Figure 2-3 Regulatory Bodies in Norway

2.1.1.1.4 Ensuring Fair Access to Transmission and Distribution Networks [3]

Generators and transmission/distribution operators are required to be legally separated. In addition, transmission and distribution operators are required to run separate books and records from the other businesses.

2.1.1.2 Germany

2.1.1.2.1 Deregulations in Perspective [4]

In Germany, there was no federally owned electricity company, and electricity was supplied by the vertically integrated 8 large private sector operators (that generated, transmitted, distributed and sold electricity) and small local infrastructure service companies financed by local municipalities.

In response to the order of the 1st EU Electricity Directive that called for electric power deregulation, Germany proceeded to the full deregulation of retail sales as well as the separation of electricity transmission and distribution from generation and retail, after amending the related laws and regulations,

[3] "Overseas electric business Part I (the first volume) year 2014", Japan Electric Power Information Center, Inc.
[4] "Overseas electric business Part I (the first volume) year 2014", Japan Electric Power Information Center, Inc.

in the late 1990s.As a result, the 8 large private sector players saw consolidation to 4 vertically integrated companies – i.e. E.ON, RWE, EnBW and Vattenfall.

2.1.1.2.2 Price Controls and Players

Transmission and distribution prices are regulated and subject to price control, and generation and retail prices are un-regulated and open to market competition, including small-lot retail customers.

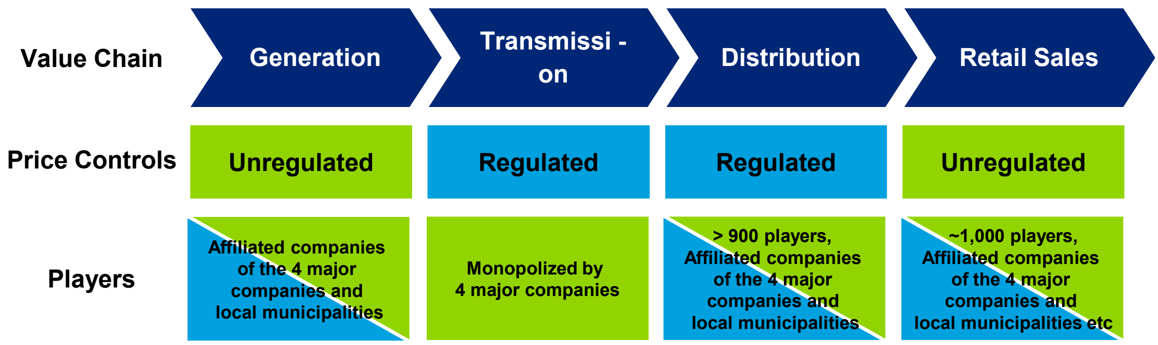
Power generations are open to the private sector and the 4 largest private players in the electricity sector – i.e., affiliates of E.ON, RWE, EnBW and Vattenfall – represent nearly 50% of the total market share.

The transmission market is regionally monopolized by 4 companies (Amprion, 50Hertz, Tennet TSO, TransnetBW), all of which were once affiliated with the aforementioned 4 largest private players (E.ON, RWE, EnBW, Vattenfall). Due to the requirements of EU Electricity Directive that required unbundling of transmission businesses, 3 of the 4 largest players have sold their stakes in the affiliated transmission companies, excepting TransnetBW, an affiliate of EnBW.

The distribution market consists of more than 900 operators comprising 1) the affiliates of the 4 largest private players, 2) the other smaller private players and 3) public sector players. Some private sector distribution operators are selling their stakes to public sectors.

In the retail market, over 1,000 players, consisting of 1) the aforementioned 3 segments of distribution players and 2) pure retail private players, exist.

Price controls and main players are summarized as below.



Source: Prepared by DTFA in reference to the website of Japan Electric Power Information Center, Inc.

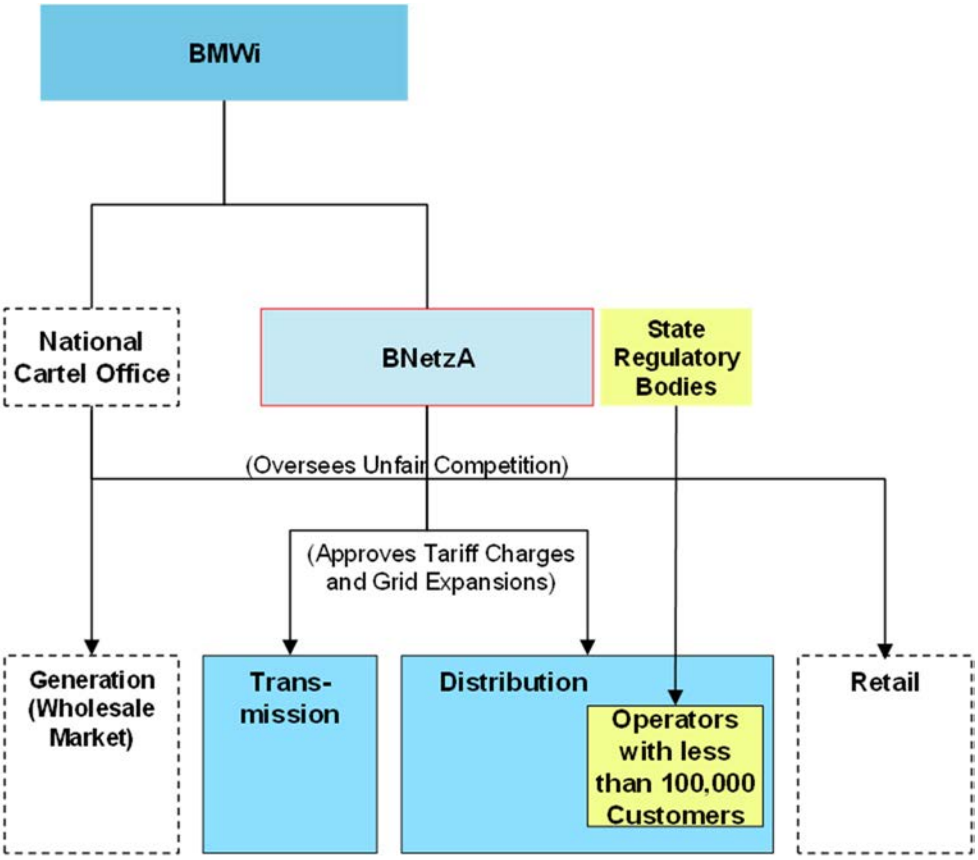
Figure 2-4 Price Controls and Players

2.1.1.2.3 Regulatory Bodies [5]

The Federal Network Agency for Electricity, Gas, Telecommunications, Post and Railway (BNetzA), an affiliated agency of the Federal Ministry of Economics and Technology (BMWi), is the supervisory authority for transmission and distribution system operators, and approves tariff charges and grid expansions.

State regulatory bodies are the supervisory authorities of distribution system operators with less than 100,000 customers, and each state government has the authority to independently determine tariff levels.

[5] "Overseas electric business Part I (the first volume) year 2014" published by Japan Electric Power Information Center, Inc.



Source: Prepared by DTFA based on
- "Year 2011 business of furtherance and adjustment of electric power source location (field survey of electricity charges overseas)", Mitsubishi Research Institute
- "Submitted document at the sixth committee of electricity system restructuring", Ministry of Economy, Trade and Industry

Figure 2-5 Regulatory Bodies in Germany

2.1.1.2.4 Ensuring Fair Access to Transmission and Distribution Networks [6]

Transmission and distribution sectors are required to have accounting and functional separation in order to ensure neutrality. Fairness to access is also secured through the promulgation and observation of grid management guidelines.

2.1.1.3 Great Britain

2.1.1.3.1 Deregulations in Perspective [7]

After World War II, the nationalization law ("Electricity Act 1947") was enforced to expedite recovery, and consolidation of several hundred operators into the Central Electricity Generating Board(CEGB) was expedited.

Until 1990, generation, transmission, and distribution sectors were monopolized by public sector operators. However, the negative aspects of the nationalized monopoly – the inefficiencies and operations that take the demand side (customers) lightly – became highlighted and, as a result, the "Electricity Act 1989" was

[6] "Overseas electric business Part I (the first volume) year 2014" published by Japan Electric Power Information Center, Inc.
[7] "Overseas electric business Part I (the first volume) year 2014", Japan Electric Power Information Center, Inc.

passed into law in July 1989 and became enforced in March 1990.

2.1.1.3.2 Price Controls and Players

Prices for transmission and distribution are regulated, whereas prices for generation and generation are unregulated.

M&A restrictions on the sector were lifted in 1995, and vertical integration of generation and retail sales, as well as entries by large European companies accelerated. As a result, the "Big 6" companies now account for 70% and 90% market share in generation and retail respectively.

In the distribution sector, consolidations by U.S. and Hong Kong companies are also active.

Transmission is monopolized by the National Grid group

Price controls and main players are summarized as below.

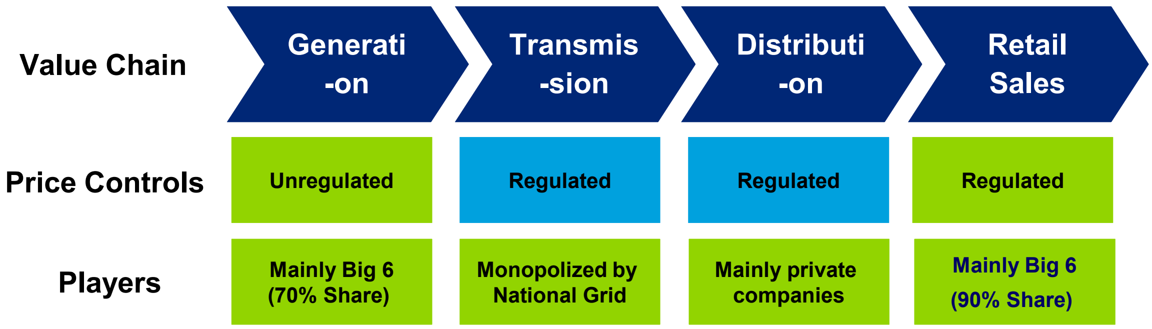
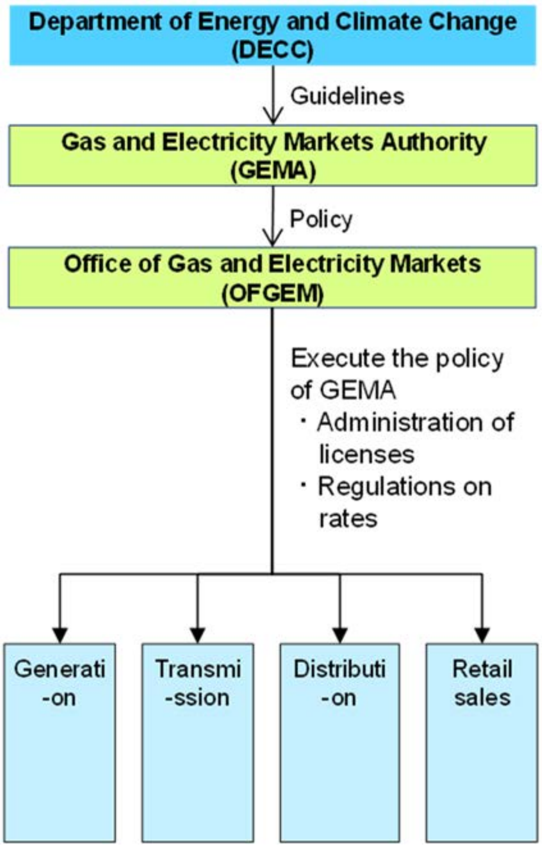


Figure 2-6 Price Controls and Players

2.1.1.3.3 Regulatory Bodies

In England / Wales (as well as Scotland but not Northern Ireland), the Electricity Market Authority (GEMA) is the regulatory authority and its implementing agency is the Office of Gas and Electricity Markets (OFGEM). OFGEM administers licenses for generation, transmission, distribution and retail, and approves regulatory rates for transmission and distribution.



Source: Prepared by DTFA based on "Overseas electric business Part I (the first volume) year 2014" published by Japan Electric Power Information Center, Inc.

Figure 2-7 Regulatory Bodies in England / Wales (and Scotland)

2.1.1.3.4 Ensuring Fair Access to Transmission and Distribution Networks [8]

Acquisition of a license from the Gas and Electricity Markets Authority (GEMA) or the competent ministers is required in order to operate an electricity business over a certain size.

Distribution licenses are not issued to generators or electricity suppliers, and transmission license holders are prohibited from electricity sales and purchases for non-ancillary related services. These restrictions have been introduced to promote fair access.

2.1.1.4 Australia

2.1.1.4.1 Deregulations in Perspective [9]

Until the 1980s, for each stage, the state government exclusively supplied electricity as a vertically integrated electricity supplier.

Since the 1990s, as the federal government called for productivity improvements and many state governments became heavily indebted, state governments have taken steps toward deregulation. As of 2013,

[8] "Overseas electric business Part I (the first volume) year 2014", Japan Electric Power Information Center, Inc.
[9] "Overseas electric business Part I (the second volume) year 2014" published by Japan Electric Power Information Center, Inc.

6 out of 8 states/regions have been fully deregulated.

2.1.1.4.2 Price Controls and Players

Prices for transmission and distributions are regulated in all states, whereas prices for generation are unregulated in all states, and price controls have been adopted in some states.

Current price controls and main players are summarized as below.

Value Chain		Generation	Transmission	Distribution	Retail Sales
Price Controls	QLD	Unregulated	Regulated	Regulated	Mixed
	NSW	Unregulated	Regulated	Regulated	Mixed
	ACT	Unregulated	Regulated	Regulated	Mixed
	VIC	Unregulated	Regulated	Regulated	Unregulated
	SA	Unregulated	Regulated	Regulated	Unregulated
	TAS	Unregulated	Regulated	Regulated	Mixed
	NT	Unregulated	Regulated	Regulated	Mixed
	WA	Unregulated	Regulated	Regulated	Mixed
Players	QLD	State government・Private company	1 state government	2 state governments	23 state governments and private companies
	NSW	State government・Private company	1 state government	3 state governments	23 state governments and private companies
	ACT	State government・Private company	—	1 private company	23 state governments and private companies
	VIC	State government・Private company	1 private company	5 private companies	20 private companies
	SA	State government・Private company	1 private company	1 private company	18 private companies
	TAS	State government・Private company	1 state government	1 state government	5 state governments and private companies
	NT	State government・Private company	1 state government	1 state government	2 state governments
	WA	State government・Private company	2 state governments	2 state governments	12 state governments and private companies

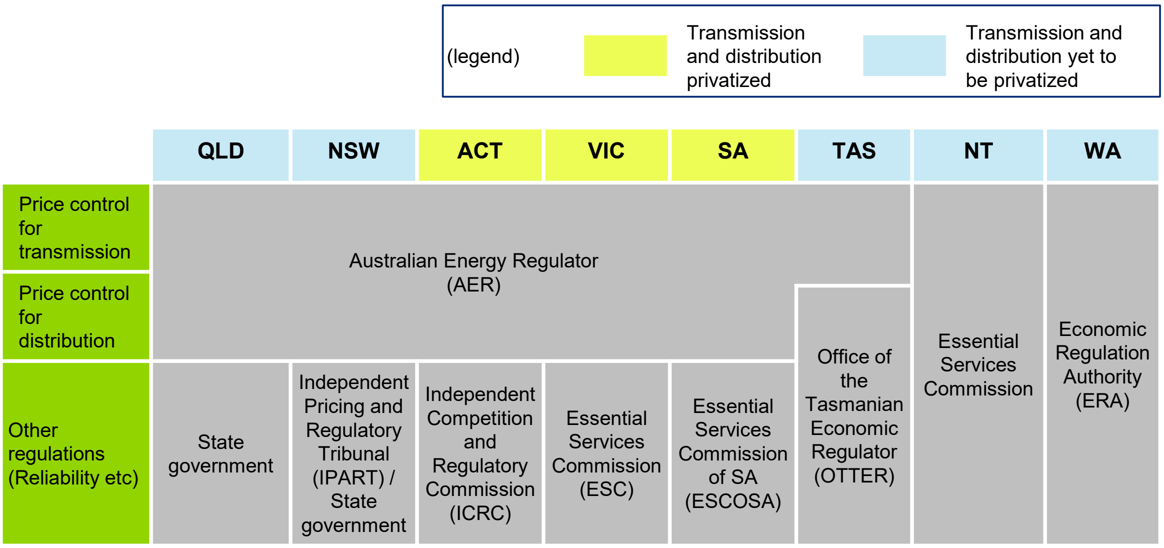
Source: Prepared by DTFA in reference to "Overseas electric business Part I (the second volume) year 2014" published by Japan Electric Power Information Center, Inc. and "State of the Energy Market" published by AER

Figure 2-8 Price Controls and Players

2.1.1.4.3 Regulatory Bodies [10]

Though regulating authorities differ by states, generally speaking the Australian Energy Regulator (AER) regulates prices for transmission and distribution, and state governments control other items such as the standards for reliability.

[10] "Overseas electric business Part I (the second volume) year 2014" published by Japan Electric Power Information Center, Inc.



Source: Prepared by DTFA in reference to "Overseas electric business Part I (the second volume) year 2014" published by Japan Electric Power Information Center, Inc.

Figure 2-9 Regulatory Bodies for Transmission and Distribution in Australia

2.1.1.4.4 Ensuring Fair Access to Transmission and Distribution Networks [11]

Although each state has different policies, generation, transmission, and distribution require legal and ownership unbundling, and the same applies to distribution and retail sales, in order to ensure neutrality.

2.1.1.5 United States

2.1.1.5.1 Deregulations in Perspective [12] [13] [14] [15]

Historically speaking, new entries to the electricity market were legally restricted across the United States.

However, as a result of events such as oil crises and the California electricity crisis of the 1970s, the Public Utilities Regulatory Policies Act (PURA), enacted in 1977, admitted new entries to generation sectors, opening the doors to electricity deregulation. The deregulations that started in the generation sector made gradual progress, such as obligating open access to transmission operators and establishing an independent operator that ensures neutrality.

[11] "Overseas electric business Part I (the second volume) year 2014" published by Japan Electric Power Information Center, Inc.
[12] "Overseas electric business Part I (the first volume) year 2014" published by Japan Electric Power Information Center, Inc.
[13] "Overseas electric business Part I (the first volume) year 2014" published by Japan Electric Power Information Center, Inc.
[14] NERC web site
[15] "Research on regulatory institutions about overseas electricity business" (Sep. 2013) published by Agency for Natural Resources and Energy

2.1.1.5.2 Price Controls and Players

Prices for transmission and distribution are regulated in all states, whereas prices for generation are unregulated for all states, and price controls have been adopted in some states.

In the retail sector, a dozen states and Washington D.C. have been fully deregulated. As a result of the Californian electricity crisis resulting in subsequent price hikes, some states have stopped deregulation processes and some have stepped back to partial deregulations.

Current price controls and the main players in the 13 states in the North Eastern region and Washington D.C. are summarized as below.

	Generation		Transmission		Distribution		Retail Sales	
	Price Controls	Players	Price Controls	Players	Price Controls	Players	Price Controls	Players
OH							Unregulated	
PA							Unregulated	
IL							Unregulated	
NC							Regulated	
VA							Stopped deregulation	
IN							Regulated	
MI	Unregulated	Private companies, local gov't, IPP, etc.	Regulated	Private companies, Local gov't, etc.	Regulated	Private companies, Local gov't, etc.	Partially Unregulated	Private companies, Local gov't, etc.
TN							Regulated	
KY							Regulated	
NJ							Unregulated	
MD							Unregulated	
WV							Regulated	
DE							Unregulated	
D.C.							Unregulated	

Figure 2-10 Price Controls and Players

2.1.1.5.3 Regulatory Bodies [16] [17]

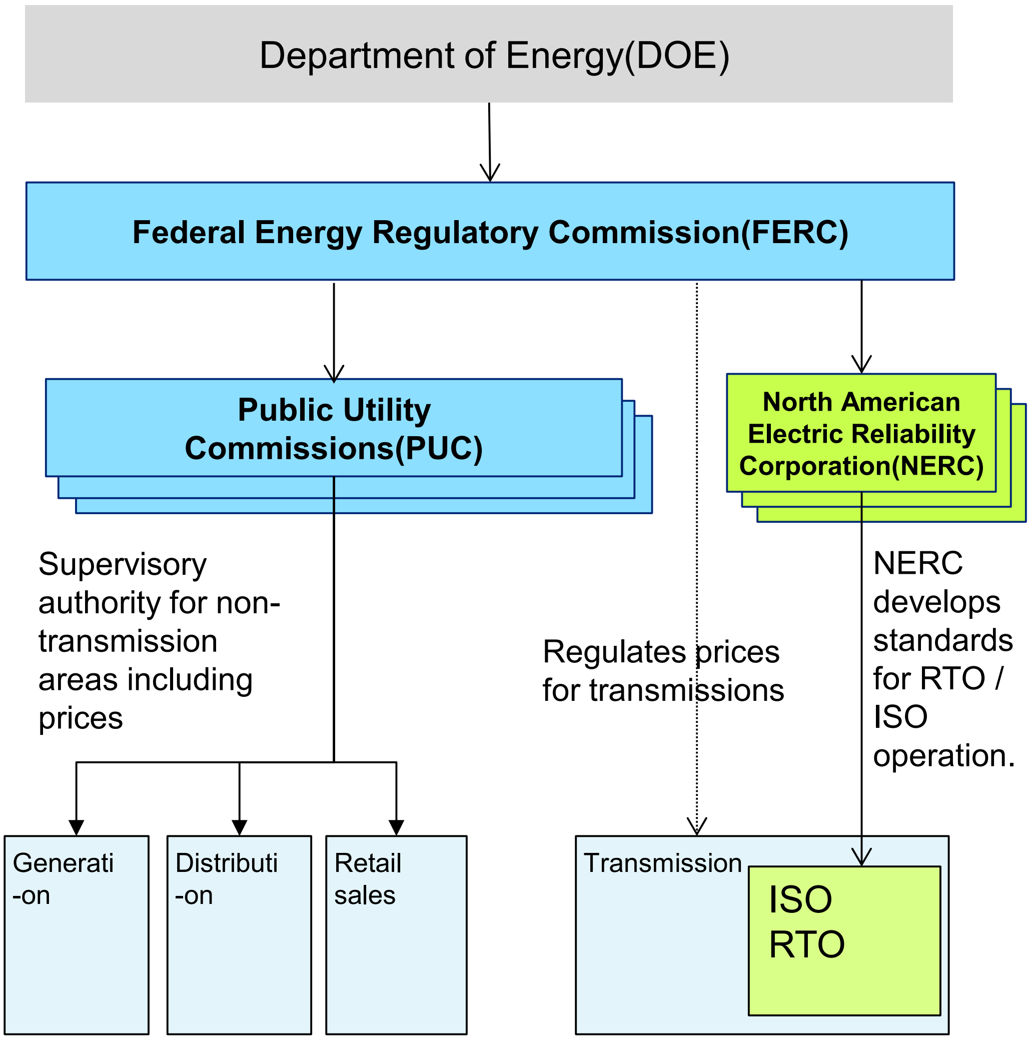
The Federal Energy Regulatory Commission (FERC) is the federal regulating authority for wholesale markets and transmissions.

[16] "Research on regulatory organization for overseas electricity business", Agency for Natural Resources and Energy
[17] "Overseas electric business Part I (the first volume) year 2014", Japan Electric Power Information Center, Inc.

Distribution and retail sales are regulated at the state level by each state's Public Utilities Commission (PUC).

With respect to transmissions, the North American Electric Reliability Corporation (NERC), an entity authorized by FERC, sets the standards for transmission reliability. NERC consists of 8 local entities that cover the whole of North America.

In addition, with respect to transmissions, Independent System Operators (ISO) and Regional Transmission Organizations (RTO) manage grid networks observing the standards set by NERC, as well as operate wholesale electricity markets. There are 7 ISOs/RTOs across the United States with each responsible for its region, managing transmission networks without owning grids so as to warrant fair access by all generators. The difference between ISOs and RTOs is that an ISO covers a single state whereas an RTO covers multiple states.



Source: Prepared by DTFA based on "Overseas electric business Part I (the first volume) year 2014" published by Japan Electric Power Information Center, Inc.

Figure 2-11 Regulatory Bodies in the United States

2.1.1.5.4 Ensuring Fair Access to Transmission and Distribution Networks [18] [19]

A FERC order (FERC Order 888) obligated separation of transmission and generation. Also, as mentioned, ISOs/RTOs manage transmission networks without owning grids so as to warrant fair access by all generators. However, the ISOs/RTOs do not cover the entire United States – i.e., they consume 2/3 of the electricity of the nation.

2.1.2 Price Controls

It might be noted that while the term “price control” refers to revenue a power wheeling operator is allowed to recognize under price control regulations in a given country, the term “transmission pricing” refers to the charge a power wheeling operator bills to loads and/or generators for the power wheeled.

This section covers price controls and wheeling charge is covered in the next section.

2.1.2.1 Price Control Approaches in Power Wheeling [20] [21] [22]

One of the main objectives of the electricity sector reforms carried out in many countries is to achieve efficiency in investments and operations through the introduction of price control mechanisms.

In power wheeling or electricity transmission and distribution, three major approaches in price controls exist – Rate of Return (ROR), revenue cap and price cap.

The sections that follow briefly summarize these three approaches.

2.1.2.1.1 Rate of Return (ROR) Approach

The ROR allows operators to recover their operating and capital costs as well as receive a return on capital.

Proponents of the ROR approach have argued that the rate formulas are relatively easy to follow and that the operators will not earn excessive profits.

Opponents have argued that this approach does not provide incentives for cost savings, but rewards over-investments.

The ROR approach is believed to have caused in-efficiency, which has led to the introduction of incentive-based regulations such as revenue cap and price cap.

2.1.2.1.2 Price Cap Approach

The price cap approach decouples the operator’s profit from costs by setting a price ceiling in transmission and distribution charges.

Proponents of the price cap approach have argued that this approach provides the operator with an incentive to maximize profit by minimizing costs and allows the utility to keep the cost savings achieved.

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[18] “Overseas electric business Part I (the first volume) year 2014”, Japan Electric Power Information Center, Inc.
[19] “Ensuring stability and fairness of electricity supply”, Ministry of Economy, Trade and Industry
[20] “Year 2010 business of furtherance and adjustment of electric power source location (survey on fee structure in the electric business in the U.S. and Europe)”, Ministry of Economy, Trade and Industry
[21] “Challenge of regulation of incentive in transmission and distribution sectors in Germany”, Central Research Institute of Electric Power Industry
[22] Benchmarking and regulation of electricity transmission and distribution utilities: lessons from international experience”, Tooraj Jamasb, December 2000

Opponents have argued that, because their total revenue is not capped (despite the cap on the price charged to their customers), operators do have the incentive to maximize sales revenue, and that this may conflict with socially desirable objectives such as demand-side management to reduce carbon emissions.

2.1.2.1.3 Revenue Cap Approach

The revenue cap approach regulates the maximum allowable revenue that a utility can earn.

Proponents of the revenue cap approach have made a similar argument to the price cap approach in that the revenue cap approach provides operators with the incentive to maximize profit by minimizing costs, but that revenue cap is superior to price cap in that it can better align socially desirable objectives (e.g., carbon emission reduction) with those of the operator, as their maximum revenue becomes decoupled from the amount of electricity transmitted/distributed once their revenue reaches the ceiling.

However, the revenue cap approach has been criticized for limiting the operator's incentives to increase revenue through innovations.

2.1.2.2 Norway

2.1.2.2.1 Characteristics [23] [24]

Transmission and distribution prices are controlled in Norway through the system of revenue cap.

The revenue cap is updated annually by NVA. If the actual revenue exceeds the revenue cap the amount is returned to customers through reduced tariffs, and if the actual revenue is below the revenue cap the amount is returned to the distribution and transmission operators through increased tariffs.

2.1.2.2.2 Regulatory Formula [25] [26] [27] [28]

A simplified version of the revenue cap formula is as follows:

Revenue cap=40%×Cost base + 60%×Norm cost (*)

Table 2-1 Elements of Revenue Cap Formula(Norway)

Item	Description
Cost base	This consists of 1) operating and maintenance cost after adjusting for inflation, 2) depreciation, 3) regulatory asset base multiplied by the weighted average cost of capital, and 4) value of network losses
Cost norm	Cost base as calculated by NVE. It is calculated for each company based on the benchmarking analysis of the efficiency of comparable network companies

23 "Year 2011 business of furtherance and adjustment of electric power source location (field survey of electricity charges overseas)", Mitsubishi Research Institute
24 "Basic structure of electric competitive market", The Research Institute of Economy
25 "Year 2011 business of furtherance and adjustment of electric power source location (field survey of electricity charges overseas)", Mitsubishi Research Institute
26 "The Norwegian revenue cap regulation", Jens Naas-Bibow, CIRED, 12 May 2013
27 "Regulation of grid companies in Norway", Statnett, 16 May 2013
28 "Statnett SF", Standard & Poor's, 18 December 2012

* Certain pass-through costs such as the following are recoverable by the operator without regards to the Revenue cap:

- Costs relating to the purchase of network services from other network companies
- Property tax
- R&D up to a certain level

2.1.2.3 Germany

2.1.2.3.1 Characteristics [29] [30] [31]

From 2006 to 2008, transmission and distribution charges were determined through the "full-cost method" which reflected the cost of conducting business as proclaimed by each operator after the assessments by BNetzA.

In 2009, the "Revenue-cap method", a system for setting the prices charged by regulated monopolies by limiting the total revenue in a given regulatory period, was adopted, and this is the method currently employed in Germany.

The regulatory period under the German Revenue-cap method is 5 years, with the current regulatory period running from 2014 to 2018.

2.1.2.3.2 Regulatory Formula [32]

A simplified version of the revenue cap formula is as follows:

"Revenue cap (Allowed revenue)"
= Permanently controllable cost + (Efficient cost + Inefficient cost)×(⊿CPI – Efficiency factor)

+ Quality element + (Settlement of) Regulatory account

[29] "Challenges of incentive regulations in transmission and distribution business in Germany", Central Research Institute of Electric Power Industry
[30] "E.ON's European Distribution Business", E.ON
[31] "Year 2011 business of furtherance and adjustment of electric power source location (field survey of electricity charges overseas)", Mitsubishi Research Institute
[32] "Overseas electric business Part I (the first volume) year 2014", Japan Electric Power Information Center, Inc.

Table 2-2 Elements of Revenue Cap Formula(Germany)

Item	Description
Permanently non-controllable costs	Costs such as taxes and employee benefits, as stipulated under law, that are beyond the efficiency efforts of the operators
Efficient costs	Minimum costs that are thought to be incurred by efficient operator
Inefficient costs	Costs that are incurred by inefficient operator but not thought to be incurred by efficient operator
Efficiency factor	The general sectorial productivity factor reflecting efficiency improvements of the grid business in general
Quality elements	Applicable only to medium voltage and low voltage line operations Operators maintaining a high quality will have up to 4% of the "Inefficient cost" added to the revenue cap, as a reward Operators with low quality would be penalized as much as 2% of the "Inefficient cost", as a reduction from the revenue cap "Quality" is measured through only one parameter: SAIDI (System Average Interruption Duration Index)
(Settlement of) Regulatory account	Difference between allowed revenues and actual revenues (positive or negative) are "booked" to this regulatory account

Operators deemed to have incurred the "Inefficient cost" have a gradually increasing disallowed "Inefficient cost" over the 5 year regulatory period and as of the 5th year of the regulatory period, no such "Inefficient cost" is allowed to be included in the "Revenue cap (Allowed revenue)."

"Efficiency factor", which is the general sectorial productivity factor reflecting efficiency improvements of the grid business in general, is applied to the sum of "Efficient cost " and "Inefficient cost"(after considering the change in CPI or "⊿CPI"), with the impact of an annual and gradually increasing reduction in the operator's Revenue cap (Allowed revenue). To be clear, the "Efficiency factor" is not applied to "Permanently non-controllable costs" – i.e., costs such as taxes and employee benefits that are beyond the efficiency efforts of operators.

Other adjustment items include such items as "Quality element", which can be added to or deducted from the allowed revenue depending on the operator's SAIDI, and "(Settlement of) Regulatory account", which is the difference between allowed revenue and actual revenue that can be added to or subtracted from next year's allowed revenue (there are also other factors such as the allowance for the investment cost for transmission grid expansion).

2.1.2.4 Great Britain[33] [34] [35] [36] [37] [38]

2.1.2.4.1 Characteristics

From the 1990s, price controls were achieved through the so-called "RPI-X Revenue Cap" regulation, which sets a capped revenue that fluctuates in line with the Retail Prices Index (RPI) less a predetermined X% reduction, allowing the regulated operator to keep the cost it saved through efficiency improvements.

Though the RPI-X Revenue Cap regulation had made a significant contribution to halving the network costs since the 1990s, OFGEM, recognizing the need to encourage network companies to actively perform the following, introduced a new regulatory framework called RIIO (Revenue set with Incentives for delivering Innovation and Outputs.)

- Play a full role in the delivery of a sustainable energy sector: transmission and distribution operators were charged with causing delays in connecting renewable electricity generators to the system
- Deliver network services with long-term value for money and for future consumers: efficiency remained an important objective of the regulation

RIIO succeeds the concept of allowed revenue but makes, among others, the following fundamental changes:

- Rather than setting allowed revenue for the operating (OPEX) and capital outlay (CAPEX) separately, RIIO combines the two into total expenditure (TOTEX): this approach reflects the view by OFGEM that OPEX and CAPEX incentives are so different under RPI-X that some operators shifted costs between OPEX and CAPEX in an inefficient manner.
- RIIO extends the price control period from 5 years to 8 years: the longer period is intended to highlight the long-term nature of the transition into a low-carbon economy.
- RIIO outputs are more clearly articulated into delivering five key output categories: the outputs are linked to the calculation of allowed revenue and/or to the reputational impact of the operator, etc.

[33] "Overseas electric business Part I (the first volume) year 2014", Japan Electric Power Information Center, Inc.
[34] "Year 2011 business of furtherance and adjustment of electric power source location (field survey of electricity charges overseas)", Mitsubishi Research Institute
[35] "Annual Reports and Accounts 2013/14", National Grid
[36] "The way to RIIO", Frontier Economics, October 2011
[37] RIIO – A new way to regulate energy networks, OFGEM, 4 October, 2010
[38] "A Trip to RIIO in Your Future?" Peter Fox-Penner, Dan Harris, and Serena Hesmondhalgh, October 2013

The five key output categories are as follows:

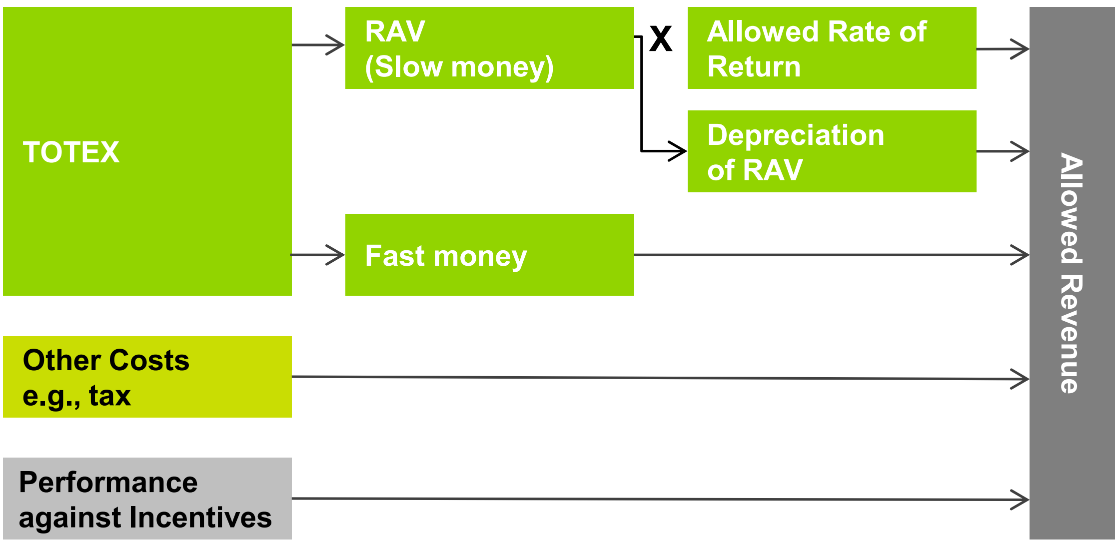
Table 2-3 Explanations of the Five Key Output Categories

Item	Explanation
Safety	Ensuring the provision of a safe energy network
Reliability (and availability)	Promoting networks capable of delivering long-term reliability, as well as minimizing the number and duration of interruptions experienced over the price control period, and ensuring adaptation to climate change
Environmental impact	Encouraging companies to play their role in achieving broader environmental objectives – specifically facilitating the reduction of carbon emissions
Customer and stakeholder satisfaction	Maintaining high levels of customer satisfaction and stakeholder engagement, and improving service levels
Customer connections	Encouraging networks to connect customers quickly and efficiently

The current regulatory period runs from 2013 to 2021.

2.1.2.4.2 Regulatory Formula [39]

A simplified version of the revenue cap formula under RIIO is as follows:



Source: "Annual Reports and Accounts 2013/14", National Grid

Figure 2-12 Simplified Allowed Revenue Formula under RIIO

[39] "Year 2011 business of furtherance and adjustment of electric power source location (field survey of electricity charges overseas)" published by Mitsubishi Research Institute

The TOTEX is a split between "Fast Money" and "Slow Money": Fast Money represents the amount of TOTEX which an operator is allowed to recover in the current year whereas the Slow Money is added first to RAV (Regulatory Asset Value) but the operator is allowed to collect the related depreciation thereof and a return on RAV.

Also, RIIO has introduced new incentive mechanisms to align operators' objectives with those of customers and other stakeholders. For example, an operator's performance against customer satisfaction targets can have a positive or negative effect of up to 1% of allowed annual revenues.

2.1.2.5 Australia

2.1.2.5.1 Characteristics [40] [41]

In transmission, all states have adopted the Revenue cap method, whereas in distribution, some adopt Revenue cap while others adopt the Price cap method. However, starting in 2016, all the states will have adopted the Revenue cap method even in the distribution sector.

2.1.2.5.2 Regulatory Formula [42]

Revenue cap

Under the Revenue cap method, AER approves the total amount of the Revenue cap (at net present value basis) for the 5 year regulatory period after examining the operator's projections for OPEX and CAPEX for the same period.

Each year's revenue cap is then determined so as to smooth out and minimize year-on-year change, after considering the adjustments for incentive regulations*.

Price cap

Unit price under Price cap is derived by dividing each year's projected amount of electricity wheeling into the allowed revenue for each year in the manner described under Revenue cap above.

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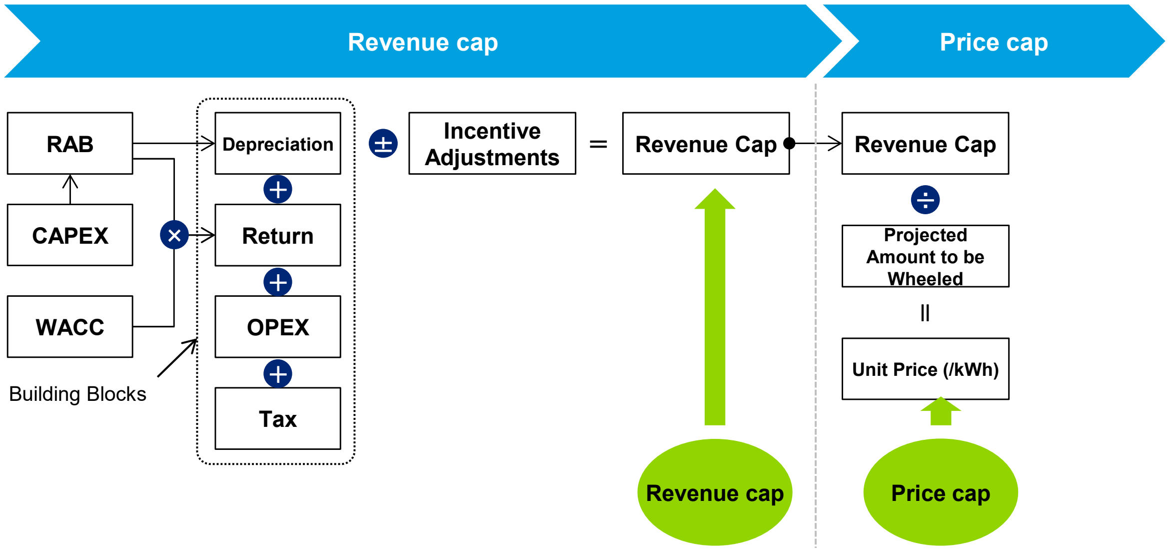
[40] "Overseas electric business Part I (the second volume) year 2014" published by Japan Electric Power Information Center, Inc.
[41] Various public information from AER
[42] Various public information from AER , Mr. Chris Pattas "Market model and Australian experience in regulatory reform (Oct 2011)", Frontier Economics, "Regulatory arrangements for electricity network pricing(Oct 2014)"



Source: Prepared by DTFA based on "Market model and Australian experience in regulatory reform", Chris Pattas, October 2011; "Regulatory arrangements for electricity network pricing", Frontier Economics, October 2014; and AER published materials

Figure 2-13 Calculation Methodologies for Revenue Cap and Price Cap

* Incentive regulations

AER recognizes 4 incentive regulations – i.e., STPIS, DMIS, EBSS and CESS as below:

Incentive	Related Area	Description	T	D
STPIS (Service Target Performance Incentive Scheme)	Supply Reliability, Customer Service, Service Level	■ Incentives to improve both network reliability/quality and customer services	✓	✓
DMIS (Demand Management Incentive Scheme)	Allowed revenue	■ Intended to alleviate financial stress caused by demand side management program and resulting decline in use of electricity		✓
EBSS (Efficiency Benefit sharing scheme)	OPEX Efficiency	■ If operator ended with less OPEX spending than that assumed at the beginning of a regulatory period, such difference (i.e., excess revenue) is not disallowed: it will be shared between operator (more revenue) and customers (reduced bill)	✓	✓
CESS (Capital Expenditure Sharing Scheme)	CAPEX Efficiency	■ If operator ended with less CPEX spending than that assumed at the beginning of a regulatory period, such difference (i.e., excess revenue) is not disallowed: it will be shared between operator (more revenue) and customers (reduced bill)	✓	✓

■ :Has already been adopted ■ :Expected to be adopted

Source: Prepared by DTFA based on AER published materials

Figure 2-14 Incentive Regulations as Defined by AER

2.1.2.6 United States [43] [44]

2.1.2.6.1 Characteristics

Transmission and distribution prices in the United States are controlled through the system of revenue cap.

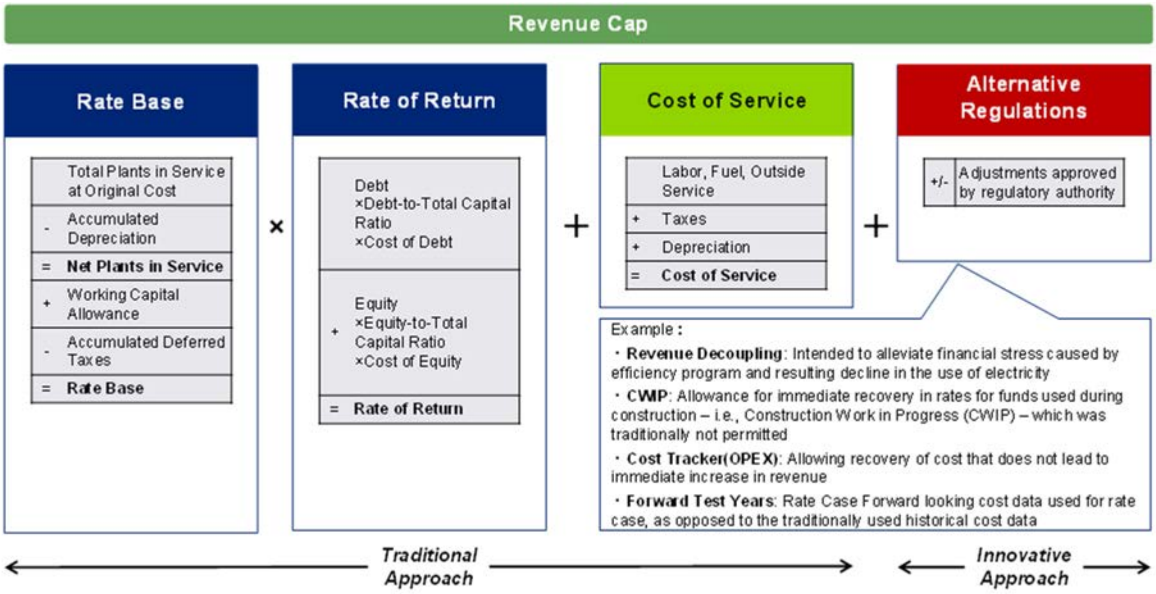
“Alternative Regulations” have been introduced in the United States in order to allow for network operators to recover costs or avoid frequent changes in rate case, etc.

2.1.2.6.2 Regulatory Formula [45]

Allowed revenue is determined based on the “Traditional” revenue requirement approach that considers “Rate Base”, “Rate of Return” and “Cost of Service”, as well as the “Innovative” approach – or the “Alternative Regulations”.

The below table summarizes the revenue cap formula.

43 “Annual Report2013”, National Grid
44 “Electricity Regulation in the US: A Guide 2011”, The Regulatory Assistance Program
45 “Electricity Regulation in the US: A Guide 2011”, The Regulatory Assistance Program



Source: Prepared by DTFA from “Electricity Regulation in the US: A Guide 2011”

Figure 2-15 Revenue Cap Formula for the United States

2.1.3 Transmission Pricing

2.1.3.1 Summary

As mentioned, while the term “price control” refers to revenue a power wheeling operator is allowed to recognize under price control regulations in a given country, the term “transmission pricing” refers to the charge a power wheeling operator bills to loads and/or generators for the power wheeled.

In some countries, cost of transmission is paid only by loads while in others the cost is shared by both loads and generators.

As for pricing methodologies, broadly speaking, there are two methods in transmission pricing – the “Postage Stamp” method and the “Locational” method.

The Postage Stamp method refers to the pricings based on average system costs.

Its advantages include [46]:

- **Simplicity**: It is simple and easy to implement with no mathematical complications involved.
- **Ease of obtaining political backing**: Being very simple and straightforward, it is easy to get political backing to be implemented.

Its disadvantages include:

- **No consideration for the use of network**: Postage stamp allocation does not take into consideration the extent of use of the network by a particular transaction.

There are variations on the postage stamp method such as separate charges for peak, particular seasons, weekends, etc.

The Locational method refers to a method where the transmission price varies depending on the location of

[46] MPTEL website: http://nptel.ac.in/courses/108101005/46

loads and/or generators. This method attempts to overcome the disadvantages of the postage stamp method and, as such, may sacrifice the advantages of it – i.e., simplicity and ease of obtaining political backing.

There are many variations to locational pricing – e.g., the "Contract Path" method, which is based on charging the transacting entities between two points, and the "MW Mile" method, which employs power flow simulation to determine the flow of transacted power in various lines.

The below table is a high-level summary of the transmission price payer and transmission pricing methodology.

Table 2-4 Transmission Price Payers

	Payer	
	Loads	**Generators**
Norway	67% (roughly)	33% (roughly)
Germany	100%	–
UK (England and Wales, Scotland)	73% (historically)	27% (historically)
Australia (NEM※)	100%	–
United States (PJM)	100%	–

Table 2-5 Transmission Pricing Methodology

	Transmission Pricing Methodology	
	Postage Stamp	**Locational Charge**
Norway		✓
Germany	✓	
UK (England and Wales, Scotland)		✓
Australia (NEM※)	✓ (50%)	✓ (50%)
United States (PJM)		✓
Morocco	✓	
Japan	✓	

*NEM: Australian National Electricity Market (NEM) is a real-time nodally-dispatched but zonally-settled market containing 5 states South Australia, Tasmania, Victoria, New South Wales and Queensland.

Source: Prepared by DTFA based on below:

"International transmission pricing review", Frontier Economics Pty Ltd

"Transmission Grid Access and Pricing in Norway, Spain and California – a comparative study", Helle Gronli et al.

"Locational Marginal Pricing", PJM

2.1.3.2 Norway

Loads and generators pay tariffs in three components: 1) "Energy charge", 2) "Residual charge", 3) "Capacity charge".

- Energy charge is the locational marginal cost, paid by both load and generator. It is based on marginal grid losses and is differentiated by point-of-connection
- Residual charge is the fixed charge. Loads are charged based on average consumption during the peak hours over the last 5 years, whereas generators are charged based on average annual output over a historic range
- Congestion charge is paid by generators

2.1.3.3 Germany

Loads pay a postage-stamped charge called the Grid Utilization Charge which recovers infrastructure costs, ancillary service costs and line losses.

Charges vary by voltage (extra high, high, medium and low) and utilization time but not by location.

2.1.3.4 Great Britain

Both loads and generators pay tariffs.

Tariffs are priced as 'Transmission Network Use of System' (TNUoS) tariffs, which have two components: a Locational charge and a Residual charge:

- Locational charge varies by generation / demand zone, and approximates the 'Long Run Marginal Cost' (LRMC) of transmission services at various nodes on the network
- Residual charge is a non-locational charge designed to recover remaining required revenue not recovered via locational charges

2.1.3.5 Australia

Loads pay 100% of the tariff which consists, among others, of the following:

- Postage stamp charges
- Cost-reflective network pricing, which is the LRMC of using the network at any given location

2.1.3.6 United States

Loads pay 100% of the Locational Marginal Pricing, which reflects the value of the energy at the specific location (e.g., grid loss) and time (congestion) it is delivered.

2.1.4 Ancillary Services and Imbalance Services

2.1.4.1 Ancillary Services

Ancillary services are the services required by the transmission or distribution system operator to enable them to maintain the integrity and stability of the transmission or distribution system as well as the power quality.

The below table briefly explains the 4 main components of ancillary services.

Table 2-6 Main Components of Ancillary Services

Main Components of Ancillary Services	Definition
①Frequency Control	Maintaining the frequency within the given margins by continuous modulation of active power
②Voltage Control	Maintaining voltage through injecting or absorbing reactive power by means of synchronous or static compensation
③Operating Reserve	Availing generating capacity to the system operator to meet demand in case a generator goes down or there is another disruption to the supply
④Black Start Capacity	Recovering an electric power station or a part of an electric grid to operation without relying on the external transmission network

All the countries covered in this case study are equipped with the 4 main components of ancillary services.

2.1.4.2 Imbalance Services

As the electricity network cannot store energy, any "imbalance" or mismatch between supply and demand must be balanced immediately by the transmission system operator.

As the below table shows, imbalances are settled at market for all countries but the balancing intervals vary by country.

Table 2-7 Imbalance Settlements for the 5 Countries Covered in This Case Study

Elements of Imbalance Settlements	Norway	Germany	UK (England and Wales, Scotland)	Australia NEM	United States PJM
Balancing Interval	1hour	15 minutes	30 minutes	5 minutes	1 hour
Existence of Balancing Market	Yes	Yes	Yes	Yes	Yes

2.1.5 Inter-region/country Wheeling Charges [47]

2.1.5.1 European Region[48]

In Europe, "Regulation (EU) 838/2010" sets out the guidelines relating to the compensation mechanism transmission operators receive for the costs incurred as a result of hosting cross-border flows of electricity. These is guidelines are observed by the members of "ENTSO-E" (the European Network of Transmission System Operators for Electricity) – i.e., 42 transmission systems operators from 35 European countries, including but not limited to EU member countries such as Germany and the United Kingdom as well as non-EU member countries such as Norway.

ENTSO-E was established and given legal mandates by the "EU's Third Package" in 2009, with the objectives of integrating renewable energy sources into the grid system and completing a pan-European energy market that is affordable, sustainable and secure.

2.1.5.2 United States

As mentioned in the case study of the United States, Regional Transmission Organizations (RTOs) manage

[47] "Material for the first working group meeting of system utility institution", Agency for Natural Resources and Energy

[48] Website of the European Network of Transmission System Operators for Electricity

and settle inter-state electricity transmissions through the operations of wholesale electricity markets.

2.2 Power Wheeling in Japan

2.2.1 Electric Power Industry System in Japan

In Japan, after the end of the completely state-controlled period during World War II, the nationwide electric power industry was divided into nine areas in 1951. Then, nine privately owned and vertically integrated General Electricity Utilities (GEUs) were established monopolistically in each region. (Later, the tenth GEU, Okinawa Electric Power Company, joined due to the reversion of Okinawa to Japan.) After that, this formation remained for over forty years.

In 1995, the power generation market was opened to new entries (the introduction of Independent Power Producers – IPPs) for the purpose of an increase in the profit of the nation through a drop in electric bills and the improvement of service standards via the introduction of competition. At the same time, Specified Electric Utilities (businesses using their own on-site generation, transmission and distribution facilities to supply electricity directly to customers in defined areas) also gained market access.

【The 1st Electricity Sector Reform】

In 2000, the retail market was partially opened. Customers with maximum demand of 2,000kW or more at 20kV or more became able to choose a power supplier. The conventional General Electricity Utilities had to leave their transmission lines open and started wheeling services to new PPSs (Power Producer and Supplier).

【The 2nd Electricity Sector Reform】

In the Electricity Enterprises Law revision of 2003, the open range of the retail market was scheduled to expand progressively as follows.

・April 2004 - Expansion to consumers with maximum demand of 500kW or more at 6.6kV or more.

・April 2005 - Expansion to consumers at 6.6kV or more (with maximum demand of 50kW or more).

・April 2007 - Commencement of study about whether the retail market should be entirely opened or not. (In actual fact, as a result of the study in April 2007, the entire opening of the retail market was shelved.)

In that revision, the following three measures were also included: 1) the foundation of a nation-wide wholesale electricity business market (currently the Japan Electric Power eXchange: JEPX) for the purpose of activation of the liberalization market, 2) the establishment of a neutral organization (Electric power System Council of Japan: ESCJ) which performed rule-making, dispute processing and so on regarding electric power system use, and 3) the introduction of three act regulations (the information firewall, the prohibition of discriminatory treatment, and the segment account separation for GEUs).

【The 3rd Electricity Sector Reform】

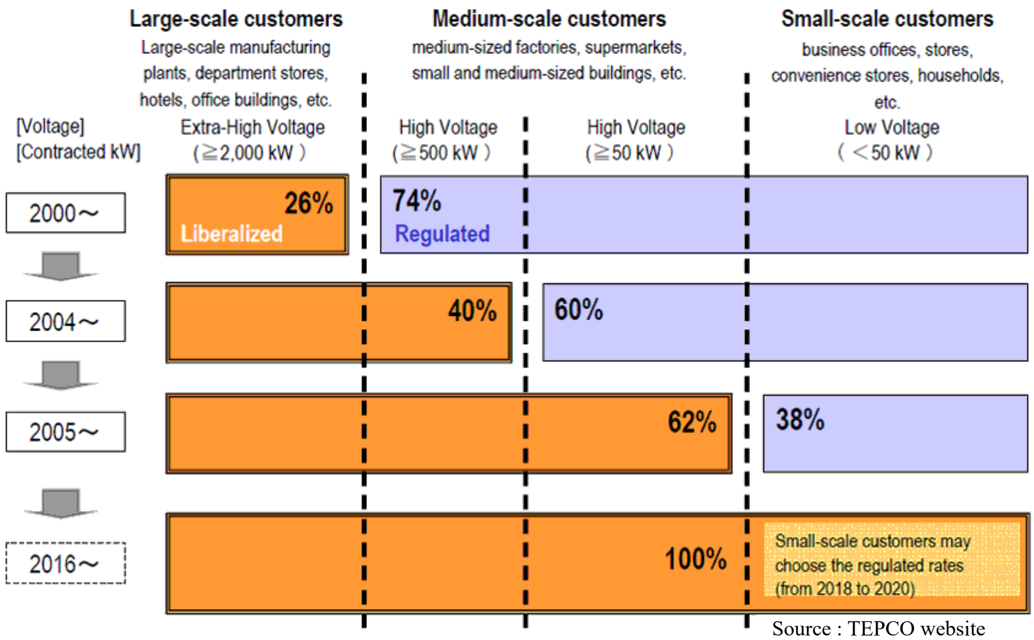
In April 2013, the Japanese cabinet approved the bill "Electric power network reform plan", which consisted of complete de-regulation of the retail market, legal separation of the transmission and distribution sectors, and foundation of wide-area system operators. In addition, the bill determines the process of the de-regulation as follows. In the bill, the tariff menus were decided to be kept until 2020 to ensure customers' benefits.

【The 5th Electricity Sector Reform】

・April 2015 Foundation of wide-area system operators

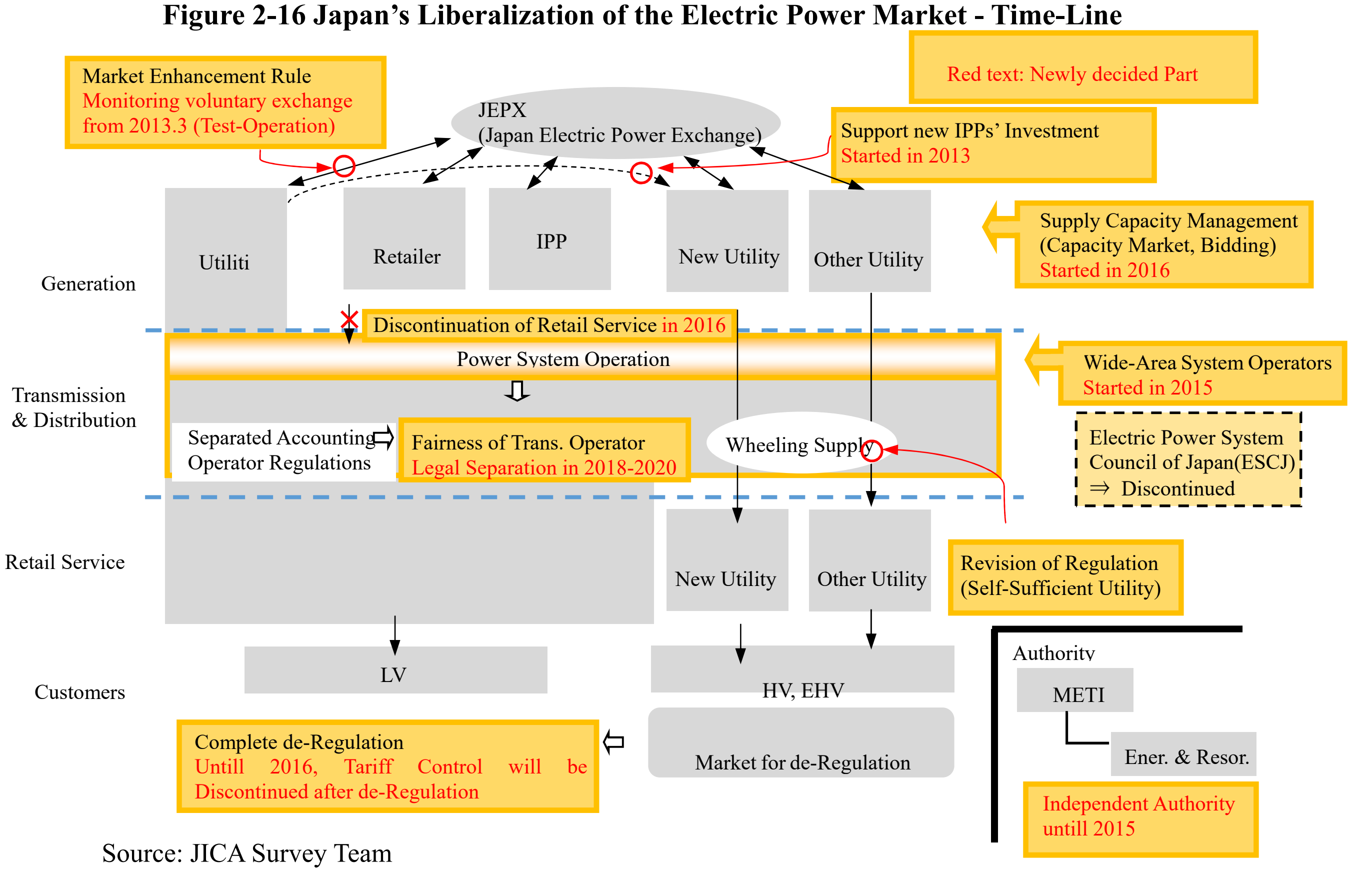
・April 2016 Complete de-regulation of retail market

・April 2020 Legal separation of transmission and distribution sectors



Source : TEPCO website
(based on METI publications)

Figure 2-16 Japan's Liberalization of the Electric Power Market - Time-Line



Source: JICA Survey Team

Figure 2-17 The 5th Electricity Sector Reform (Japan)

2.2.2 Outline of the Regulatory Rates System for Power Transmission and Distribution

Power transmission and distribution rates are subject to regulations mandating a total cost calculation by which a unit rate is set making the costs estimated for a given future period (on a business-year basis) equal to rate revenues.

For a given voltage level in the location of demand, the rates, consisting of a base rate and energy charge, are set respectively for extra-high voltage, high voltage and low voltage. Note that a fee to connect power generating plants with power systems is fully paid in the contribution in aid of construction at the time of construction, and it is therefore not included in the said base rate and energy charge.

Furthermore, a rate calculation method is specified by a ministerial ordinance to ensure that the retail sector of general electricity utilities and Power Producer and Suppliers (PPS) will compete under a fair business environment. It is also prohibited to provide a wheeling service that charges rates other than those calculated as above, further requiring accounting separation, resulting in a system designed to achieve fairness.

2.2.2.1 Features

As mentioned above, the system is designed taking into account fairness, to be achieved by requiring compliance with rate calculation rules and accounting separation.

While the rate calculation rules will be described more specifically in “Outline of method of calculating regulatory rates” in 2.3.2.3 below, the system is intended to calculate a wheeling service rate appropriately, starting with the total costs of power transmission and distribution, and generation and retail, which are subsequently classified in more detailed costs for power transmission and distribution, and generation and retail.

With respect to annual settlement of accounts, the system is intended to ensure greater fairness by managing the balance of payments, thus requiring the inclusion of a wheeling service in financial accounting.

2.2.2.2 Regulatory Authority

While the regulatory authority concerned with the system is the Electricity Market Surveillance Commission, currently placed under the Ministry of Economy, Trade and Industry (METI), it is also subject to regulations provided by the Fair Trade Commission of Japan, pursuant to the Antimonopoly Act.

In addition, the Organization for Cross-regional Coordination of Transmission Operators, with which all the electricity utilities are affiliated, has been independently established, taking into account non-discriminatory rule-making related to power systems.

2.2.2.3 Outline of Method of Calculating Regulatory Rates

Power transmission and distribution rates are subject to regulations mandating a total cost calculation by which a unit rate is set making the costs estimated for a given future period (on a business-year basis) equal to rate revenues. The detailed calculation method is described below (see Appendix2).

Note that power transmission loss is not set out because retailers are mandated to prepare and maintain a power supply capability that covers such estimated loss.

The calculation steps involve extracting the costs required for a wheeling service (costs related to transmission and high voltage distribution: B) from supply costs in the electricity business sector which reflect achievable management efficiency in the future (the total cost: A). From the resulting costs, the costs related to transmission and high voltage distribution to meet extra-high voltage and high-voltage demand

(C and D) are extracted. Therefore, the costs for network usage, namely the wheeling service rate paid by PPS, correspond to the costs incurred for electricity supplied by our company, ensuring fairness (the values are a three-year average of the business years from 2012 through 2014).

1. Calculation of the total cost (A)

Incorporating achievable efficiency in the future, a forward looking cost-based method is applied to calculate the costs required for our company to meet all kinds of demand for extra-high, high and low voltage in a given period for which the said costs are estimated.

Total cost (A): 5,678.3 billion yen[49]

The above costs are classified into the applicable business sector (hydraulic power generation, thermal power generation, nuclear power generation, new energy generation, transmission, transformation, distribution, sales, and general administration categories).

The costs incurred for substation facilities for transmission, transformation and distribution, which are subject to accounting requirements, are distributed in the applicable sector among hydraulic power generation, thermal power generation, nuclear power generation and new energy power generation.

<Principle cost items of each sector>

Cost of hydraulic power generation (88.9 billion yen)

… Repair expenses, cost of water usage, depreciation, and other

Cost of thermal power generation (2,784.1 billion yen)

… Fuel costs, repair expenses, depreciation, and other

Cost of nuclear power generation (443.8 billion yen)

… Nuclear fuel costs, repair expenses, depreciation, and other

Cost of new energy generation (1.5 billion yen)

… Repair expenses, commission fees, depreciation, and other

Transmission costs (319.4 billion yen)

… Repair expenses, rent, depreciation, and other

Substation costs (147 billion yen)

… Repair expenses, rent, depreciation, and other

Distribution costs (488 billion yen)

… Repair expenses, rent, depreciation, and other

Sales costs (128.9 billion yen)

… Commission fees, costs related to promotion and development, and other

2. Extraction of costs related to transmission and high-voltage distribution (B)

From the total costs (A) obtained in 1, the costs incurred for a wheeling service (costs related to transmission

[49] JPYIDR = 118

and high-voltage distribution (B)) are specifically extracted in an appropriate manner, using an ABC method.

※ ABC method (Activity Based Costing)

A method wherby the costs commonly related to multiple sectors are distributed into each applicable sector by identifying the cause of the cost in detail, following steps including:

- a cost with an identifiable cause is distributed (directly classified) to the applicable sector and, where unable to do so, the cost is distributed to multiple sectors based on an objective and reasonable benchmark (cost driver) pursuant to the ministerial ordinance of METI.

(a) Distribution of general administration costs to other sectors

- Costs related to multiple sectors such as research expenses and head office expenses are classified as “general administration costs” (496.6 billion yen) and distributed to the eight sectors based on the above-mentioned ABC method.

(Example) How to distribute general administration costs

- After the personnel costs included in general administration costs (including salary and allowances) are directly classified where applicable, the remaining costs are distributed to the eight sectors based on a benchmark (cost driver) of “the proportion of the number of persons in each sector”.

(b) Extraction of costs related to transmission and high-voltage distribution

- A wheeling service delivers electricity using transmission and distribution networks which are part of our company’s facilities, and therefore the following costs associated with the said service are extracted specifically from the eight sectors based on the ABC method, as in the general administration costs.

① Facility costs of transmission line such as transmission lines and steel towers

: Transmission costs (400.6 billion yen)

② Transformation facilities to transform power voltage, necessary to deliver extra-high voltage power

: Transformation service costs for power receiving (116 billion yen)

③ Transformation facilities to transform power voltage, necessary to deliver high voltage power

: Transformation service costs for distribution (73.5 billion yen)

④ Facility costs of distribution lines including distribution lines and utility poles, dedicated to delivering high voltage power

: Costs of high-voltage transmission (373.6 billion yen)

⑤ Costs to maintain frequency of power delivered in transmission networks

: Costs of ancillary services (32 billion yen)

⑥ Costs of monitoring and control to stabilize transmission networks

: Costs of power supply to networks (15.9 billion yen)

⑦ Costs of measurement and rate calculation of power delivered

: End-user costs (205.9 billion yen)

The resulting aggregation of the above wheeling service costs is referred to as the costs related to transmission and high-voltage distribution (B: 1,217.6 billion yen).

3. Extraction of costs related to transmission and high-voltage distribution to meet extra-high voltage and high voltage demand (C and D)

For power networks connecting a power generation plant with the service point, an extra-high voltage transmission network is a facility commonly used for meeting extra-high, high and low voltage demand. Therefore, a wheeling service rate for users of extra-high voltage is calculated by the costs of transmission networks included in those related to transmission and high-voltage distribution being distributed to the costs for extra-high voltage demand with a reasonable rate of allocation, considering the type of electricity use (such as the ratio of the amount of power and maximum power) (C).

Costs related to transmission and high voltage distribution to meet extra-high voltage demand (C)

: 160.3 billion yen

On the other hand, high voltage distribution networks are facilities dedicated to meeting high and low voltage demand. Therefore, a wheeling service rate for users of high voltage is calculated by the costs related to transmission networks, and those of high voltage distribution networks included in those related to transmission and high-voltage distribution, being respectively distributed to the costs for high voltage demand with a reasonable rate of allocation, considering the type of electricity use (such as the ratio of the amount of power, maximum power, and contract demand) (D).

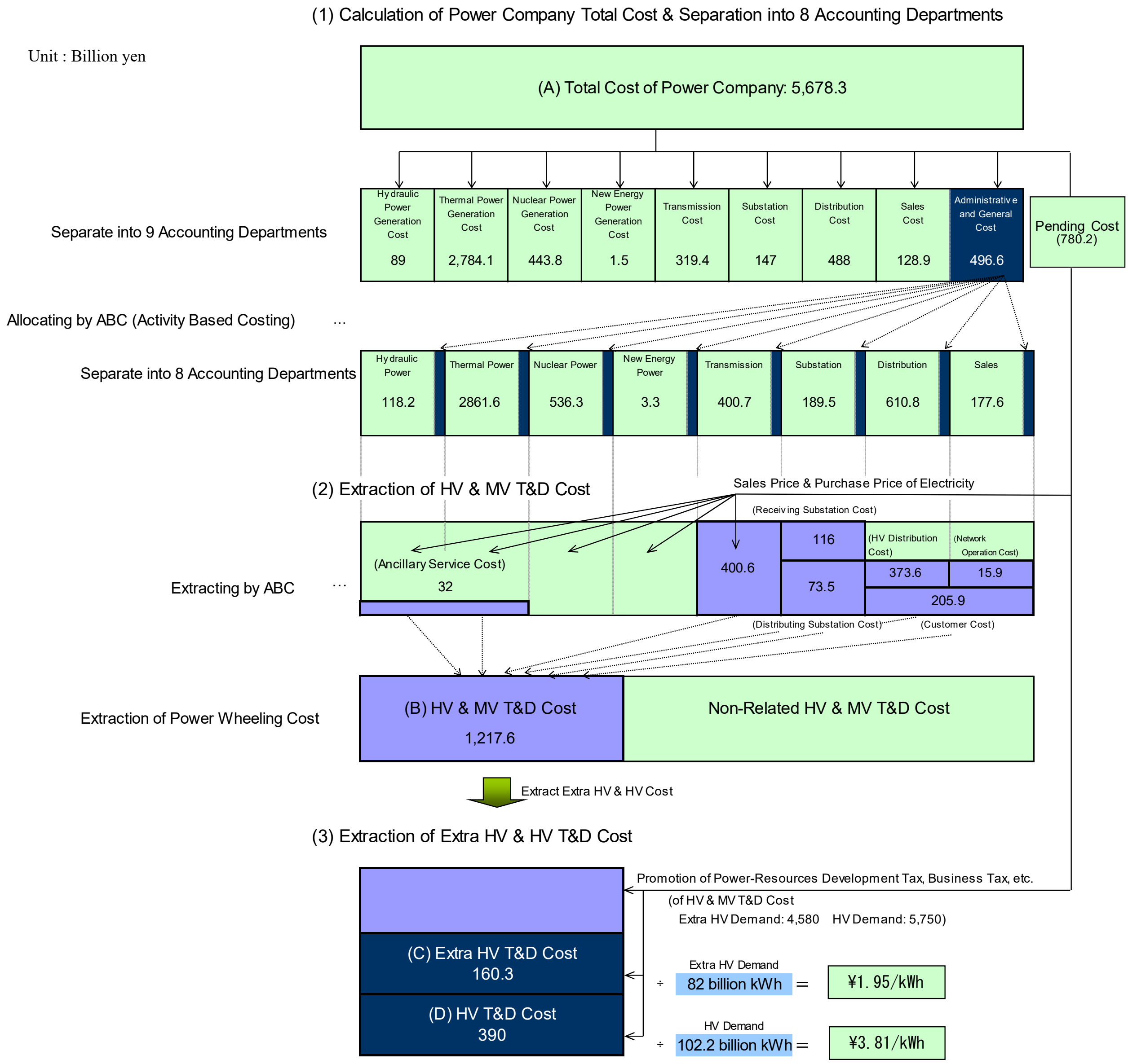
Costs related to transmission and high voltage distribution to meet high voltage demand (D)

: 390 billion yen

These calculation steps enable fairness to be achieved simultaneously between the electricity use of our company and that of the Specified Electricity Utility and other utilities, and between different types of demand.

4. Determination of a wheeling service cost

The base rate and energy charge are determined so that the costs related to transmission and high voltage distribution respectively obtained in 3 for extra-high voltage and high voltage demand correspond to the respective rate revenues from extra-high voltage and high voltage demand in a given period in which the costs are estimated. (¥0.35/kWh)



Source: TEPCO HP

Figure 2-18 Flow of the Cost Structure Sorting in Wheeling Charge Calculation

2.2.3 Cross-Area Wheeling Service Rates

As mentioned above, while wheeling service rates are set respectively by the ten different service areas in Japan, the rate of a cross-area wheeling service remains the same. This is known as postage stamp pricing.

Until 2005, a cross-area wheeling service entailed a payment of the costs related to the trunk network in each service area. With a view to facilitating efficient use of power sources, however, the costs were abolished. Note that for a cross-area wheeling service, the area-based costs incurred for the trunk lines are recovered from the wheeling service rates in the service areas of the demand.

2.3 Electric Power Industry System and Power Wheeling in Thailand

2.3.1 Deregulations in Perspective[50]

From the 1980s, a drastic review of the electric utility system was planned, which made the entry of private capital into the power generation sector possible in 1992. In addition, as a result of events such as the impact of the economic hit due to the Asian crisis of 1997 and requests from the IMF, the "Master Plan for State Sector Reform" was created. This plan included the entire liberalization of the division and privatization of the power companies and power pool market. However, as the structural reforms did not progress much, the power pool market was scrapped. Even though privatization of the power company was realized for a period, the High Administrative Court determined this to be unconstitutional in relation to the proceedings for the privatization and annulled the laws and regulations governing the privatization. Because an injunction was carried out on the listing, it reverted to a Corporation.

The electric business system had three companies, EGAT (Electric Generating Authority of Thailand), MEA (Metropolitan Electricity Authority) and PEA (Provincial Electricity Authority) until 1992. EGAT had the role of power generation and power transmission, MEA and PEA, of power distribution.

Since 1992, private capital has entered power generation. In addition, SPP (Small Power Producers) and VSPP (Very Small Power Producers) have emerged. The electricity capacity of SPP is more than 10MW and less than 90MW; that of VSPP is less than 10MW (mainly renewable energy).

2.3.2 Price Controls and Players

Though power generation contains private capital, from the point of view of tariff-regulation there is a regulated tariff system in the areas of power generation, transmission and distribution, and retail. Regulated tariffs are classified into wholesale tariff and retail tariff, and each regulatory body is different.

In terms of power generation operators, there are many players such as EGAT, EGCO (separated from EGAT; independent power producer), SPP and VSPP. They also import from Laos and Malaysia.

The power transmission business is a monopoly of EGAT. They purchase electricity as a single buyer from other power generators excluding the VSPP.

Power distribution and retail are conducted by the same operators, with MEA and PEA making up the majority. As exceptions, there are customers which EGAT and SPP supply directly to.

Price controls and main players are summarized as below.

[50] "Overseas electric business Part I (the second volume) year 2014" published by Japan Electric Power Information Center, Inc.

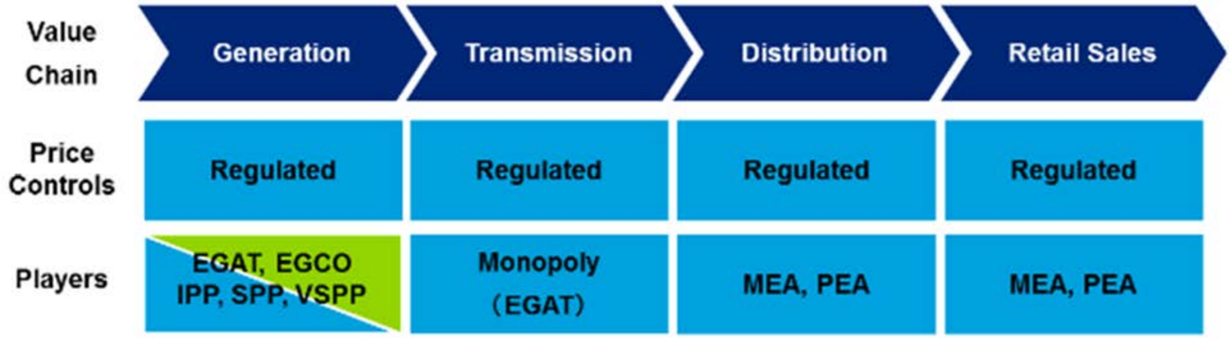


Figure 2-19 Price Controls and Players

Source: Prepared by “Overseas electric business Part I (the second volume) year 2014” published by Japan Electric Power Information Center, Inc.

2.3.3 Regulatory Bodies [51]

The Ministry of Energy oversees the energy sector, and has jurisdiction over the power companies of EGAT, MEA and PEA. In the Ministry of Energy, there is an energy policy and a planning office that is responsible for planning and energy policy. They conduct the tariff regulations, such as wholesale from power producers to EGAT, and from EGAT to MEA/PEA.

The Ministry of Energy is the organization that carries out the supervision and monitoring of the energy industry in general and it was established on the basis of the energy industry law enacted in December 2007 (EIA). The agency conducts tariff regulations and issuance of business licenses regarding power retail, such as for EGAT, MEA and PEA.

[51] “Overseas electric business Part I (the second volume) year 2014” published by Japan Electric Power Information Center, Inc.

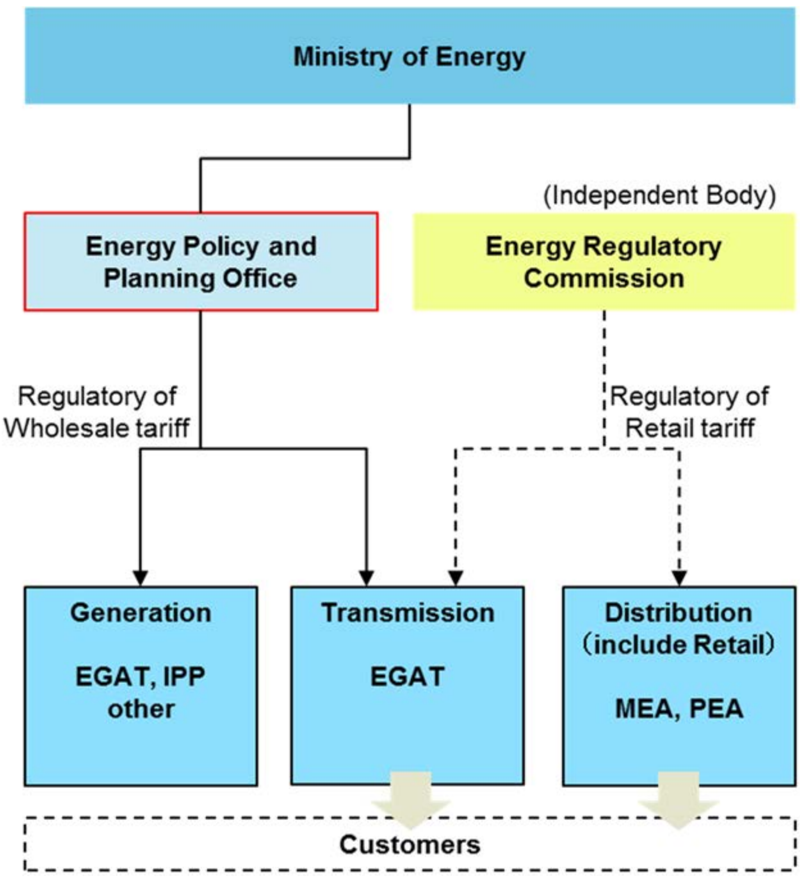


Figure 2-20 Regulatory Bodies in Thailand

Source: Prepared by "Overseas electric business Part I (the first volume) year 2014" published by Japan Electric Power Information Center, Inc.

2.3.4 Ensuring Fair Access to Transmission and Distribution Networks [52]

Although the same entity has power generation and transmission, it has maintained neutrality, including accounting separation, via the privatization of generation, the regulation of wholesale and retail prices and the promotion of functional separation. In addition, the equipment management and system operation for transmission and distribution has been promoted under the jurisdiction of the government.

2.3.5 Characteristics [53]

There are two types of regulated tariffs, retail price and wholesale price, as described above. The wholesale tariff is regulated by EPPO, and the retail tariff (MEA and PEA) is regulated by ERC. The retail tariffs of MEA and PEA have almost the same tariff structure. In addition, the wholesale price uses different tariff calculation methods for each operator.

[52] "Power Tariff Structure in Thailand", Energy Regulatory Commission
[53] "Overseas electric business Part I (the first volume) year 2014" published by Japan Electric Power Information Center, Inc.

2.3.6 Regulatory Formula [54]

The wholesale price transmitting from EGAT to MEA/PEA consists of the generation price and transmission price (pay-per-use per kWh, time zone), the connection price (capacity price per MVA/years) and a power factor fee in the case of deviation from the reference power factor. They have been determined for each receiving voltage.

If you unload from the generation entities, such as IPPs, to EGAT as a single buyer, it becomes a price system in accordance with the power generation type, trading power amount, contract period and contract contents. In addition, the price system is composed of "available capacity price" and "energy amount price", or "installed capacity price" (fixed costs, equipment costs, debt service costs)" and "energy amount price". This is determined by the bid.

In regard to the retail price, MEA and PEA have adopted the same price structure (except for part of the price menu) and this is calculated by the basic fixed costs (Base tariff) and the automatic adjustment price (Ft). This is reviewed every two years. The basic fixed costs include construction costs for power equipment such as generation, transmission and distribution; the basic fuel costs; repair costs (business reward rate of 4.8% is also considered). Although the Regulator is ERC, the final approval will be carried out at NEPC (National Energy Policy Committee).

The automatic adjustment price is a regulated tariff, introduced in order to achieve the following purposes.

- ✧ Reflect the cost of appropriate and fair electricity procurement
- ✧ Reflect different electricity prices in response to the daily time zone
- ✧ Consider the usage of low income earners and encourage efficient use

The intent of Ft is to reflect content which is difficult for companies to control, such as fuel costs and power purchase costs (purchased from IPPs, etc., including imports), in the electricity price. This is automatically reflected in the electricity price based on four months of each year (the period from May to August) and calculated in four months per unit.

The concept of the Ft calculation is as below.

[54] "Overseas electric business Part I (the first volume) year 2014" published by Japan Electric Power Information Center, Inc.

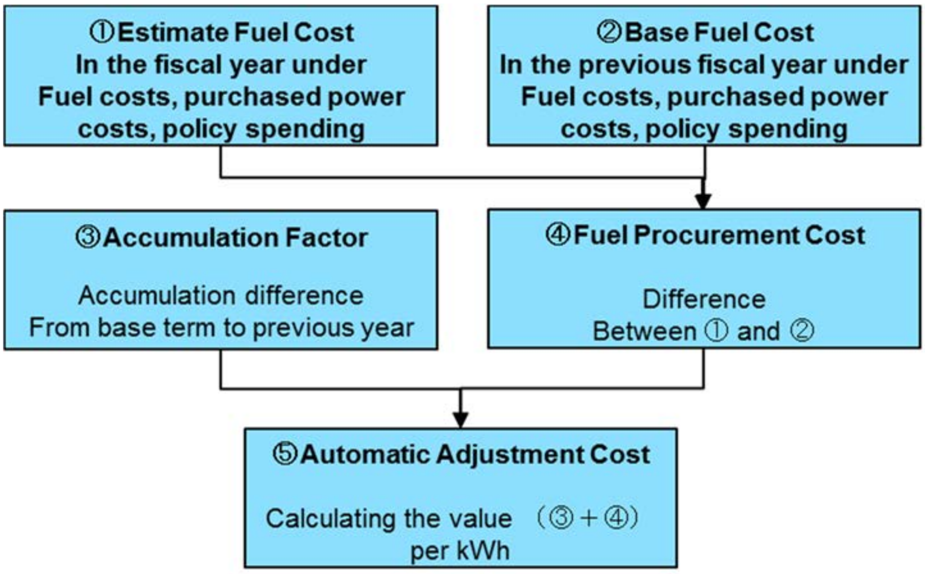


Figure 2-21 Concept of Ft calculation

Source: Prepared by "Overseas electric business Part I (the first volume) year 2014" published by Japan Electric Power Information Center, Inc.

2.3.7 Transmission Pricing [55]

In Thailand, EGAT is responsible for the power transmission business in one company. From the point of view of the price structure described above, customers eventually have to bear this via the power distribution company.

The price system changes according to the receiving voltage (230kV, 115kV, 69kV, 11-33kV), receiving point (115 / 69kV only) and usage time. There is no gap between regions.

2.4 Electric Power Industry System and Cases of Power Wheeling in the Philippines

2.4.1 Deregulations in Perspective[56]

Large-scale power shortages occurred in the 1990s, and liberalization of the power sector started by advancing legislation aimed at securing power (entry of IPPs, etc.). The regulatory bodies then promoted conditions advantageous to IPP entry to promote further private investment.

Since 2000, there have been disadvantages for the Power Authority NPC due to the liberalization of the power sector. Therefore, they have deteriorated financially as the power distribution price was suppressed by law. In response to this situation, power business reform was undertaken and the Electric Power Industry Reform Act (EPIRA) was established in June 2001.

Following this, they implemented measures aimed at liberalization such as the sale of NPC generation assets to the private sector, transferring the business rights of Transmission Corporation (TransCo), the establishment of the Wholesale Electricity Spot Market (WESM) and the introduction of open access (retail liberalization).

With the enforcement of the EPIRA, privatization of the NPS has been promoted, divided into the power generation sector, the power transmission sector, and the power distribution and retail sector. Therefore,

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55 "Overseas electric business Part I (the first volume) year 2014" published by Japan Electric Power Information Center, Inc.
56 "Overseas electric business Part I (the first volume) year 2014" published by Japan Electric Power Information Center, Inc.

with regard to the sectors other than power transmission, promotion of competition and the building of market mechanisms was expected. However, the financial clique of the Philippines (Lopez, Aboitiz, San Miguel) acquired power generation companies, distribution companies and retail companies, and the reality is that it has become an oligopoly without regulation.

2.4.2 Price control and Players

There is a regulated tariff system for power transmission, but power generation, power distribution and retail have been liberalized.

The power generation operators are NPC, 27 IPP companies (the number of Philippines IPP Association members). The IPP power generation ratio is 71.5% (2011), with IPPs being the majority.

The only power transmission operator is National Grid Corporation of the Philippines (NGCP). In addition, Transmission Corporation (TransCo), which was spun off from NPC (National Power Corporation), carries out supervision and asset management for the business.

In terms of power distribution and retail operators, there are many distribution companies, including 20 private power distribution companies such as MERALCO (Manila Electric Co.), and 110 electric cooperatives (ECs). In addition, there are 27 retailers (RESs), which are new entrants via the introduction of the open access system.

Price controls and main players are summarized as below.

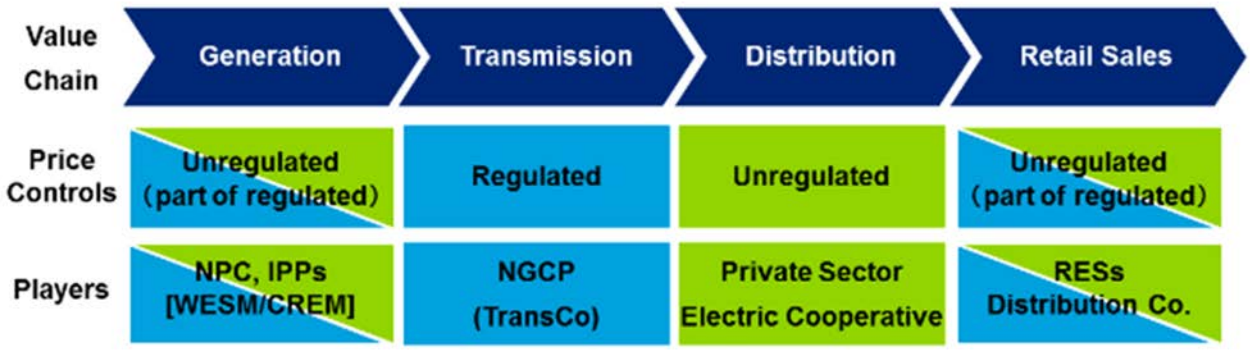


Figure 2-22 Price Controls and Players

Source: Prepared by "Overseas electric business Part I (the second volume) year 2014" published by Japan Electric Power Information Center, Inc.

2.4.3 Regulatory Bodies [57]

The regulatory bodies are the Energy Regulatory Commission (ERC) and Department of Energy (DOE). DOE is responsible for the development of long-term energy planning and the power development plan. In particular, ERC has authority over general regulation and supervision for the development of the rules stipulated by EPIRA and the promotion of competition in each department (power generation, transmission and distribution and retail).

After the EPIRA enforcement, Power Sector Assets and Liabilities Management Corporation (PSALM) was established. NRC promotes the management of the disposable assets, such as its power generation assets, the power transmission business rights and the PPA contract management, and sales and delegation

[57] "Overseas electric business Part I (the first volume) year 2014" published by Japan Electric Power Information Center, Inc.

for the private sector. They have been promoting privatization.

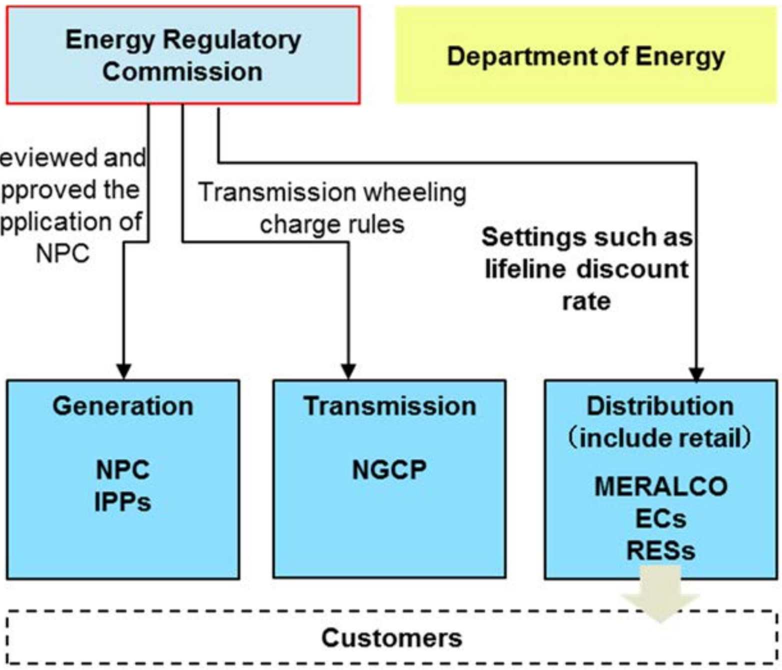


Figure 2-23 Regulatory Bodies in the Philippines

Source: Prepared by "Overseas electric business Part I (the first volume) year 2014" published by Japan Electric Power Information Center, Inc.

2.4.4 Ensuring Fair Access to Transmission and Distribution Networks [58]

By separating generation companies, transmission companies and distribution companies, functional separation and accounting separation have been realized and neutrality has been maintained.

In addition, the grid code is created by the ERC, and TransCo has a business director. This ensures neutrality from the aspect of business operations.

2.4.5 Characteristics [59]

The current transmission prices are controlled through the system of revenue cap. Limitation of income is provided in the regulatory period (five-year cycle). The maximum amount for the year is calculated based on the previous year's revenue amounts.

The first period of regulation was scheduled to end on December 31, 2004. However, it was extended until December 31, 2006, and the regulation items were supposed to be included in the extension.

2.4.6 Regulatory Formula [60]

A simplified version of the revenue cap formula is as follows:

[58] "Overseas electric business Part I (the first volume) year 2014" published by Japan Electric Power Information Center, Inc.
[59] "Rules for Setting Transmission Wheeling Rates", Energy Regulatory Commission, September 16, 2009
[60] "Rules for Setting Transmission Wheeling Rates", Energy Regulatory Commission, September 16, 2009

Maximum allowed revenue

＝(Maximum allowed revenue in previous year × {1＋Change in Weighted Index - Productivity factor})

- Correction Factor - Portion of the net income derived

Table 2-8 Elements of Revenue Cap Formula (Philippines)

Item	Description
Maximum allowed revenue in previous year	Maximum allowed revenue for Regulatory Year (Previous Year) On 1 January 2004 : PhP 24,591 million
Change in Weighted Index	Change in the weighted index in response to changes in consumption price index and the dollar exchange
Productivity factor	Factor of efficiency in the case of an extension of the first regulatory period
Correction Factor	Factor to adjust the difference between the previous year's actual income and previous maximum allowed revenue
Portion of the net income derived	Income from derivative business engaged in by the Regulated Entity or by TRANSCO (during the 12 month period on 30 Sep. in the previous Regulatory Year)

2.4.7 Transmission Price [61]

For the transmission price, it is possible to collect from system users, and customers and power producers will bear this. This price includes the transmission wheeling price, system operation price, meter reading price and ancillary service price.

The transmission wheeling price is set with a unit price for each system. This price structure composes long-term use and short-term use, Luzon-Visayas-Mindanao Region (system unit). Therefore, customers pay the price for the postage stamp method, including regional disparities.

2.5 Points to Consider before Entrance into Indonesian Wheeling Business

Summarized below are some of the points to consider before entrance into the Indonesian wheeling business from private sector players' perspectives.

[61] "Overseas electric business Part I (the first volume) year 2014" published by Japan Electric Power Information Center, Inc.

Table 2-9 Points to Consider before Entrance into Indonesian Wheeling Business (1)

Item	Description
Tariff regulation	■ Tariff formula is clearly defined through a formula with detailed explanations ■ Tariffs are set through transparent processes and there exists little room for discretion by regulatory authority ■ Profitability (WACC) assumed in tariff regulation ■ Cap and floor in revenue ■ Incentive regulations (in order to pursue upside in revenues) ■ Likelihood of volatility in revenue over longer time span
Market potential	■ Market size ■ Growth prospects
Local partner	■ Precedence of alliance termination with foreign partner without legitimate reason ■ Relationship with governments ■ Corruption, connections with anti-government and/or anti-social organizations ■ Material litigation ■ Experience in electricity sector ■ Financial conditions ■ Prospects of further reductions in costs and/or improvements in quality (such as loss and SAIDI) through know-how transfers (in the case a partner is already in the grid business)
Demand risk	■ Amount of electricity wheeled does not reach the projected level

Table 2-10 Points to Consider before Entrance into Indonesian Wheeling Business (2)

Item		Description
Operating risk	Human capital risk	■ Unable to hire employees with skills and abilities needed for operations
	Workers' risk	■ Unable to secure enough employees needed for operations due to strikes and/or turnover
	Risks of infrastructure and rapid deterioration	■ Likelihood of accidents and/or additional expenditure increases due to the unexpected rapid deterioration of infrastructure
	Interface risk	■ Interfaces with generators and retailers are poorly managed resulting in destruction of transmission and distribution operations
Supplier risk		■ Supplies of replacement components become disrupted ■ Electricity supplies from generators become disrupted
Political risk	Legal and approval risk	■ Changes in laws, tax rates and permits relating to the project etc., as well as changes in the stance of a policy maker, negatively impacting private sector operator
	Expropriation risk	■ Infrastructure or facility constructed and installed by private sector operator utilizing its own money is expropriated
	Currency non-transfer risk	■ The private sector operator experiences difficulties in business continuity as a result of the inconvertibility of local currency to its home currency, or inability to transfer funds in local currency to its home currency
	Political force majeure	■ Occurrences of wars or civil disturbances cause difficulties in business continuity

Table 2-11 Points to Consider before Entrance into Indonesian Wheeling Business (3)

Item		Description
Natural disaster risk		■ Natural disasters and other catastrophic events resulting in delay or stoppage in operations
Financial risks	Inflation risk	■ Unanticipated acceleration of inflation causes deterioration in profit
	Interest rate risk	■ Increase in borrowing costs as a result of interest rate increase causes deterioration in profit
	Currency risk	■ Unfavorable fluctuation in foreign currency causes deterioration in profit

2.6 Considerations in the introduction of Indonesian Wheeling Business Scheme

The power sector used to be vertically integrated: electric power production, power distribution, and transmission. However, in the 1970s, liberalization in the Power generation business started in the USA. Following this, the Retail sector was liberalized in developed countries to enable direct supply contracts from Generators to Retailers with power wheeling schemes. The form of retail company liberalization differs depending on the country. German retailers now number more than 1000; however, two major retail companies dominate Thailand’s distribution network, and direct supply customers from small power generators are allowed as exceptions.

However, it is necessary for all countries to design a power wheeling scheme to ensure that the power grid is used in a fair and unbiased manner. As a result, power grid operation businesses in many countries are separated from generation and retail businesses. Thailand and Japan do not have completely separate generation and retail businesses. However, they have to have separate accounting, and must treat fairly power wheeling users which are not electric utilities. This is regulated by law. The Indonesia sectors which introduce a power wheeling scheme will have to have separate accounting in each sector and might be treat fairly power wheeling users which are not electric utilities. The power wheeling cost is under the regulation of the government. This is the case for all of the countries described in this chapter. Basically, the power wheeling cost is determined to recover the costs for the power grid. However, there are various calculation methods for the power wheeling cost - for example, rate of return regulation methods and Price cap, revenue methods which can improve the efficiency and quality of the grid. Calculation methods for the power wheeling cost and rate of return, and quality bonus of the grid, have been reviewed every few years in the United States and Europe. They are very complex methods, and have been improved over a long period based on transitions in the power wheeling system. Therefore, we will suggest an easy-to-understand method for the first power wheeling system introduced in Indonesia.

Pricing methodologies can be categorized into two methods: the “Postage Stamp” method and the “Locational” method.

The Locational method refers to a method that varies the transmission price depending on the location of loads and/or generators. Furthermore, it takes into consideration the extent of use of the network by a particular transaction. Norway, the United Kingdom, half of Australia and the United States have adopted the Locational method.

The Postage Stamp method refers to a pricing scheme based on average costs for the power system. The Postage Stamp method has advantages, such as simplicity and ease of political consensus among stakeholders. Germany, half of Australia, Japan and Morocco have adopted the Postage Stamp method.

Because of simplicity and clarity in pricing, the JICA survey team recommends the Postage Stamp method as the initial pricing method to be introduced. In future, the usage of the power wheeling system must be reviewed to consider the appropriate method at that time.

Chapter 3 Power Sector in Indonesia

3.1 Current Power Sector

The law for electricity currently enforced in Indonesia is “Law of the Republic of Indonesia Number 30 of 2009 concerning Electricity”, the so-called “New Electricity Law”. Under the law, government ordinances and ministerial ordinances specify detailed rules for power supply licenses and permissions regarding electricity businesses.

The regulations of the law directly related to power wheeling are designed (i) to allow private companies to participate in power generation, transmission, distribution and power selling businesses, (ii) to force “electric power sales business with and/or without power distribution”, to obtain the determination of their business areas (Wilayah Usaha) from the government and (iii) to let the central government and regional governments approve the electrical grid rent prices.

The following figure shows the configuration of the “New Electricity Law”.

(Institutional Roles of Power sector)

Definition of Power Supply Business
- Public power supply business
- Captive power supply business.
- Power generation;
- Power transmission;
- Power distribution;
- and/or power sales.

Roles of the State and the Government
- The State: Controlling electric power supplies
- The Competent Government and Regional Governments: policies, regulation, and supervision

Participants for Power Supply Businesses
- state-owned entities
- region-owned entities
- private entities
- cooperatives
- self-reliant communities

PLN
- Receives first priority to conduct public power supply business.

(Permits and Licenses of Power Supply Business)

Public Power Supply Business
- Power Supply License (IUPTL)

Power Distribution and/or Power Sales
- Determination of Business Area (Wilayah Usaha) by Government (1 (one) entity within 1 (one) business area)

(Setting/Approval of Electric Power Prices/Tariffs)

Power Sales Prices and Electrical Grid Rent Prices
- Approval by the competent government or regional government

Consumer power tariffs
- Government sets power tariffs upon consent of the House of Representatives

Figure 3-1 Configuration of “New Electricity Law”

The "New Electricity Law" is outlined as follows.

1. Power supply business includes public power supply business and captive power supply business. Public power supply business includes power generation, power transmission, power distribution and/or power sales.
2. Power supplies shall be under the control of the state. The competent Government and regional governments shall establish policies, regulations, and supervision of power supply business.
3. Private entities, cooperatives, and self-reliant communities may participate in power supply business.
4. Any person engaging in public power supply must hold a power supply license (IUPTL)
5. Power supply license holders must receive determination of their business area (Wilayah Usaha) to perform power distribution and/or power sales business. Public power supply business shall be conducted by 1 (one) entity within 1 (one) business area.
6. State-owned entities (indicating PLN) shall receive first priority to conduct public power supply business. PLN is deemed to have held a power supply license.
7. The competent Government or regional governments shall give approval for power sales prices and electrical grid rent prices. The Government shall set power tariffs for said regions upon consent of the House of Representatives. Any region within one business area may vary in consumer power tariffs.
8. General electricity plan shall be prepared under the national energy policy upon consultation with the House of Representatives. Regional general electricity plan shall be prepared under the national general electricity plan upon consultation with the Regional House of Representatives.

The power sector in Indonesia is regulated and supervised by the Ministry of Mineral Resources (MEMR). There are other governmental organizations related to the power sector, such as the Ministry of State Owned Enterprises (MSOE), which manages PLN and owns its stock; the National Energy Council (DEN), which establishes the energy policy and plans and coordinates this; and the National Nuclear Energy Agency (BATAN), which is in charge of research and development for nuclear energy.

The power generation businesses are carried out by PLN, IPP or PLN's subsidiary companies. PLN and PLN's subsidiary companies share 77% of the total generation capacity. 20% is shared by IPPs and the remaining capacity comes from rental generators. In particular, for the Java-Bali system, 82% is shared by PLN or PLN's subsidiary companies. PLN is a state-owned company and its stock is 100% owned by the government. The power sector is regulated and supervised by MEMR. PLN organizes its business units and holds the stock of subsidiary companies that carry out power generation business or power generation with power transmission and distribution business in the specified areas. The following figure shows the scheme of the power sector in Indonesia and PLN's organization.

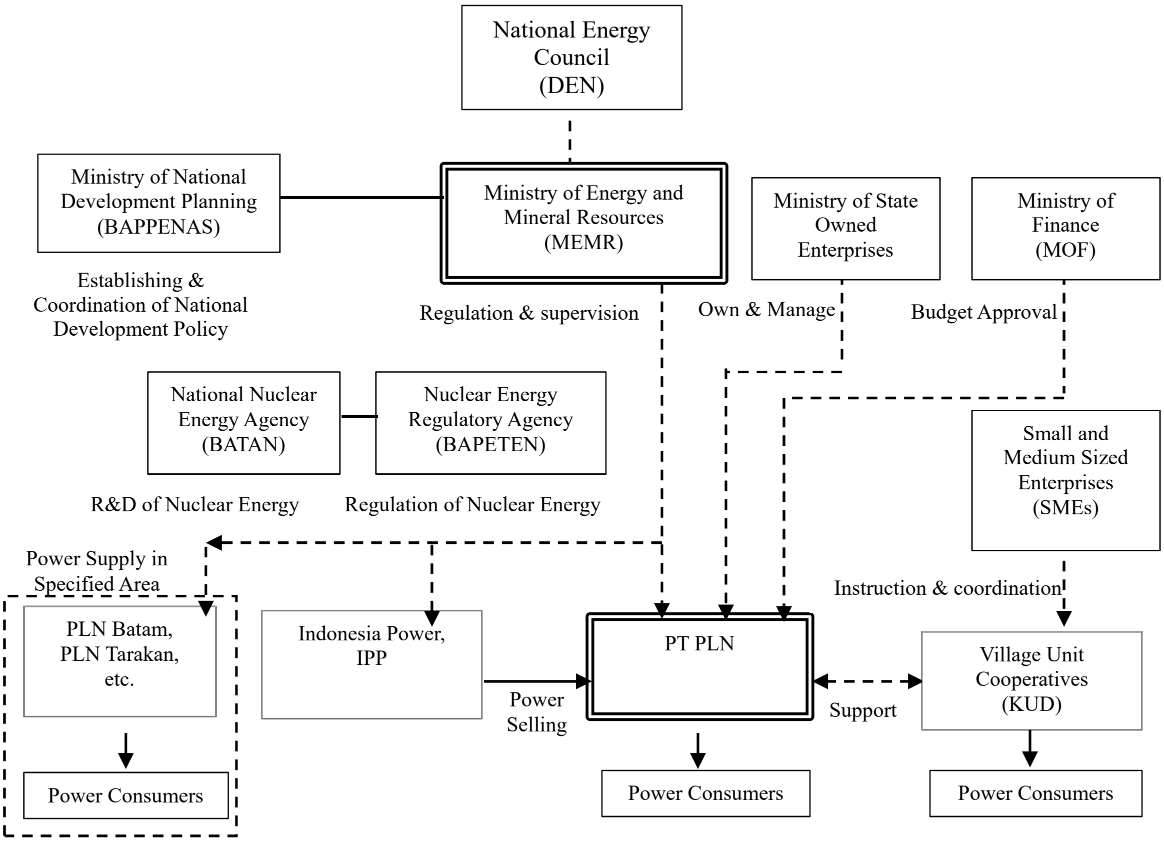


Figure 3-2 Scheme of Power Sector in Indonesia

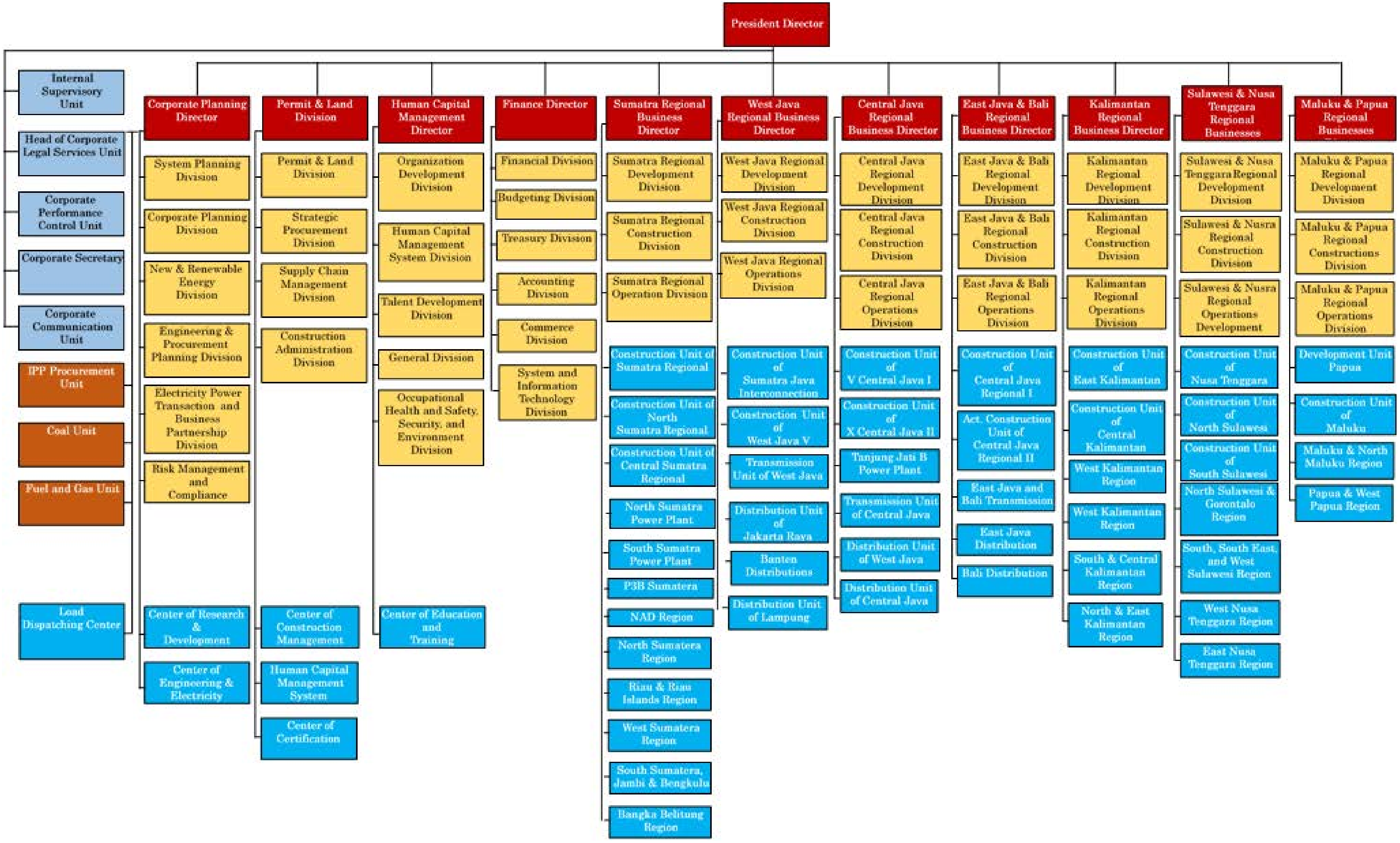


Figure 3-3 Organization of PLN

The following figure shows the structure of the electricity buying and selling business in Indonesia. A company selling electricity obtains determination of its business area (Wilayah Usaha) from the government according to the electricity law. Almost all the power consumers purchase electricity from PLN and belong to PLN's business areas. PLN has its own power stations and also buys electricity from PLN's subsidiary companies and IPPs. Some power consumers purchase electricity from other companies who obtain their own business areas (companies colored in green). Currently, companies other than PLN who obtain their own business areas own and operate their power stations and the distribution system used to supply electric power to their business areas.

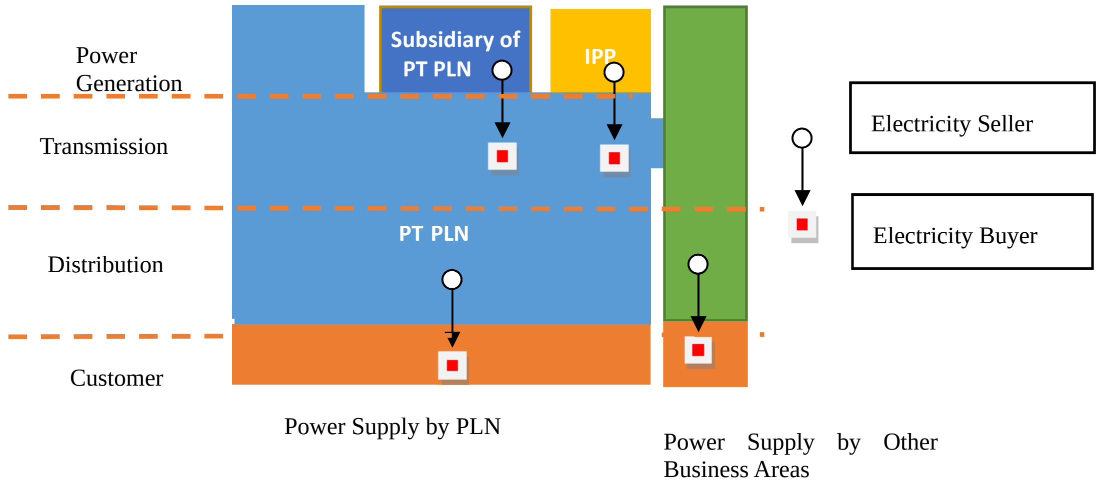


Figure 3-4 Power Supply Structure in Indonesia

3.2 Legal Basis for Power Wheeling in Indonesia

Electric power business in Indonesia has been conducted for a long time based on the "Law No. 15/1985 on Electricity" as the fundamental law. The implementation of decentralization has, however, been started based on "Law No. 22/1999 on Local Governing" and "Law No. 25/1999 on Financial Balance between Central and Local Government", and this has led to a high requirement for clarification of the division of the roles played by the central and local governments in the electric power sector by incorporating the concept of decentralization. In order to deal with such environmental changes, "Law No. 30/ 2009 on Electricity" was issued as a new electricity law, which can accommodate the issue of decentralization, and this is the existing electricity law. This electricity law (articles 8, 9 and 10) defines the whole structure of the electric power business as follows:

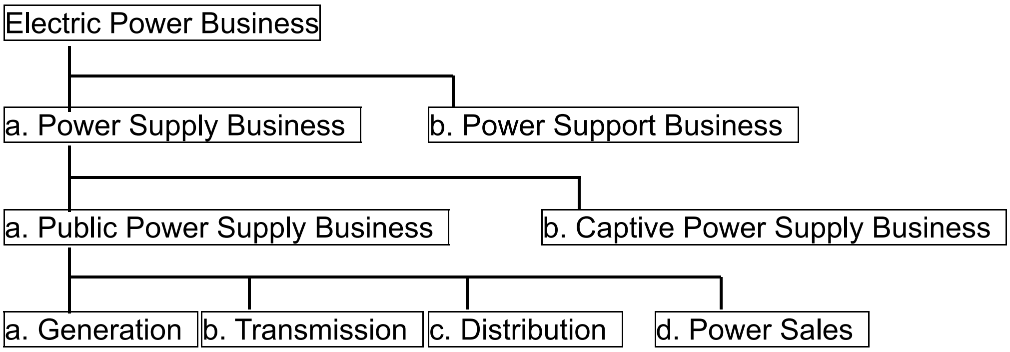


Figure 3-5 Structure of Electric Power Business in Law No. 30/2009

Key terms used in the electricity law are defined in article 1 as follows:

Table 3-1 Key terms of the electricity law

・Power supply business	: power procurement through generation, transmission, distribution, and sale to consumers
・Consumers	: any person or entity that purchases power from power supply license holders
・Electric power sales Business	: any activity through which to sell power to consumers
・ Power Supply Business License (*IUPTL*)	: a license to conduct public power supply business
・Operating license (*IO*)	: a license under which to provide captive power supplies
・Business area (*Wilayah Usaha*)	: an area the Government determines as a place at which power supply business is conducted by power distributing and/or selling entities.

There is no description of "Power Wheeling" in any articles in "Law No. 15/1985 on Electricity", while the existing electricity law, "Law No. 30/2009 on Electricity", mentions "Power wheeling" with the term "lease of electricity network". In addition to the law, "Government Regulation No. 14/2012 on Power Supply Business Activities" and "Ministerial Regulation of Ministry of Energy and Mineral Resources No. 1/2005 on Power Supply Cooperation and Joint Utilization of Transmission Network", which are further provisions under the electricity law, stipulate basic provisions on "Power wheeling" including authority to give licenses, prices, requirements for applicants and procedures for licenses. These regulations provide the legal basis for the power wheeling scheme in Indonesia. Figure 3.2.1 shows the major laws and regulations related to the electric power business.

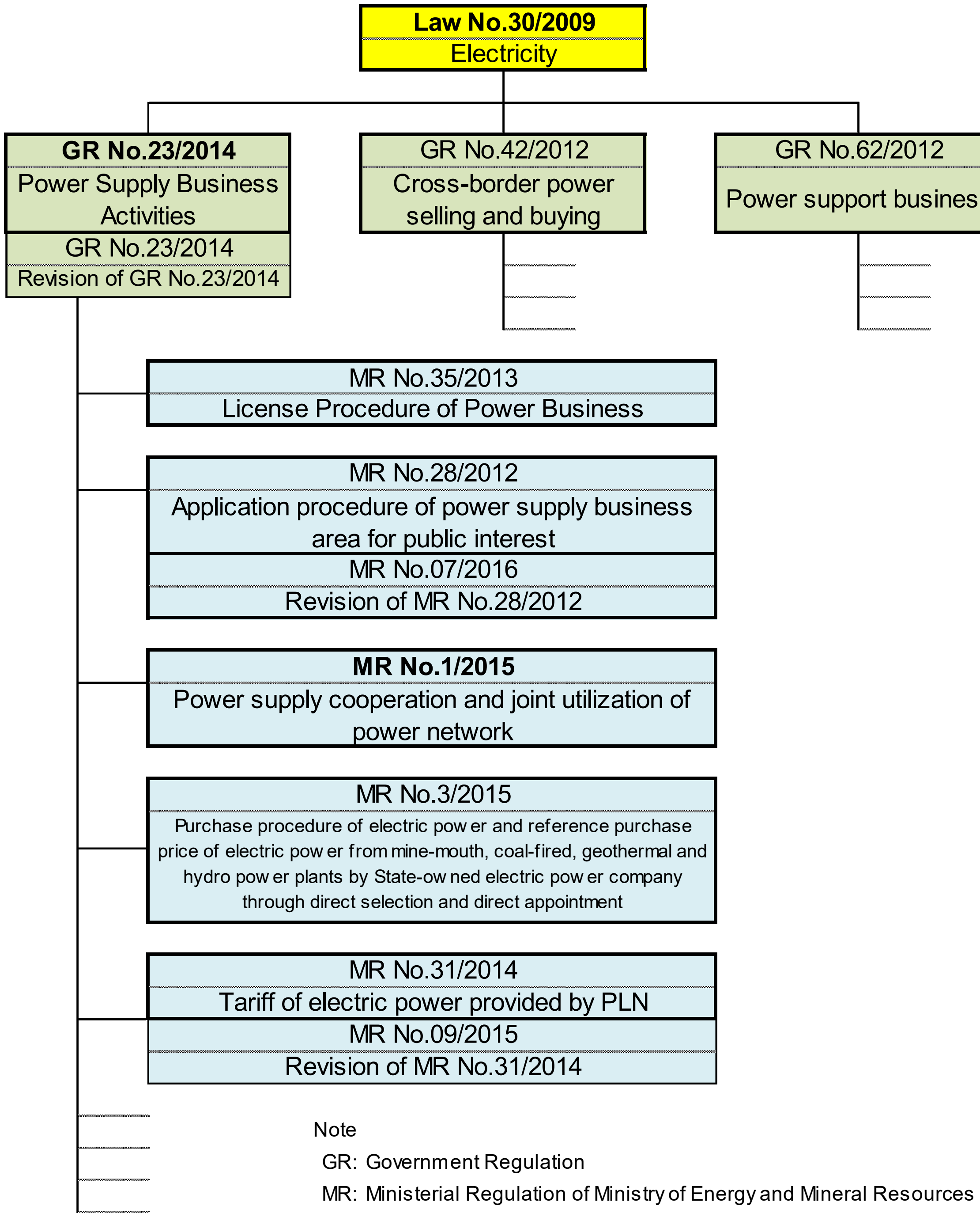


Figure 3-6 Laws and Regulations concerning Electric Power Business

(1) Provisions on "Power Wheeling" in "Law No. 30/2009 on Electricity"

The existing electricity law (law No. 30/2009) provides that state-owned entities (PLN) shall receive first priority to conduct public power supply business, while private entities, cooperatives, and self-reliant communities may participate in power supply business, and power grids may be leased to power supply business license holders. Under the current legal framework, private entities' participation in any field of the power supply business is ensured.

In the existing law, there are no clear definitions or detailed provisions concerning the power wheeling scheme, but Article 5 refers to the authority of the government for lease of power networks and the price for lease of power networks, and Article 33 provides the price for lease of electric power as follows:

Article 33

(1) Power sales prices and lease prices for power network shall be set under the principle of sound business.
(2) The competent Government or regional governments shall give approval for power sales prices and lease prices for power network.
(3) Power supply license holders are prohibited to apply power sales prices and lease prices for power network without agreement of the Government or the regional

Figure 3-7 Law No. 30/2009 Article 33

Table 3-2 shows an outline of the provisions in the articles in Law No. 30/2009 relevant to "power wheeling".

Table 3-2 Major Provisions in "Law No. 30/2009 on Electricity" (the existing electricity law)

Article	Outline of Provisions
Article 2	▪ Principles and purpose
Article 3	▪ Responsibilities in Power Supply Businesses (Central Government & Local Government)
Article 5	▪ Authority of government in utility business (Policy development, regulation/guideline development, RUKN development, approval, etc.) ▪ Authority of state government in utility business (Local policy development, local RUKN development, approval, etc.)
Article 7	▪ Methodology/process of General Electricity Plan development
Article 8	▪ Structure of power business (power supply business and power support business)
Article 9	▪ Structure of power supply business (public and captive)
Article 10	▪ Structure of public power supply business (power generation, transmission, distribution and power sales) ▪ Restriction of business area (only one entity in one business area) ▪ Determination of business areas by the government
Article 11	▪ Entities who conduct public power supply business (state-owned entities, region-owned entities, private entities, cooperatives, and self-reliant communities engaged in the field of power supplies) ▪ Giving first priority to State-owned entities (PLN) to conduct public power supply business
Article 19	▪ Structure of licenses for power supply (license for power supply business and operating license (captive power)) ▪ Any person engaging in public power supply must hold a power supply license
Article 28	▪ Obligation of power supply business entities (power quality, reliability, compliance with safety requirements, priority use of national products)
Article 33	▪ Principles for setting power sales prices and lease prices for power network ▪ Authority of government in approval of power sales prices and lease prices for power network
Article 34	▪ Setting of Power tariff

(2) Provisions on “Power Wheeling” in “Government Regulation No. 14/ 2012”

“Government Regulation No. 14/2012” established in January 2012 is the most important government regulation among those that mention further provisions under “Law No. 30/2009 on Electricity”, and has provisions on the overall power supply business activities. For the power wheeling scheme, the Government Regulation provides that the power transmission business shall open up opportunities for the joint utilization of transmission. Obligation to open up utilization opportunities along the transmission lines is done through a network lease between power supply business license holders who perform transmission business with the party that would utilize the transmission network.

Table 3-3 shows an outline of the provisions in the articles of this government regulation relevant to “power wheeling”.

Table 3-3 Major Provisions in “Government Regulation No. 14/2012 on Power Supply Business Activities” (1)

Article	Outline of Provisions
Chapter I	General Provisions
Chapter II	Power Supply Business
Part One	General
Article 2	・ Structure of Power Supply Business (Public and Private)
Part Two	Public Power Supply Business
Paragraph 1	General
Article 3	・ Structure of public power supply business (power generation, transmission, distribution and power sales) ・ Integrated power supply business
Article 4	・ Obligation as transmission business to open opportunities for joint utilization of transmission network in public interest ・ Joint utilization of transmission network through lease of network between power supply business license holders ・ Joint utilization of transmission network implemented in accordance with the capacity of the transmission network ・ Price for transmission network lease approved by the Minister, Governor or Regent/Mayor
Article 5	・ Provisions on joint utilization of distribution network (almost the same as Article 4 (transmission network))
Article 7	・ Restriction of distribution, power sales and integrated power supply business (only one entity in one business area)
Article 9	・ Definitions of business entities referred to in Article 7 (state-owned enterprises, locally-owned enterprises, private enterprises incorporated in Indonesia, cooperatives, and self-help communities) ・ Giving first priority to State-owned entities (PLN) to conduct public power supply business
Paragraph 2	Power Supply Business License
Article 10	・ Obligation as power supply business to obtain power supply business license (*IUPTL*) ・ Authority of government in giving power supply business license (*IUPTL*) (the Minister, Governor or Regent/Mayor)

Table 3-4 Major Provisions in "Government Regulation No. 14/2012 on Power Supply Business Activities" (2)

Article	Outline of Provisions
Article 12	・ No need to obtain a new power supply license (*IUPTL*) for power selling or power network leasing between power supply business license (*IUPTL*) holders ・ Authority of government in approval of power sales prices and lease prices for power network
Article 13	・ Requirements for application of power supply business license (*IUPTL*) ・ Additional requirements for application of power supply business license (*IUPTL*) for transmission or distribution business (need for power network lease agreement between prospective applicants who utilize the transmission network or distribution network) ・ Additional requirements for application of power supply business license (*IUPTL*) for distribution business, power sales business and integrated power supply business (need for having business area (*Wilayah Usaha*) designated by the Minister and Power Supply Business Plan)
Article 19	・ Application procedure for power supply business license (*IUPTL*) for distribution business, power sales business and integrated power supply business (need for having business area (*Wilayah Usaha*)) ・ Procedure for obtaining business area (*Wilayah Usaha*) (need for recommendation from the Governor or Regent/Mayor)
Article 24	・ Allowed Power Supply Business conducted by power supply business license (*IUPTL*) holders (power purchase, lease of power network and interconnection of power networks) ・ Cross-country interconnection of power networks should be conducted based on the permit from the Ministry
Article 25	・ Power purchase and/or lease of power network by power supply business license (*IUPTL*) holders with other power supply business license (*IUPTL*) holders should be conducted based on the power supply business plan (*RUPTL*) ・ Procedure for purchase of power and others
Part Three	Power Supply Business for Self Interest
Chapter III	Land Use
Chapter IV	Power Sales Price, Lease of Power Network and Electricity Tariff
Part One	Power Sales Price and Lease of Power Network
Article 39	・ Authority of government in approval of power sales prices and lease prices for power network (the Minister, Governor or Regent/Mayor)
Article 40	・ Currency of Power Sales Price and Lease of Power Network
Part Two	Electricity Tariff
Article 41	・ Setting of Electricity Tariff
Chapter 5	Engineering
Chapter 6	Guidance and Supervision
Chapter 7	Administrative Sanctions
Chapter 8	Closing Provisions

In April 2014, Government Regulation No. 23/2014 was issued to revise part (Article 8 and Article 26) of Government Regulation No. 14/2012. However, all the articles of this regulation related to the lease of power networks were unchanged.

(3) Provisions on "Power Wheeling" in "Ministerial Regulation of Ministry of Energy and Mineral Resources No. 1/ 2015"

In January 2015, the Ministry of Energy and Mineral Resources formally stipulated the adoption of "Power Wheeling" by partial-opening of the transmission and distribution networks supposed as high-voltage power demand ("Ministerial Regulation of Ministry of Energy and Mineral Resources No. 1/ 2015 on Cooperation of Power Supply and Joint Utilization of Power Network"). However, in this Ministerial Regulation, there are no provisions concerning the formula for computation of the "wheeling charge", detailed requirements for obtaining a license for power wheeling business, and/or detailed technical requirements or negotiation procedures for interconnection with PLN's grid.

In this Ministerial Regulation, the articles from Article 4 to Article 7 mention provisions on the joint utilization of power networks, and the articles from Article 8 to Article 11 mention provisions on joint utilization of distribution networks.

Table 3-3 shows an outline of the provisions in the articles of this government regulation relevant to "power wheeling".

Table 3-5 Major Provisions in "Ministerial Regulation of Ministry of Energy and Mineral Resources No. 1/2015" relevant to Power Wheeling (1)

Article	Outline of Provisions
Article 4	(1) Power Transmission Business can be conducted by the Power transmission entity as follows: a. Power supply business license (*IUPTL*) holders in the power transmission sector, or b. Integrated power supply business license (*IUPTL*) holders having power transmission networks. (2) Power Transmission Business as referred to in Clause (1) is not restricted by business areas (*Wilayah Usaha*).
Article 5	(1) Power Transmission Business as referred to in Article 4 should open an opportunity for joint utilization of power transmission networks. (2) Joint utilization of transmission network as referred to in Clause (1) should be conducted in accordance with the ability of the capacity of the power transmission network and Grid Code. (3) In an area where a Grid Code has not yet been established, joint utilization of power transmission network as referred to in Clause (1) should refer to the Grid Code agreed mutually. (4) Management of system operation in the joint utilization of power transmission should be done by the system operator that operates the largest system in the local system. (5) Other technical agreements that have not yet been set out in the Grid Code should be set out in the joint agreement and, as a part of the joint agreement, must not be separated from the lease agreement of power transmission. (6) Lease price of power transmission network should follow the lease price that is applied in Transmission Business Entity as referred to in Article 4 as a lease provider of power transmission network that has already obtained an agreement from the Minister or Governor in accordance with the authority. (7) Joint utilization of power transmission network as referred to in Clause (1) does not require a new power supply business license (*IUPTL*).

Table 3-6 Major Provisions in "Ministerial Regulation of Ministry of Energy and Mineral Resources No. 1/2015" relevant to Power Wheeling (2)

Article	Outline of Provisions
Article 6	(1) Power supply business license (*IUPTL*) holders in power generation sector, Power supply business license (*IUPTL*) holders having a business area (*Wilayah Usaha*) and operation license (*IO*) holders can utilize power transmission network owned by transmission business entity as referred to in Article 4. (2) To utilize power transmission network, license holders as referred to in Clause (1) should submit proposal to transmission business entity as referred to in Article 4. (3) Proposal as referred to in Clause (2) should come with: a. Power supply business license (*IUPTL*) or operation license (*IO*) b. Utilization plan for power transmission network including: 1. Location and length of network; 2. Type and capacity of power plant; 3. Period; 4. Consumer characteristics; and 5. Power quality. (4) In the case that the above-mentioned proposal is submitted to transmission business entity as referred to in Article 4, and the permit is obtained from the Minister, the applicant should convey a copy of the application to the Director General. (5) Transmission business entity as referred to in Article 4 gives approval or rejection for the application as referred to in Clause (2) within 5 (five) working days after the application has been received completely and properly. (6) Transmission business entity as referred to in Article 4 should conduct negotiations related to the joint utilization of power transmission network with the user candidate of power transmission network that has already obtained the approval as referred to in Clause (5), within 30 (thirty) working days after the approval. (7) In the case that transmission business entity as referred to in Article 4 gives rejection, written reasons should be attached. (8) Transmission business entity should submit its approval of lease price in accordance with the results of negotiations to the Minister or the Governor in accordance with the authority to get approval. (9) The Minister or the Governor in accordance with the authority should give approval or rejection for the proposal of lease price for the power transmission network within 30 (thirty) working days after the proposal is submitted by Transmission business entity as referred to in Clause (8). (10) In the case that the Minister or the Governor rejects the proposal of network lease price, the transmission business entity should conduct renegotiation.
Article 7	Transmission business entity should sign lease contract of transmission network with the party who will utilize the transmission network after getting the approval of lease price for transmission network from the Minister or the Governor in accordance with the authority.

3.3 Necessary Government Approval and Business Rights for Electricity Supply Business Using Power Wheeling Scheme

All electricity supply business entities must acquire an electricity supply business license, an IUPTL, from the local government or MEMR, as MEMR's regulation stipulates. Furthermore, if the electricity supply business entity distributes electricity to public customers, the entity must be approved by MEMR to supply electricity to a particular business area, termed a Wilayah Usaha. The current Indonesian Law No. 30/2009 on Electricity stipulates that each Wilayah Usaha can be supplied by only one approved business entity, to avoid redundant investment in electricity facilities. Most business areas now belong to PLN with some exceptions. Based on this business area ownership situation, if a new business entity developing a new industrial zone newly acquires a business zone, the business zone approval can only be obtained in the following circumstances: the business area is not appointed to anybody, even PLN; it is not able to be supplied by the current owner; or it can be transferred from the current owner. Thus, if the business area is already appointed to PLN, the new electricity distribution business entity must negotiate with PLN to transfer its business area to the company, and then acquire the local government's consent so that MEMR can issue a new business area to the company.

As discussed above, each power selling business entity using the power wheeling scheme must hold an IUPTL license and business area, and it must follow all application procedures for the power wheeling scheme described in the previous section.

Further, it may also be the case that a business which has a license for private power generation receives the power at a place different from the power generation place, using power wheeling.

3.3.1 License for Electricity Supply Business (IUPTL)

The license for electricity supply business (IUPTL: Izin Usaha Penynyediaan Tenega Listrik) is defined as a "license for electricity supply business for public customers" in the current Law No. 30/2009 on Electricity. All utility business entities for generation, transmission, and distribution for public customers are obliged to obtain this license by law. The right to licensing belongs to one of 1) MEMR, in the case that the supply area covers more than two regional government areas or government business entities, 2) regional government, in the case that the supply area covers more than two local government areas, or 3) local government, in the case that the supply area is within a single local government's area. IUPTL holders are responsible for the following requirements:

a. Electricity supply of sufficient quality and reliability to satisfy corresponding technical standards

b. Best supply service for customers and residents

c. Conformity with all relevant safety laws, and

d. Prioritization of usage of domestic products and the enhancement of domestic business.

The details of the application process are defined in the Provisions on "Power Wheeling" in "Government Regulation No. 14/2012" and MEMR's regulation "MR 2013/35". Under these regulations and stipulated procedures, PLN is also to be treated as an IUPTL license holder among other IPPs and electricity supply business entities. However, the law 2009/No. 30 prioritizes PLN as a government business entity in electricity supply business, and PLN follows a particular business strategy that is different from other business entities.

3.3.2 Business Area for Electricity Supply (Wilayah Usaha)

The law 2009/No. 30 defines a Business area for electricity supply (Wilayah Usaha) as 'an area defined by the government to permit a single IUPTL license holder to distribute and/or to retail electricity within the designated area'. This law allows a monopoly in business areas, and only a Minister of MEMR can award a business area. The current procedure of Wilayah Usaha acquisition favors PLN, which already owns most of the business areas, by letting PLN decide if they're willing to supply in the area in terms of their business prospects.

Along with the application procedures, this business area for electricity supply is further defined in MEMR's regulation MR 2012/no. 28, as follows.

- Business area (Wilayah Usaha) is an area where distributors and/or electricity retailers carry out their business, and is defined by the minister of MEMR
- One business area shall be appointed to a single business entity
- The owner of the business area shall develop a reliable distribution network of sufficient quality to supply reliable and good-quality electricity to its customers.

In order to start a new application for a business area, an application document with the following information must be submitted to MEMR for the attention of the minister.

a. Identity of the applicant;
b. Legalization of business entity from the competent authority;
c. The applicant's profile;
d. Taxpayer identification number (TIN);
e. Funding ability;
f. Business area border and location map equipped with coordinate points;
g. Analysis of requirements and plans of electric power provision business in the business area proposed; and
h. Recommendation of the governor in the event that the business area as requested is cross – regency/city.

Recommendation of the regent/mayor in the event that the business area as requested is in the regency/city area.

Figure 3-8 Necessary Information for New Business Area Application

This application initiates MEMR's internal evaluation process. Since most newly-applied for business areas are owned by PLN, MEMR makes decisions on the proposed new business area based on the following criteria mentioned in Article 3 of MEMR's regulation MR 2012/no. 28.

(1) The business area as referred to in paragraph (1) may be determined in the event that:
  a. Such area has not been reached by the existing business area holder;
  b. The existing holder of business area is incapable of providing the electric power or electric power distribution network with good quality and reliability; or
  c. The existing holder of business area returns in part or in whole the business area to the Minister.

Figure 3-9 Evaluation Criteria for New Business Area Application

In March 2016, MEMR issued MR No.07/2016 as a partial revision of MR No. 2012/28. In the revised ministerial regulation, the following articles are added.

Article 4A

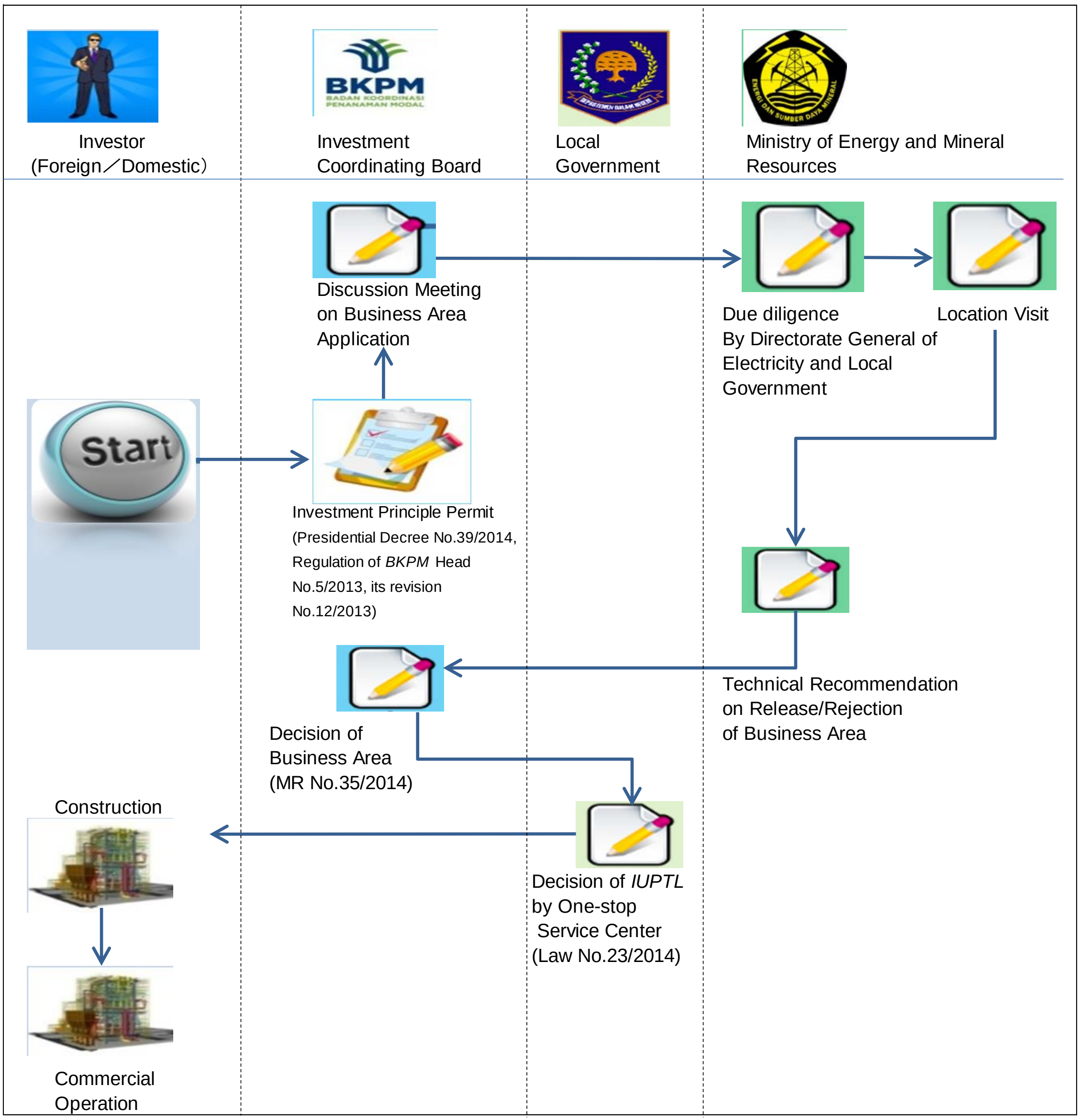
(1) In the determination of Business Area as referred to in Article 3 clause (2), Director-General on behalf of the Minister may assign a technical team to assess the technical feasibility of the determination of Business Area.

(2) Assessment of technical feasibility determination Business Areas referred to in clause (1) shall be recorded in the determination of the technical evaluation report of Business Area.

(3) Report on the results of the technical evaluation for determination of Business Areas referred to in clause (2) shall be in the form of recommendations submitted to the Minister c.q. Director General.

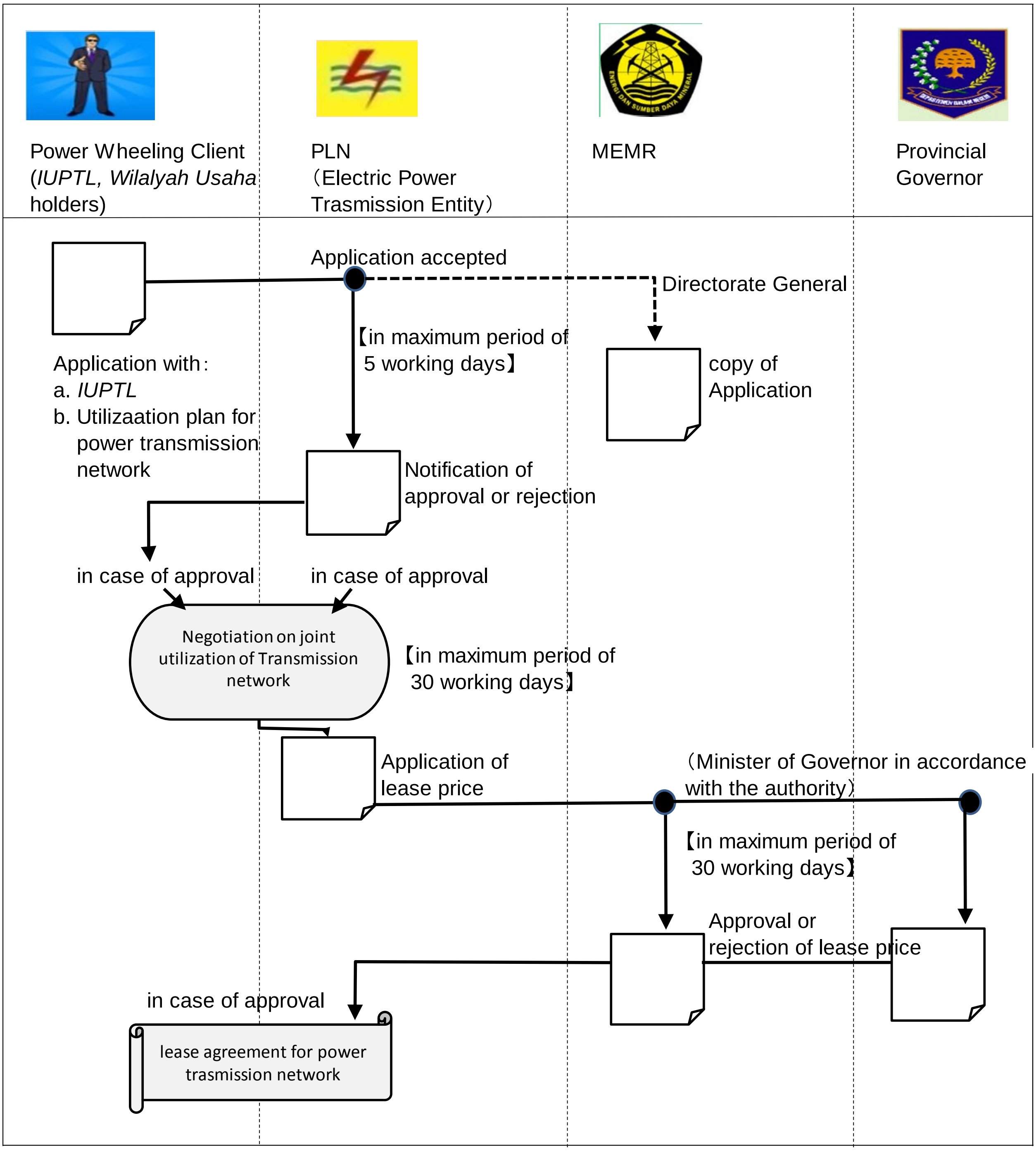
Figure 3-10 Partial revision of MR No. 2012/28

This article makes it clear that the determination of Business Area is assessed by a technical team established in the Directorate General of Electricity, in MEMR. According to MEMR, this technical team commonly consists of five people, who assess the technical feasibility based on their internal criteria. According to the Investment Coordinating Board (*BKPM*), in the new procedure of the determination of Business Area based the revised regulation, MEMR can subjectively make a determination of Business Area without asking PLN for feedback, as shown below.



Sources: JICA Project Team prepared based on *BKPM* material

Figure 3-11 New Procedure for Business Area Determination



Application Procedure for Joint Utilization of Transmission Network
in accodance with MR No.1/2015

Figure 3-12 Duration for Business Area Determination

The following map shows business entities other than PLN that own their business areas, and the chart summarizes each industrial zone with its business area.

Figure 3-13 Business Areas Not Owned by PLN

Table 3-7 Business Areas of Other Business Entities Operating (1)

No.	Name of Business entity	Details of business area			Capacity (MW)	Planned	
		Operation Date	Province	Area (ha)		MW	Year
1	PT Tatajabar Sejahtera	26/12/2012	Jawa Barat	2.3	42	-	-
2	PT Kariangau Power	2/9/2008	Kalimantan Timur	1.989,54	30	-	-
3	PT Cikarang Listrindo	9/12/2003	Jawa Barat		600	-	-
4	PT Bekasi Power	7/6/2010	Jawa Barat	460	120	400	2017
5	PT Krakatau Daya Listrik	9/5/2014	Banten	4.757,50	400	120	2015
6	PT PLN Batam	29/11/2012	Kepulauan Riau		380	70 85 40 50 130	2015 2015 2015 2016 2018

Table 3-8 Business Areas of Other Business Entities Operating (2)

No.	Name of Business entity	Details of business area			Capacity (MW)	Planned	
		Operation Date	Province	Area (ha)		MW	Year
7	PT Makmur Sejahtera Wisesa	18/3/2013	Kalimantan Selatan	4.786	60	-	-
8	PT PLN Tarakan	1/5/2013	Kalimantan Utara	250,80	58	10 20	2015 2017
9	PT Batamindo Investment Cakrawala	16/5/2013	Kepulauan Riau	320	175	-	-
10	PT Dian Swastatika Sentosa - Serang Mill	1/8/2013	Banten	524,8	190	-	-
11	PT Dian Swastatika Sentosa - Tangerang Mill	23/10/2013	Banten	28,1	19	-	-
12	PT Tunas Energi	20/12/2013	Kepulauan Riau	64	16	-	-
13	PT Panbil Utilitas Sentosa	14/2/2014	Kepulauan Riau	173,8	38	-	-
14	PT Krakatau Posco Energy	25/3/2014	Banten	388	200	-	-
TOTAL Capacity					**2.328**	**925**	

Table 3-9 Business Area Owners not yet Operating (as of Nov. 27 2015)

No.	Name of Business entity	Business area			Planned on-site capacity	
		Date	Province	Area (ha)	MW	Year
1	PT Mabar Elektrindo	9/6/2014	Sumatera Utara	693	300	2017
2	PT United Power	13/10/2014	Jawa Tengah	2.7	300 300	2019 2020
3	PT Soma Daya Utama	20/10/2014	Kepulauan Riau	4.327,7	60	2017
4	PT Karimun Power Plant	31/10/2014	Kepulauan Riau	7326,6	40	2017
5	PTPN III	31/10/2014	Sumatera Utara	1.933,8	7 2,1 50	2014 2016 2019
6	PT Sumber Alam Sekurau	14/11/2014	Kalimantan Utara	361	7,5 7,5 15	2015 2016 2017
7	PT Bakrie Power	26/11/2014	Kalimantan Timur	943,8	200	2017
TOTAL Capacity					**1.289,1**	

Table 3-10 Public Entities with Business Areas for Electricity Service (as of Nov. 27 2015)

NO.	Company Name	Certificate
1	PT Dwi Maharani-Nadi Kuasa Bersekutu SDN. BHD. Joint Venture	Telah terbit Keputusan Kepala BKPM No. 1/1/PWUPTL/2015 Tanggal 29 Januari 2015
2	PT Energia Prima Nusantara	Telah terbit Keputusan Kepala BKPM No. 2/1/PWUPTL/2015 Tanggal 31 Juli 2015
3	PT Wijaya Triutama Plywood Industri	Telah terbit Keputusan Kepala BKPM No. 3/1/PWUPTL/2015 Tanggal 29 September 2015
4	PT Natrustparadigma Listrik Mandiri (Napalima)	Telah terbit Keputusan Kepala BKPM No. ../1/PWUPTL/2015 Tanggal ….. 2015

3.4 Examples of Alternatives to Power Wheeling

Under the current electricity law, the case is considered as utilizing power wheeling when "distribution and/or power selling" businesses who are designated to have their own business area (Wilayah Usaha) purchase electricity from power stations located far away through power transmission and distribution lines owned by other companies. Because the companies who are designated to have their own business area also own their power distribution facilities, the electricity is received at the substation at the entrance to the distribution systems when the company purchases the power from other companies. Currently, because the power transmission grid is monopolized by PLN, the power wheeling is carried out by PLN and the power from generation companies is transferred to power selling companies.

The following figure shows the power wheeling scheme currently considered.

There is also another way that businesses who have a license for private power generation can receive the power at a place different from the power generation place, using power wheeling, which is not described in this chart.

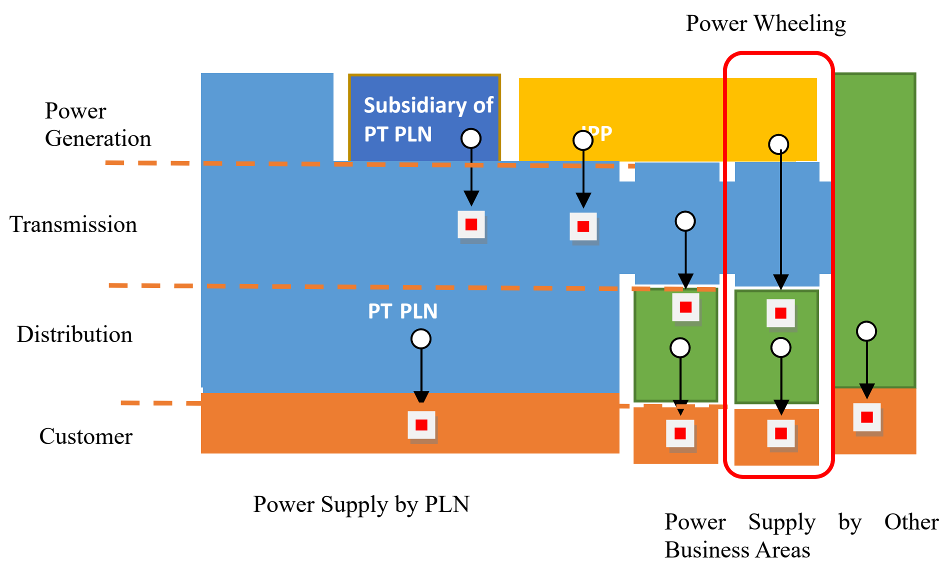


Figure 3-14 Power Wheeling Scheme Currently Considered

3.4.1 Buy-Back Method

Buy-back is a method whereby a power supply license holder other than PLN, which has its own business area, sells electricity to PLN using its own power generation facilities located far away and purchases electricity through PLN' s power grid from PLN at its business area.

3.4.1.1 Bekasi Power

This example is a case of power supply from a power station located in the business area (industrial zone) of Bekasi Power to a neighboring location using PLN's transmission line, as shown in the following figure. The power receiving point has already been used to take electricity from PLN's grid and the transmission line is extended to take the power from the power plant located in the corner of the business area using PLN's existing transmission line. The contracts between PLN and Bekasi Power are power purchase and selling agreements.

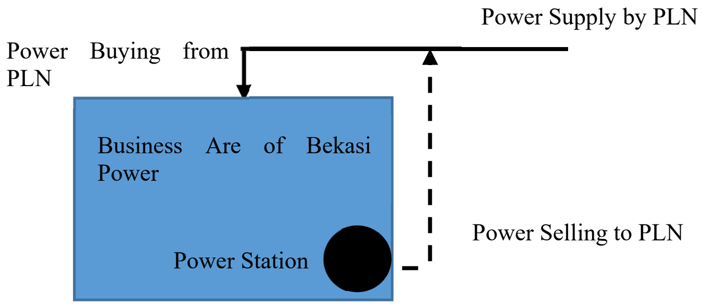


Figure 3-15 Buy-Back Method in Bekasi

3.4.1.2 Example of North Sumatra (PT Mabar Electrindo)

This example is a case of power transmission through PLN's transmission lines from a power plant installed by PT Mabar Electrindo, located 20-30km north of the industrial area and owned by this company. The power plant is located facing the sea coast to import its fuel with ease. The business has already obtained a Power Supply License (IUPTL) and Business Area determination. A thermal power plant with 2×150MW units is currently being constructed in Hamparan Perak in Deliserdan in North Sumatra. The target for its completion is the middle of 2017.

The power purchasing price from PLN in this example has been approved by the Minister of MEMR according to the "New Electricity Law" and the government ordinance.

3.4.2 Self-Supply Power Wheeling

3.4.2.1 Example of Imeco

This example is a power supply scheme from a coal fired power plant installed in West Java through PLN's transmission lines to three industrial zones, Cikaran in West Java, Semarang in Central Java and a zone in East Java where Imeco is expected to have determination of its business area.

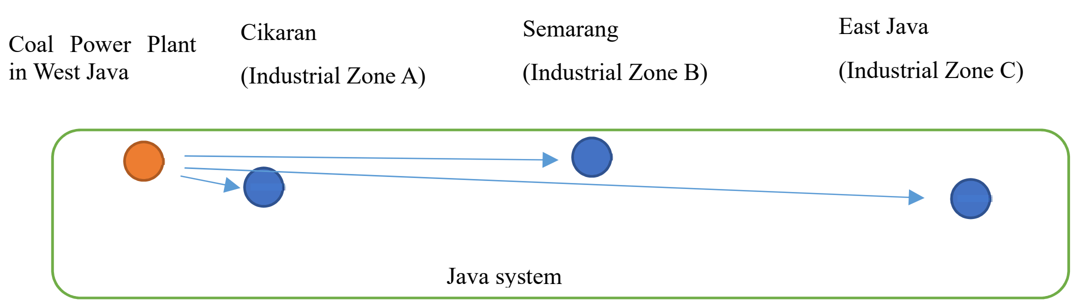


Figure 3-16 Concept of Self-Supply Power Wheeling by Imeco

The location of the power plant in West Java is recommended by PLN to mitigate the power flow in PLN's power system, normally going from Central Java to Jakarta to reduce transmission line losses and improve power system reliability.

Its power supply license and the determination of its business area are under application and not yet determined.

3.5 Merits of Utilization of Power Wheeling in Indonesia

A comparison of the contracts between the case that a private company sells power to PLN using an IPP scheme, and the case of utilizing a power wheeling scheme, is shown in the following figure. In the IPP scheme, PLN pays an IPP for power purchase according to the contract of the power purchase agreement agreed by IPP with PLN. In the power wheeling scheme, PLN receives power wheeling fees instead of paying power generation companies.

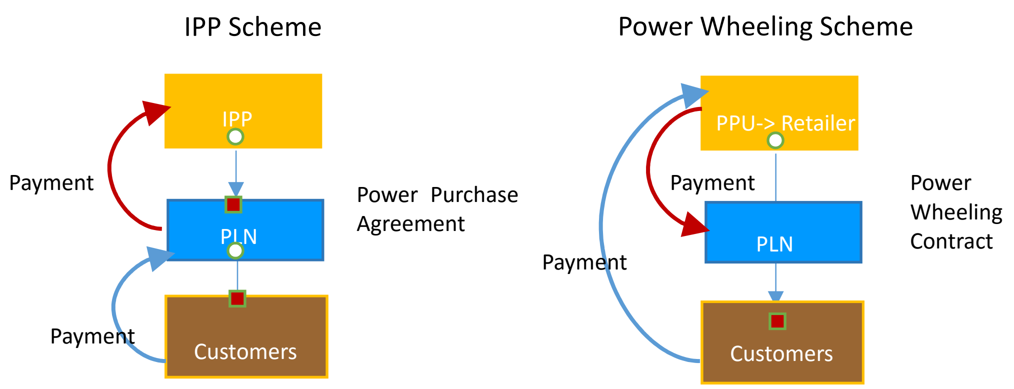


Figure 3-17 Comparison between IPP Scheme and Power Wheeling Scheme

The merits in utilizing power wheeling in Indonesia are described as follows categorized into the viewpoints of power generation companies, the transmission company (PLN) and power consumers.

- Merits of Power Generation Companies

  If the power wheeling scheme is not used, power generation companies would do their power generation business only as an IPP selling electricity to PLN. This business scheme would be acquired only through competitive bidding by a PLN public offering. On the other hand, if the power wheeling scheme is used, the contract for power buying and selling becomes a contract only with the retail side and the amount of power generation purchased will depend on customer demand. For this reason, the following benefits can be considered for the power generation business by taking advantage of power wheeling.

  - Even without going through PLN's IPP bidding process, if the company meets the conditions and secures the customers, it is possible to enter into the power generation business. *)
  - Increasing options for selling electricity. The range of investment is expanded.

  *) Cabinet order No. 14 specifies "IUPTL holders must bid for purchasing power". On the other hand, MEMR Ministerial Regulation No. 1/2015 that regulates power wheeling specifies "IUPTL holders are able to cooperate directly". This indicates that power trading directly between two parties is recognized.

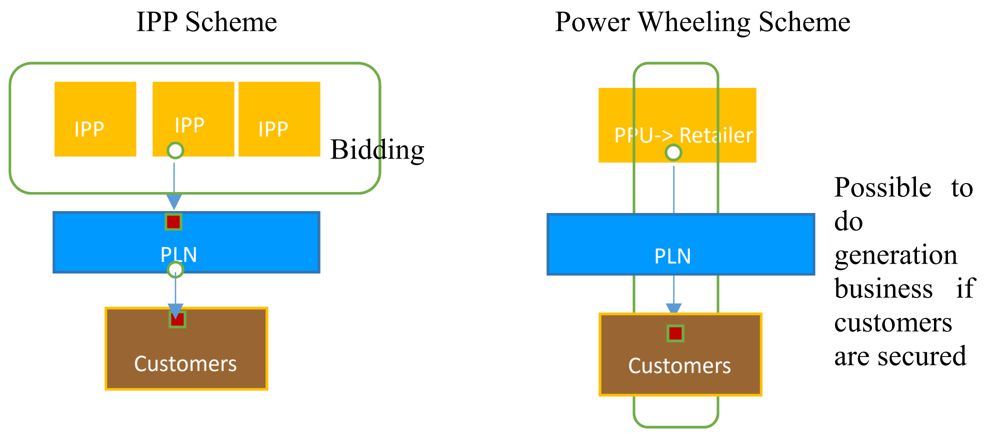


Figure 3-18 Comparison between IPP Scheme and Power Wheeling Scheme as seen from Power Generation Business

- Merits for Transmission Company (PLN)

If the power wheeling scheme is used, PLN as a transmission company does not have to purchase power from an IPP and can avoid the obligations of payment for an IPP's fuel procurement according to its power purchase agreement, and a fixed payment for the duration of unit operations. Thus, the following merits can be considered for PLN as a transmission company by utilizing the power wheeling scheme.

➢ To reduce the burden on contracts with power generation companies

Private companies will be able to contract directly with IPPs by utilizing power wheeling. Obligation to purchase power from IPPs is reduced.

✧ Reducing the burden on the performance of power purchase contract for power generation
✧ Mitigating the risk of exchange rate fluctuations to fulfill the obligation to pay IPPs for fuel procurement
✧ Reducing the burden on the fixed payment for operating time of power generators

➢ Securing revenues through firm/controllable wheeling charge collection

Although setting the wheeling charge requires final governmental approval, there is room to control it at PLN's discretion in its role as a national power company. Thus, the revenues through the wheeling charge can be secured and PLN's balance of payments can be improved for the future.

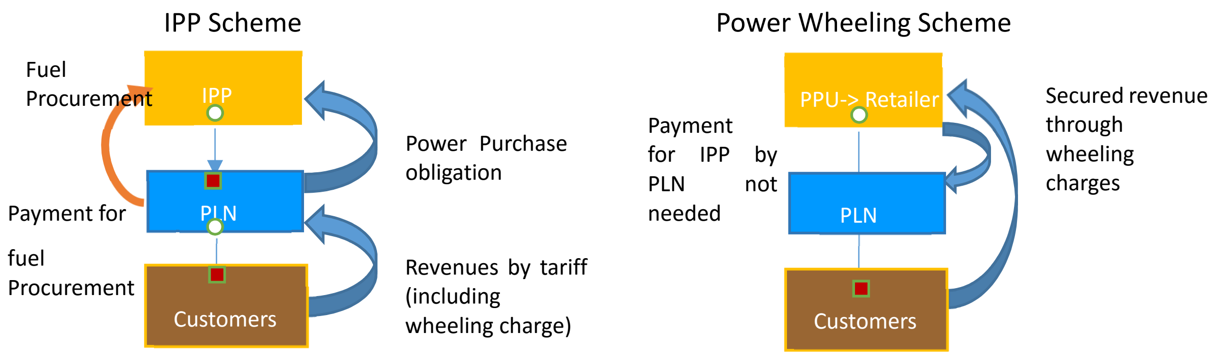


Figure 3-19 Comparison between IPP Scheme and Power Wheeling Scheme as seen from PLN

- Merits for Power Consumers (or Retailers)

  The power wheeling scheme was originally a system for power consumers or retailers to be able to select their power sources in power liberalization. Thus, the following merits can be considered for power consumers (or retailers) when the power wheeling scheme is used.

  - Because of increased alternatives for power producers to buy and to select procurement methodologies, it is possible to use power more efficiently and economically.
  - It is possible to select power generation companies relevant to the power consumers or retailers.

- Merits for Indonesia

  The introduction of the power wheeling system also prompts the entry of power generation businesses and has the effect of stimulating the economy, since setting the power wheeling tariff will require governmental approval.

  By reflecting government policies, such as subsidies or attracting power supply to particular regions, the government can control the power wheeling tariff. Thereby, it is possible to adjust the entry degree of power producers. For this reason, the following advantages for Indonesia by utilizing the power wheeling scheme are considered.

  - Increasing power supply to Industrial zones and stimulating the economy
  - Stabilizing power system by encouragement of local power production for local consumption
  - Encouraging power supply business in rural or island areas

Chapter 4 Operational Situation of T&D System in Main Area

The Economic growth rate is predicted to be 5% to 7% for Indonesia as a whole. Future increase in power demand is expected and it will increase along with the increasing population.

The below shows Electric Sales (TWh) and Power Demand (MW) in Indonesia. Electric sales are 464TWh per year in the 2024 fiscal year. The growth rate of Electric sales is expected to be 8.7%. Peak Demand is 74,536MW per year in the 2024 fiscal year. The growth rate of peak demand is expected to be 8.2%.

Table 4-1 Electric Sales and Power Demand

FY	Economic growth rate	Electric Sales (TWh)	Power Demand (MW)
2015	6.1	219	36,787
2016	6.4	239	39,880
2017	6.8	260	43,154
2018	7.0	283	46,845
2019	7.1	307	50,531
2020	7.0	332	54,505
2021	7.0	361	58,833
2022	7.0	392	63,483
2023	7.0	427	68,805
2024	7.0	464	74,536

Source: RUPTL 2015-2024 Chapter 3

The electrification rate in Indonesia is rising with the growth in power demand. It has risen from 65% in 2009 to 80.4% in 2013 in the country as a whole.

Table 4-2 Electrification rate of Indonesia

Aria	2009	2010	2011	2012	2013	2014
RE Sumatera	62.7	65.0	71.4	76.2	81.0	84.5
RE Jawa-Bali	67.6	70.5	73.6	78.2	83.2	87.0
RE Indonesi Timur	50.6	52.6	59.0	64.6	70.5	73.9
RE Indonesia	63.5	66.2	70.5	75.3	80.4	84.0

Source: RUPTL 2015-2024 Chapter 3

The below shows transmission and distribution loss.

Table 4-3 Transmission and Distribution loss

	2010	2011	2012	2013	2014
Distribution Losses	7.64%	7.34%	6.95%	7.77%	7.52%
Transmission Losses	2.25%	2.25%	2.44%	2.33%	2.37%
Network Losses	9.70%	9.41%	9.21%	9.91%	9.71%

Source: Annual Report 2014

Transmission loss and distribution loss have each been on a downward trend since 2010. However electrification rate will rise, and we have to watch the Transmission loss and Distribution loss trends, including the suppression of non-technical loss.

In this chapter, we will introduce the present and future situation of the system grid in Indonesia, in particular for the Java-Bali district (mainly West Java and Jakarta), Sumatra, and Sulawesi (South Sulawesi).

Figure 4-1 Indonesia Map

Source: RUPTL 2015-2024

4.1 Java-Bali

Java-Bali is divided into the following 5 areas. West Java is located in the west of Java-Bali. It includes Jakarta, which has concentrated power demand.

Table 4-4 Java-Bali areas

Area	Call Sign	Area Control Center (ACC)	
APB Jakarta & Banten	Area 1	ACC Cawang	Jawa Bali Control Center (JCC)
APB Jawa Barat (West Jawa)	Area 2	ACC Cigereleng	
APB Jawa Tengah &DIY (Central Jawa)	Area 3	ACC Ungaran	
APB Jawa Timur (East Jawa)	Area 4	ACC Waru	
APB Bali	Area 5	ACC Bali	

Source: PLN System Planning

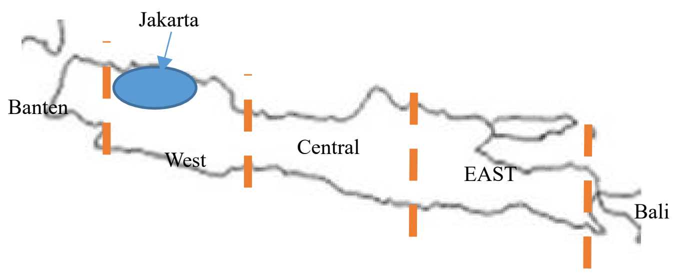


Figure 4-2 Java-Bali district

Source: JICA Team

4.1.1 Current System Structure & Power Flow

The below shows the 500kV Power flow in Java-Bali in 2015. It is divided into 5 areas. It can be confirmed that power flows from the east and west into Jakarta, which has concentrated power demand.

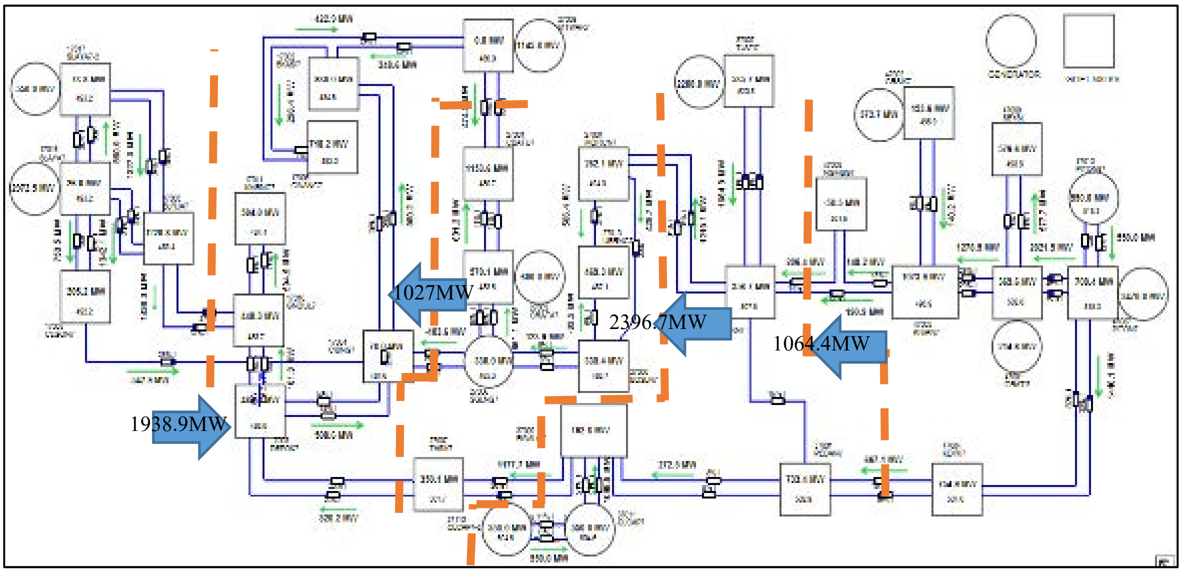


Figure 4-3 500kV Power Flow in Java-Bali in 2015

Source: PLN

4.1.2 Plan

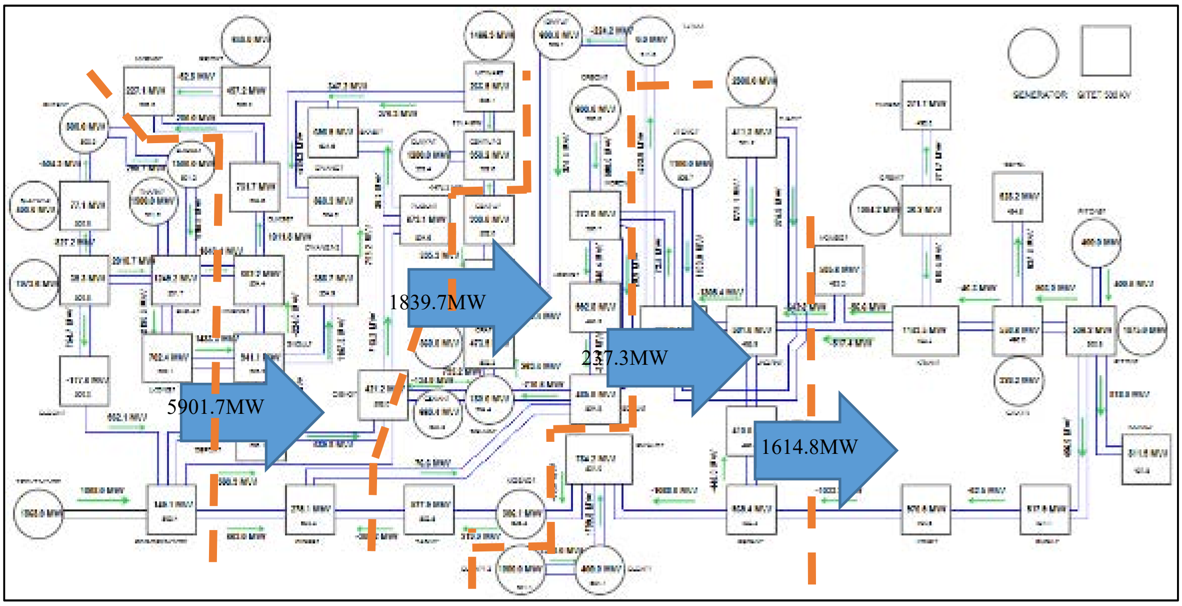
RUPTL says that there is a power development plan in West Java to achieve 12,433 MW from 2013 to 2022. Likewise, 500 kV Transmission Lines are being established from 2013 to 2022. The total is 9,836 MVA.

The below figure shows the present and future situation of the System Layout in West Java. The other figures below show power flow in 2020 (Figure 4-5) and power flow in 2024 (Figure 4-6).

It can be confirmed that the power flow has been divided into East and West (see Figure 4-5 and Figure 4-6). It is possible to surmise that power demand in Indonesia is distributed, because demand is concentrated in Jakarta.

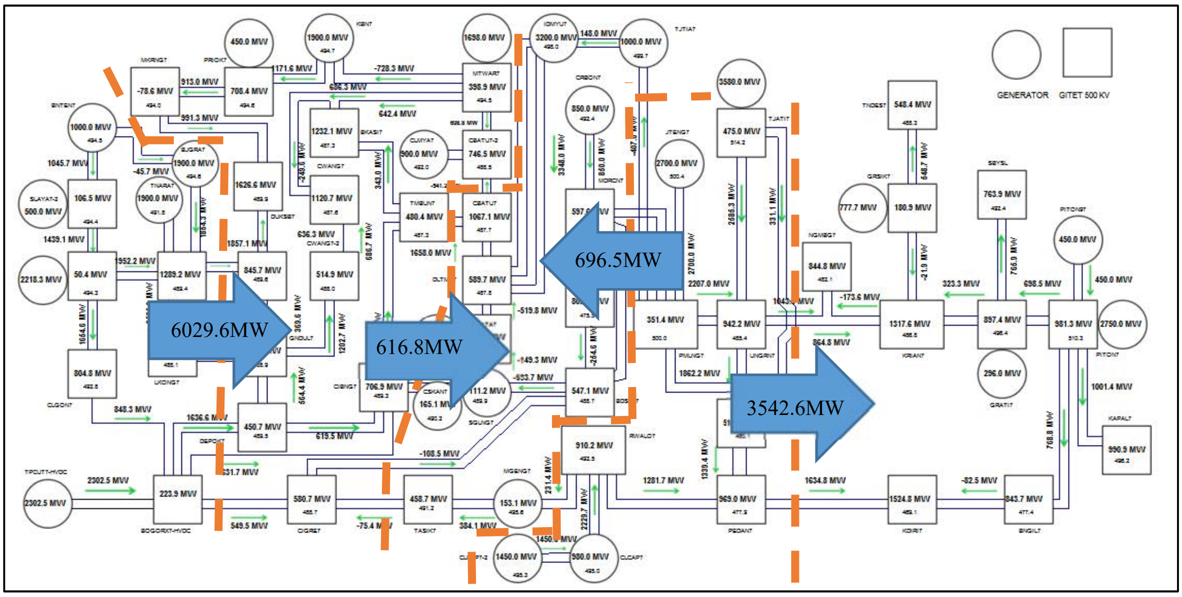
Source: RUPTL 2013-2022 Summary

Figure 4-4 Java-Bali Power System



Source: PLN

Figure 4-5 500kV Power Flow in Java-Bali in 2020

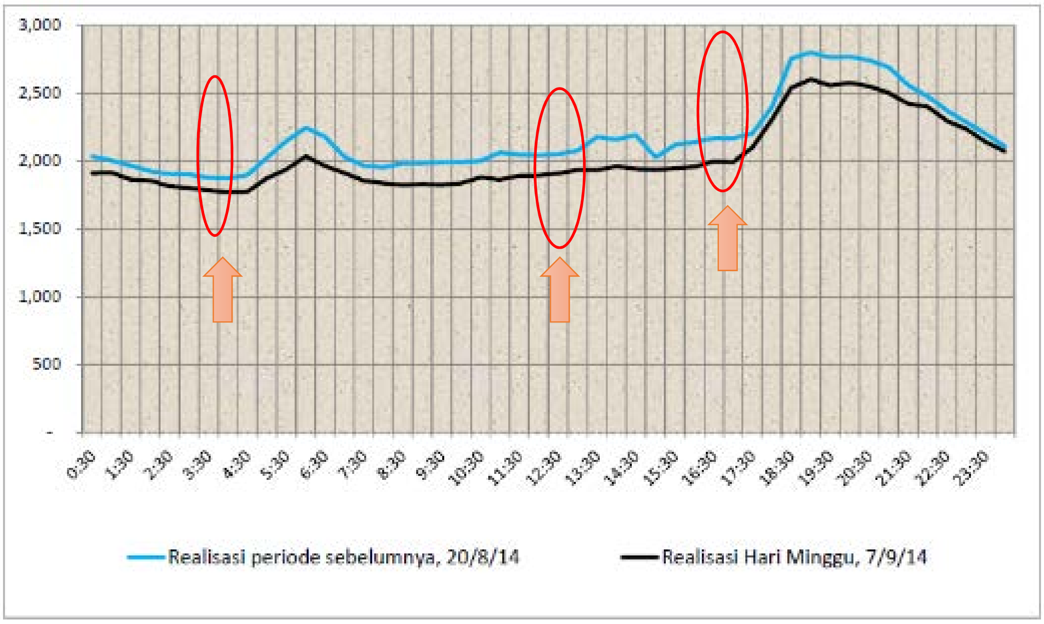


Source: PLN

Figure 4-6 500kV Power Flow in Java-Bali in 2024

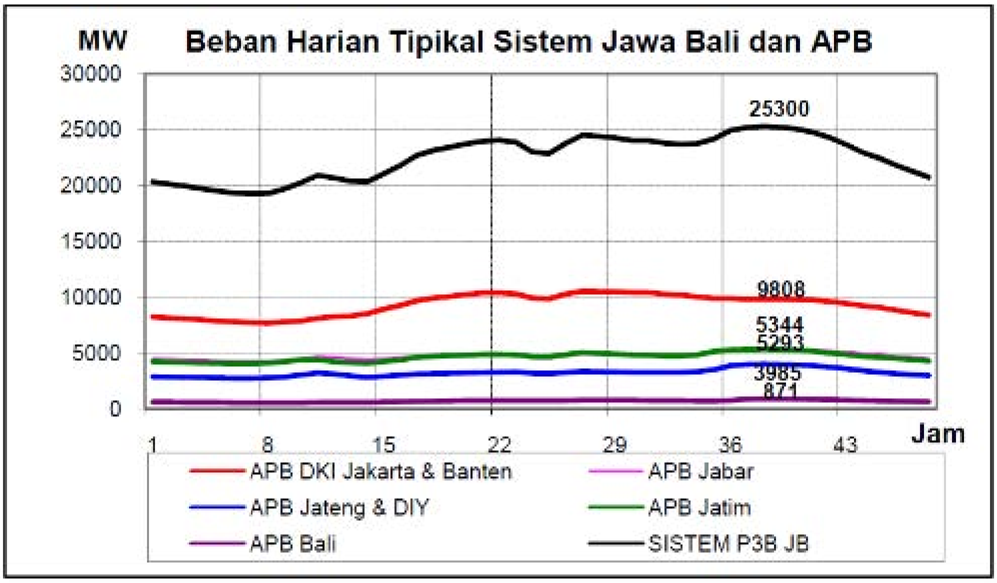
4.1.3 Current Balance between Supply and Demand

The below shows the Power Demand for Java-Bali. The demand for power rises at three times during the day: morning, noon and night. The other figure below shows a typical daily load curve in each region.



Source: PLN (P2B)

Figure 4-7 Power Demand of Java-Bali



Source: PLN (P2B)

Figure 4-8 Daily Load curve of Java-Bali

4.1.4 Review of Balance between Supply and Demand

RUPTL says that the average ratio of generation capacity to maximum demand of power plants is 132%. The reserve rate of power generation capacity to maximum demand averages 32%. This has spare capacity.

Table 4-5 The ratio of generation capacity to maximum demand

	Unit	2009	2010	2011	2012	2013	2014
A)Maximum Demand	MW	17,835	18,756	20,439	22,067	23,415	25,064
B)Power Generation capacity	MW	22,906	23,206	26,664	30,525	32,394	33,499
The ratio of (B) to (A)	%	128%	124%	130%	138%	138%	134%
The reserve rate of (B) to(A)	%	28.4%	23.7%	30.5%	38.3%	38.3%	33.7%

Source: JICA Team based on RUPTL 2015-2024 Chapter 3

The below table shows reserve rate to power generated of maximum demand, with an average of 22.9% (power generating means the actual output of the power generation capacity). The reserve power was previously low in 2011. However, the reserve rate of power generation output has been rising with the construction of power generation facilities.

Table 4-6 The Ratio of Power Generation to Maximum Demand

	Unit	2009	2010	2011	2012	2013	2014
A) Power Generation	MW	21,784	21,596	23,865	28,722	30,095	31,206
B) Maximum Demand	MW	17,835	18,756	20,439	22,067	23,415	25,064
The ratio of (A)to (B)	%	122%	115%	117%	130%	129%	125%
The reserve rate of (A) to(B)	%	22.1%	15.1%	16.8%	30.2%	28.5%	24.5%

Source: JICA Team based on RUPTL 2015-2024 Chapter 3

Table 4-7 The Ratio of Power Generation Capacity in 2014

No	Power Plant	PLN	IPP	Total	
				MW	%
1	Hydroelectric	2.159	150	2.309	6.9%
2	Thermal (Steam)	15.020	4.525	19.545	58.3%
3	Thermal (Gas)	1.978	-	1.978	5.9%
4	Thermal (Combined Cycle)	7.851	420	8.271	24.7%
5	Geothermal	360	740	1.100	3.3%
6	Diesel	296	-	296	0.9%
Total		27.664	5.835	33.499	100.0%

Source: RUPTL 2015-2024 Chapter 3

The above table shows the ratio of Hydroelectric power. It is less than 7%.

This is designed to satisfy the demand without significant impact on the power generation output.

RUPTL 2015-2024 says that a power generation plan has been developed to satisfy the levels of reliability and economy. The reliability of Java-Bali is set as follows. LOLP is less than 0.274% (LOLP: The probability of power failure). The reserve rate of equipment is from 25% to 30%. The capacity of the power generation equipment is 35% (source: RUPTL Chapter 3).

The below shows Maximum Demand and Power Generation in the Java-Bali area.

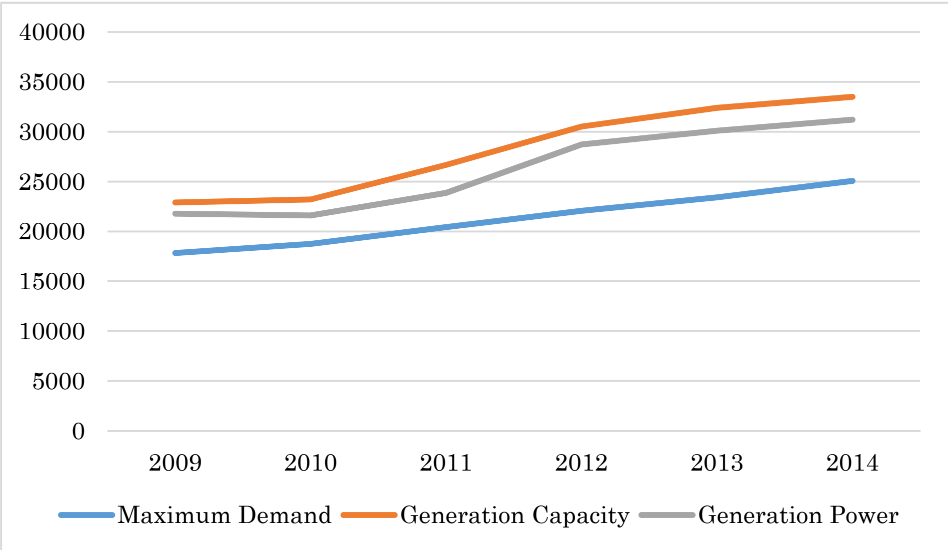


Figure 4-9 Maximum Demand and Power Generation

Source: JICA Team

4.2 Sumatra

Sumatra is located in the north of Indonesia. It has a 6 areas: Nias, Sitoli, Teluk Dalam, Pulau Tello, and Pulau Smbilian. The transmission lines are composed of 150 kV and 275 kV. Power generation capacities of PLN and IPPs are shown below. The total power generation capacity is 6,116 MW.

Table 4-8 Power Generation Capacity in Sumatra

UNIT	PLN								IPP								Total
	Thermal(CC)	Thermal(Steam)	Diesel	Thermal (Gas)	Geothermal	Hydroelectric	Other	Total	Thermal(CC)	Thermal(Steam)	Diesel	Thermal (Gas)	Geothermal	Hydroelectric	Other	Total	
Aceh	-	-	105	-	-	3	-	108	-	15	-	10	-	1	-	26	134
Sumut	-	-	14	-	-	-	-	14	-	-	-	-	-	-	-	-	14
Sumbar	-	-	31	-	-	1	-	32	-	-	-	-	-	9	-	9	41
Riau	-	7	158	-	-	-	-	165	-	5	2	6	-	-	-	13	178
S2JB	-	-	57	-	-	2	-	59	-	13	-	65	-	12	-	90	149
Babel	-	30	89	-	-	-	-	119	-	-	-	-	-	-	13	13	132
Lampung	-	-	4	-	-	-	-	4	-	-	-	-	-	-	-	-	4
Kit Sumbagut	818	710	216	340	-	254	-	2,338	-	-	-	-	-	-	-	-	2,338
Kit Sumbagsel	120	974	241	404	110	610	-	2,459	-	-	-	-	-	-	-	-	2,459
P3B Sumatera	-	-	-	-	-	-	-	-	-	227	-	260	-	180	-	667	667
計	938	1,721	915	744	110	870	-	5,298	-	260	2	341	-	202	13	818	6,116

Source: RUPTL 2015-2024 Chapter 3

Sumatra recorded a demand of 5,017 MW in September 2014, which is a supply shortage of about 2,000MW, or 35% of the total. Although power generation capacity satisfied demand, power generation was insufficient. PLN rented generators in order to solve this problem. (Source: RUPTL 2015-2024 Chapter 3)

Figure 4-10 Sumatra

Source: RUPTUL 2015-2024

4.2.1 Current System Structure & Power Flow

The below shows the power flow of the 275 kV Transmission system in Sumatra in year. North Sumatra and South Sumatra are not connected because this is a 275 kV Transmission line under construction.
The other figures below show Ache, North Sumatra, Riau State, West Sumatra State, Jambi State, South Sumatra State, Benguru State, and Lampung State.

Figure 4-11 Ache System

Figure 4-12 North Sumatra System

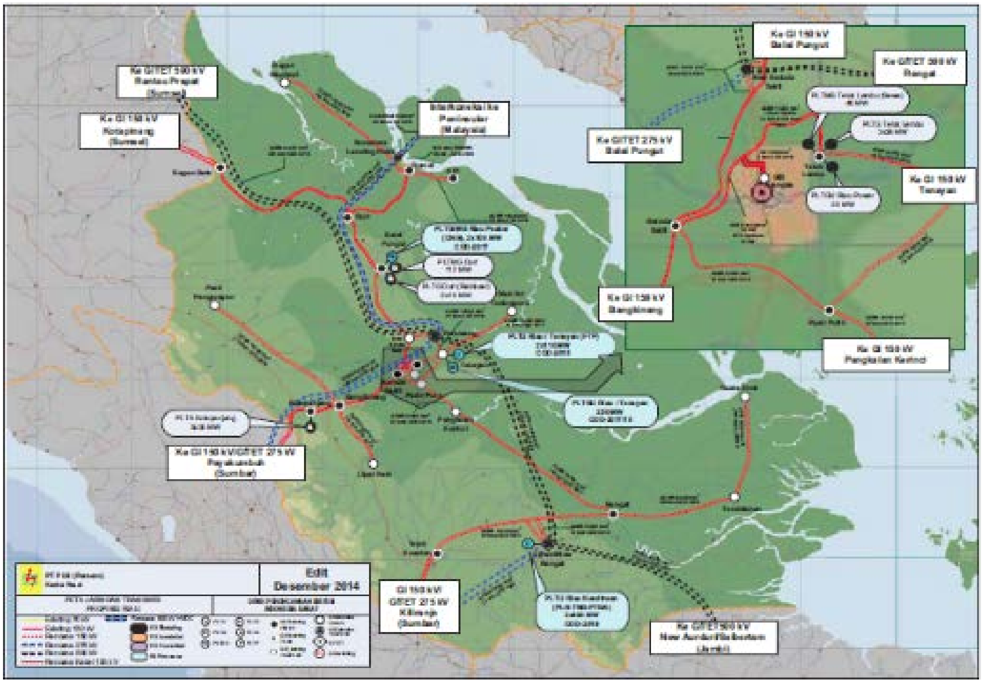


Figure 4-13 Riau System

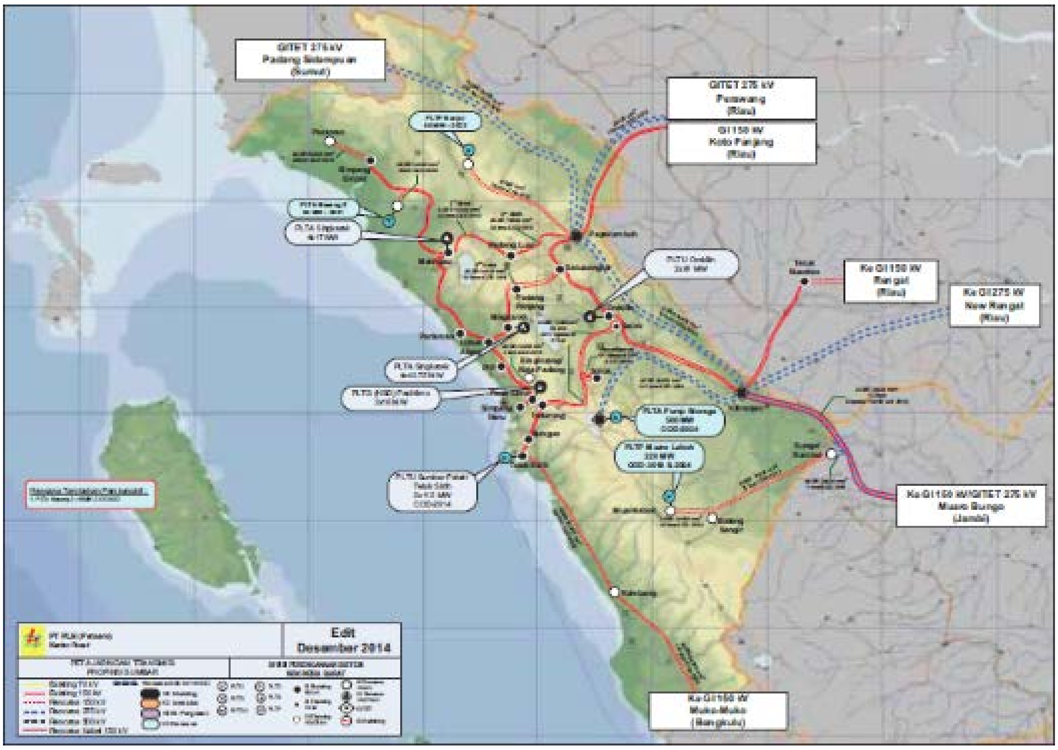


Figure 4-14 West Sumatra System

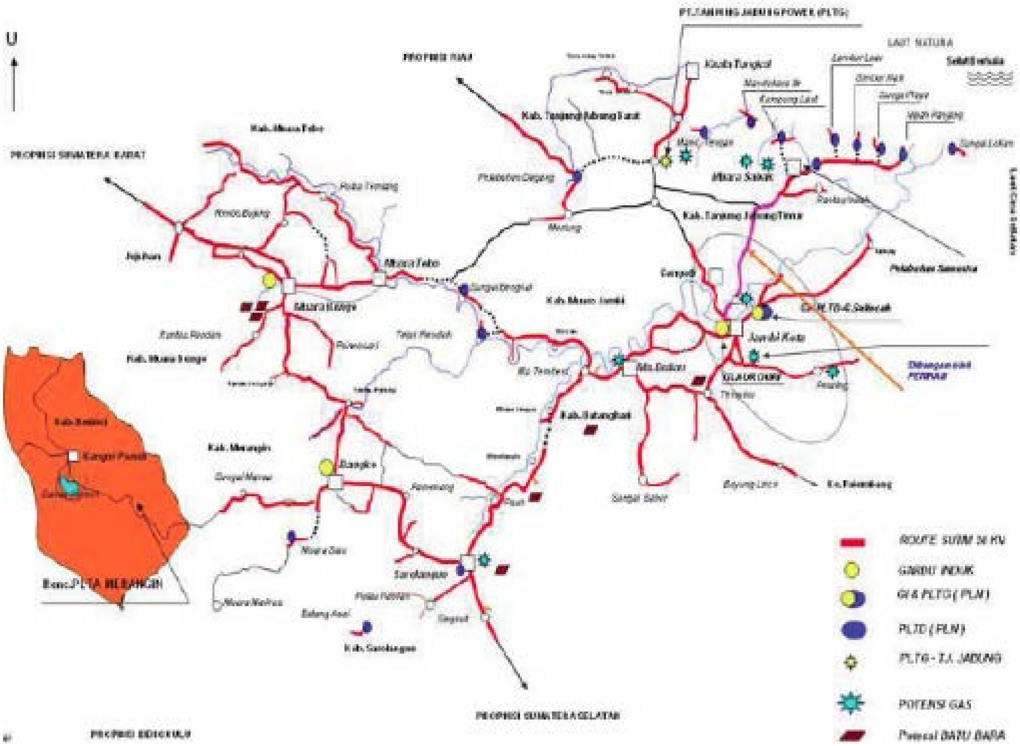


Figure 4-15 Jambi System

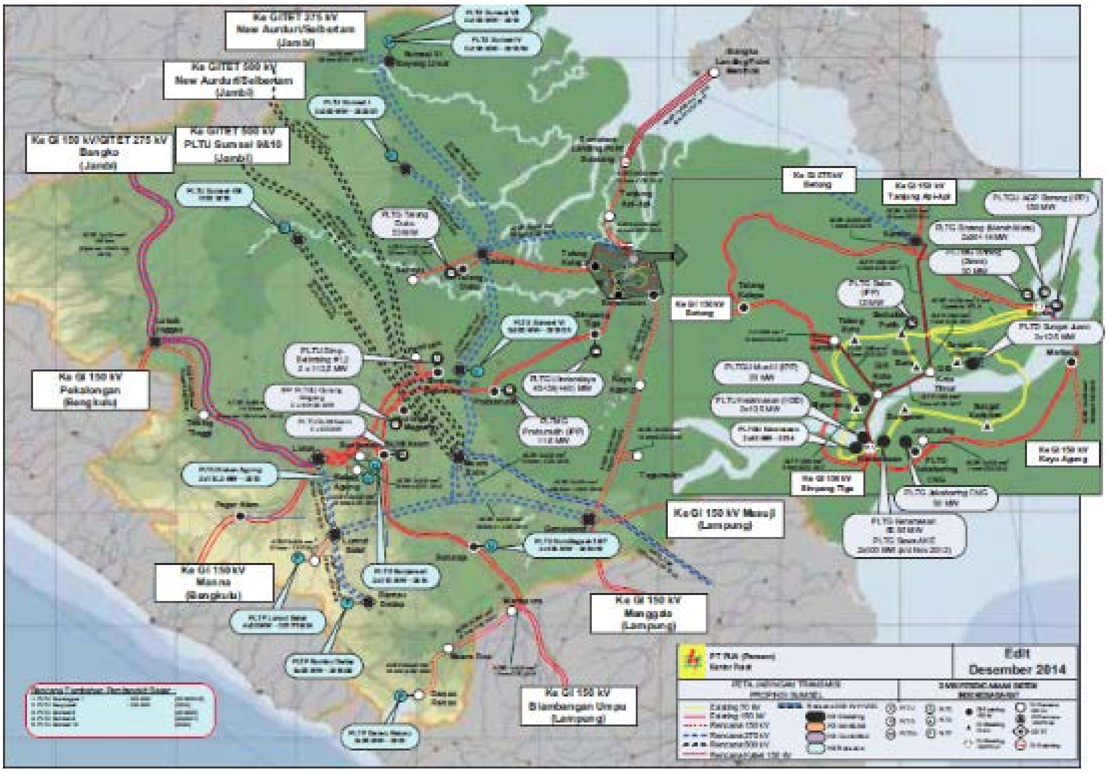


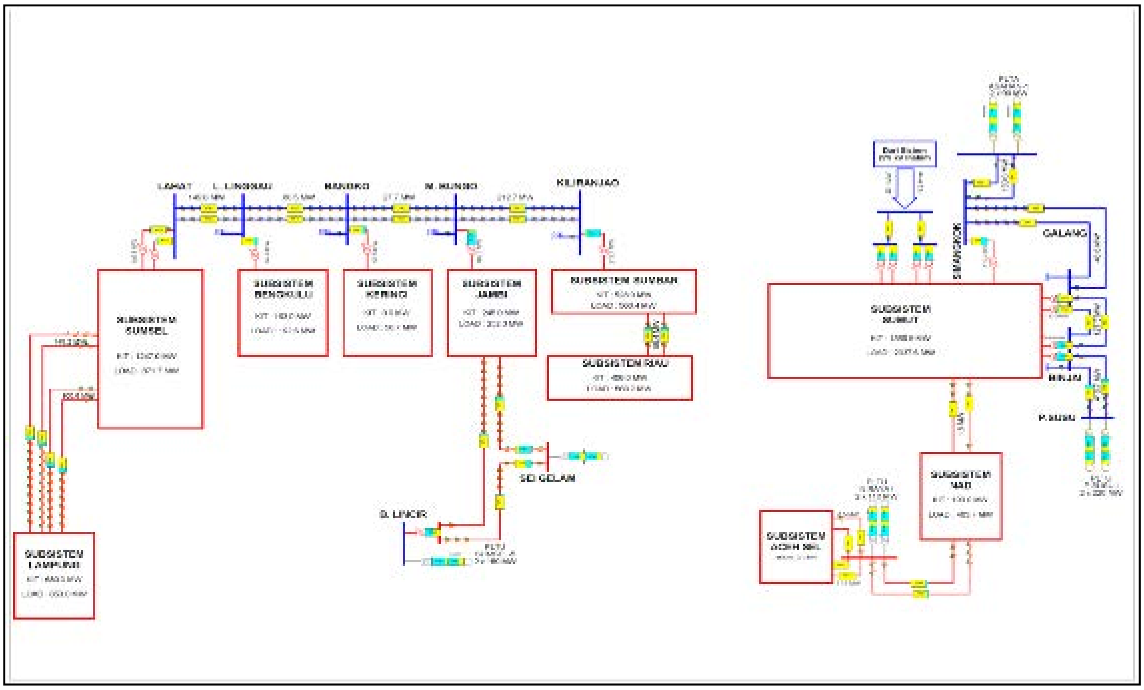
Figure 4-16 South Sumatra System

Figure 4-17 Benguru System

Figure 4-18 Lampung System

Source: RUPTUL 2015-2024 Appendix: A.1-A.10

The below power flow shows Sumatra Southeast on the left and Ache State on the right. Electric Power is flowing from the southeast to the north in Sumatra Southeast. It can also be confirmed that Ache State's electric power is flowing from the north to the southeast.



Source: PLN

Figure 4-19 Sumatra Power Load Flow in 2015

4.2.2 Plan

RUPTL says that there are construction projects in each state in Sumatra from 2015 to 2024.

Table 4-9 Power Generation Capacity of Planned Construction in 2015-2024

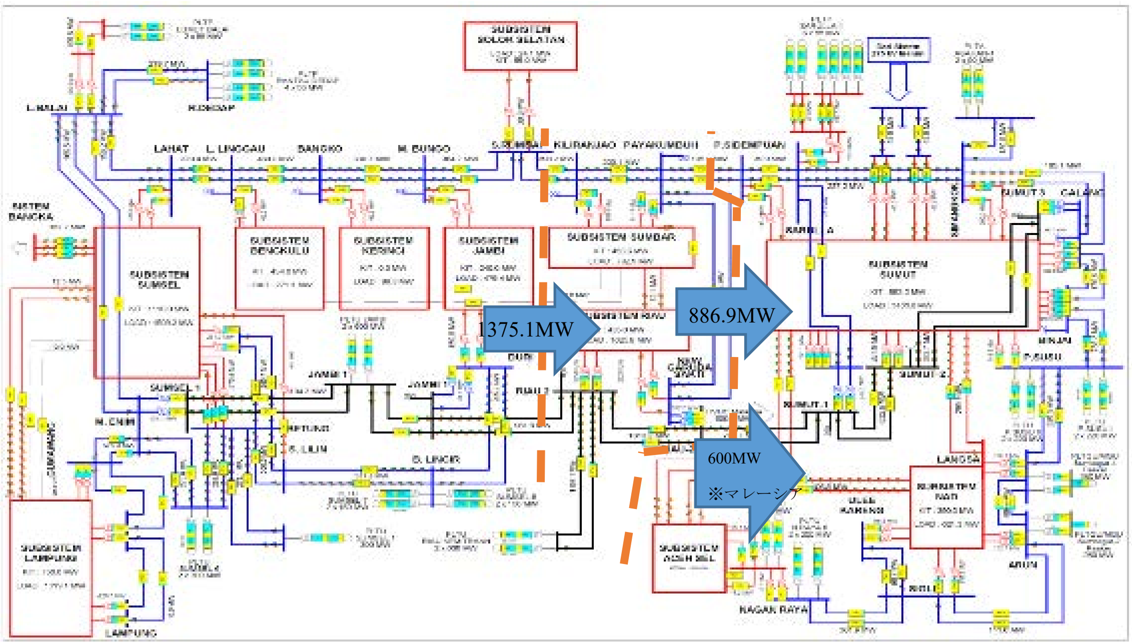
State	Existing Generation Capacity	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total Power Generation Capacity of Planned Construction (MW)
Ache	448	94	0	312	105	245	264	0	83	0	849	1,952
North Sumatra	2,487.2	451	441	272	970	914	100	250	688	910	410	5,406
Riau	492.8	220	0	290	160	1,200	0	0	0	0	0	1870
West Sumatra	692	0	0	0	70	0	0	55	149	0	650	924
Jambi	359.5	0	100	130	0	1200	0	175	175	0	110	1,890
South Sumatra	1,481.9	375	150	55	450	615	710	300	0	110	340	3,105
Benguru	248.3	0	13	45	21	255	55	0	84	0	0	473
Lampung	822.1	0	155	255	56	0	62	0	55	110	268	961

Source: JICA Team based on RUPTL 2015-2024

The below show the construction plan in Sumatra and the future power flow in 2020-2024.
Electric power is flowing from south to north in Ache State and, moreover, 600MW of power flows in Malaysia.

Source: RUPTUL 2015-2024 Chapter 3

Figure 4-20 Construction Plan in Sumatra

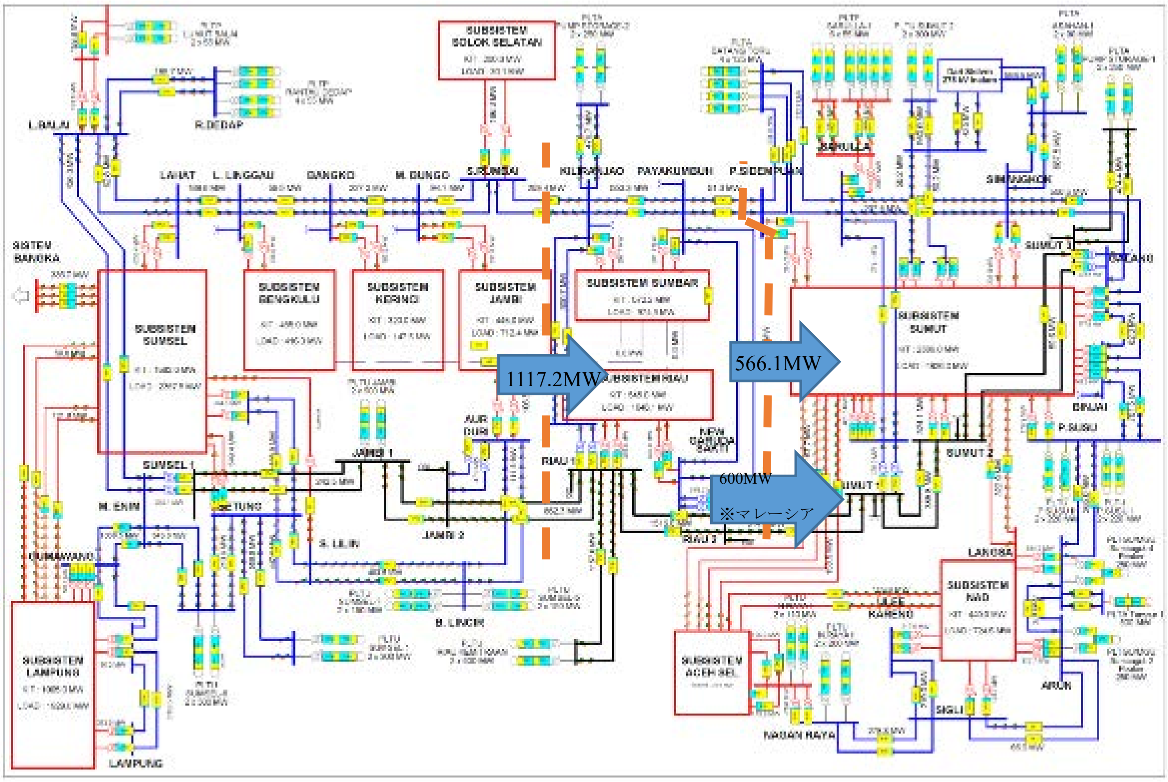


Source: PLN

Figure 4-21 Sumatra Power Load Flow in 2020

Source: PLN

Figure 4-22 Power Flow in Sumatra

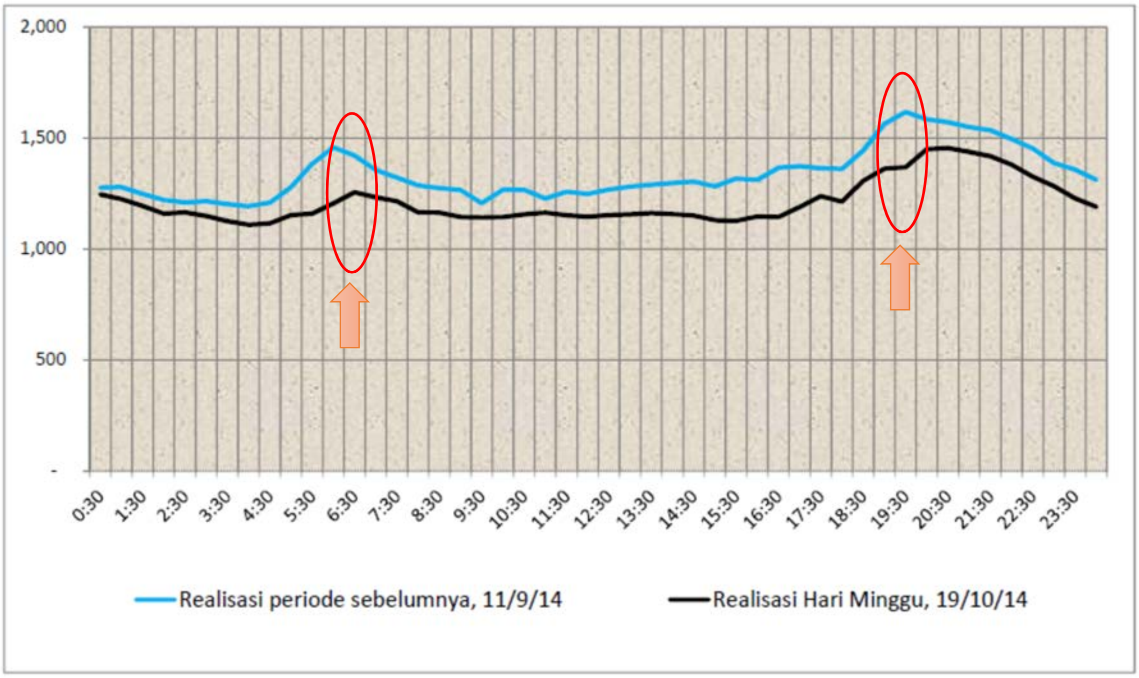


Source: PLN

Figure 4-23 Sumatra Power Load Flow in 2024

4.2.3 Current Balance between Supply and Demand

The below figure shows the Power demand for North Sumatra. The demand for power rises twice a day: early morning and night.



Source: PLN

Figure 4-24 Power Demand of North Sumatra

4.2.4 Review of Balance between Supply and Demand

RUPTL says that the reserve rate to maximum demand of power generation capacity in each state is shown in the following table (Table 4-10). It varies by region. In particular, supply and demand is insufficient in Riau state. A comparison of the Power Generation of actual output and maximum demand gives a reserve rate of 6.6% in Sumatra. It can be confirmed that supply and demand is insufficient in Sumatra (Table 4-11), but if construction of facilities is planned, supply and demand will be satisfied. The ratio of power generation capacity to demand is 173%, which means a reserve ratio of 73%. However, some states' demands will be tight, as shown by the red figures. In some states, hydroelectric power has accounted for more than 50%: Ache State, West Sumatra State, and Benguru State. It is difficult for hydroelectric power generation to ensure output. We have to watch the reserve rate to the power generation in the whole of Sumatra, and the construction plans for transmission lines.

Table 4-10 The Ratio of Power Generation to Maximum Demand in 8 States

		Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Maximum Demand	Ache	MW	416	450	484	521	560	601	645	693	744	799
	North Sumatra	MW	1,886	2,054	2,189	2,398	2,636	2,899	3,222	3,602	4,125	4,676
	Riau	MW	717	803	900	1,008	1,131	1,269	1,381	1,492	1,677	1,882
	West Sumatra	MW	581	641	681	730	778	830	878	932	981	1,033
	Jambi	MW	328	365	407	454	506	561	621	686	758	835
	South Sumatra	MW	878	967	1,067	1,182	1,312	1,459	1,583	1,708	1,912	2,147
	Benguru	MW	175	193	213	236	262	291	324	360	401	448
	Lampung	MW	817	901	994	1,097	1,200	1,293	1,393	1,500	1,648	1,810
	Total		5,798	6,374	6,935	7,626	8,385	9,203	10,047	10,973	12,246	13,630
Power Generation Capacity	Ache	MW	538	538	850	955	1,200	1,464	1,464	1,547	1,547	2,396
	North Sumatra	MW	2,938.2	3,379.2	3,651.2	4,621.2	5,535.2	5,635.2	5,885.2	6,573.2	7,483.2	7,893.2
	Riau	MW	711.3	711.3	1,001.3	1,161.3	2,361.3	2,361.3	2,361.3	2,361.3	2,361.3	2,361.3
	West Sumatra	MW	692	692	692	762	762	762	817	966	966	1,616
	Jambi	MW	359.5	459.5	589.5	589.5	1,789.5	1,789.5	1,964.5	2,139.5	2,139.5	2,249.5
	South Sumatra	MW	1,856.9	2,006.9	2,061.9	2,511.9	3,126.9	3,836.9	4,136.9	4,136.9	4,246.9	4,586.9
	Benguru	MW	248.3	261.3	306.3	327.3	582.3	637.3	637.3	721.3	721.3	721.3
	Lampung	MW	822.1	977.1	1,232.1	1,288.1	1,288.1	1,350.1	1,350.1	1,405.1	1,515.1	1,783.1
	Total		8,166.3	9,025.3	10,384.3	12,216.3	16,645.3	17,836.3	18,616.3	19,850.3	20,980.3	23,607.3
The ratio of Power Generation Capacity to Maximum Demand	Ache	MW	129%	120%	176%	183%	214%	244%	227%	223%	208%	300%
	North Sumatra	MW	156%	165%	167%	193%	210%	194%	183%	182%	181%	169%
	Riau	MW	99%	89%	111%	115%	209%	186%	171%	158%	141%	125%
	West Sumatra	MW	119%	108%	102%	104%	98%	92%	93%	104%	98%	156%
	Jambi	MW	110%	126%	145%	130%	354%	319%	316%	312%	282%	269%
	South Sumatra	MW	211%	208%	193%	213%	238%	263%	261%	242%	222%	214%
	Benguru	MW	142%	135%	144%	139%	222%	219%	197%	200%	180%	161%
	Lampung	MW	101%	108%	124%	117%	107%	104%	97%	94%	92%	99%
	Total		141%	142%	150%	160%	199%	194%	185%	181%	171%	173%
The reserve ratio of maximum demand to power Generation Capacity	Ache	MW	29.3%	19.6%	75.6%	83.3%	114.3%	143.6%	127.0%	123.2%	107.9%	199.9%
	North Sumatra	MW	55.8%	64.5%	66.8%	92.7%	110.0%	94.4%	82.7%	82.5%	81.4%	68.8%
	Riau	MW	-0.8%	-11.4%	11.3%	15.2%	108.8%	86.1%	71.0%	58.3%	40.8%	25.5%
	West Sumatra	MW	19.1%	8.0%	1.6%	4.4%	-2.1%	-8.2%	-6.9%	3.6%	-1.5%	56.4%
	Jambi	MW	9.6%	25.9%	44.8%	29.8%	253.7%	219.0%	216.3%	211.9%	182.3%	169.4%
	South Sumatra	MW	111.5%	107.5%	93.2%	112.5%	138.3%	163.0%	161.3%	142.2%	122.1%	113.6%
	Benguru	MW	41.9%	35.4%	43.8%	38.7%	122.3%	119.0%	96.7%	100.4%	79.9%	61.0%
	Lampung	MW	0.6%	8.4%	24.0%	17.4%	7.3%	4.4%	-3.1%	-6.3%	-8.1%	-1.5%
	Total		40.8%	41.6%	49.7%	60.2%	98.5%	93.8%	85.3%	80.9%	71.3%	73.2%

Source: JICA Team based on RUPTL 2015-2024

Table 4-11 The Reserve Ratio of Maximum Demand to Power Generation in 2015

		Unit	2015
(A) Maximum Demand	Ache	MW	416
	North Sumatra	MW	1,886
	Riau	MW	717
	West Sumatra	MW	581
	Jambi	MW	328
	South Sumatra	MW	878
	Benguru	MW	175
	Lampung	MW	817
	Total		5,798
(B) Power Generation	Ache	MW	409
	North Sumatra	MW	1,872.4
	Riau	MW	460.5
	West Sumatra	MW	690
	Jambi	MW	356.5
	South Sumatra	MW	1,423.1
	Benguru	MW	248.3
	Lampung	MW	749.1
	Total		6,208.9
The reserve ratio of maximum demand to power Generation	Ache	MW	−1.7%
	North Sumatra	MW	−0.7%
	Riau	MW	−55.7%
	West Sumatra	MW	15.8%
	Jambi	MW	8.0%
	South Sumatra	MW	38.3%
	Benguru	MW	29.5%
	Lampung	MW	−9.1%
	Total		6.6%

Source: JICA Team based on RUPTL 2015-2024

Table 4-12 The Proportion of Hydroelectric Power Capacity in 2015-2024

【Unit MW】

	Year	Maximum Demand	Power Generation Capacity	Electric Power	Hydroelectric power capacity (Calculation Again)	The proportion of Hydroelectric power accounting for Power Generation Capacity
Ache	2015	416	448	409	0	0
	2024	799	2,400	-	1,345.88	56.1%
North Sumatra	2015	1,886	2,487.2	1,872.4	440.1	17.7%
	2024	4,676	7,893.2	-	2,618.8	33.2%
Riau	2015	717	492.8	460.5	114	23.1%
	2024	1,882	2,361.3	-	114	4.8%
West Sumatra	2015	581	692	690	253.7	36.7%
	2024	1,033	1,616	-	897.7	55.6%
Jambi	2015	328	359.5	356.5	0	0.0%
	2024	835	2,249.5	-	350	15.6%
South Sumatra	2015	878	1,481.9	1,423.1	0	0.0%
	2024	2,147	4,586.9	-	0	0.0%
Benguru	2015	175	248.3	248.3	248.3	100.0%
	2024	448	721.3	-	397.25	55.1%
Lampung	2015	817	822.1	749.1	118.4	14.4%
	2024	1,810	1,783.1	-	174.4	9.8%

Source: JICA Team based on RUPTL 2015-2024

4.3 Sulawesi

Sulawesi is an island located in the center of Indonesia. Sulawesi has 6 states: Sulawesi, Gorontalo, Central Sulawesi, West Sulawesi, South Sulawesi and South East Sulawesi. The transmission is composed of 150 kV and 70 kV. Peak load is different in each state. South Sulawesi's generation capacity is 1,412 MW, electric power generation is 1,227 MW, and Peak Load is 1,177MW.

Source: RUPTUL 2015-2024 Chapter 3

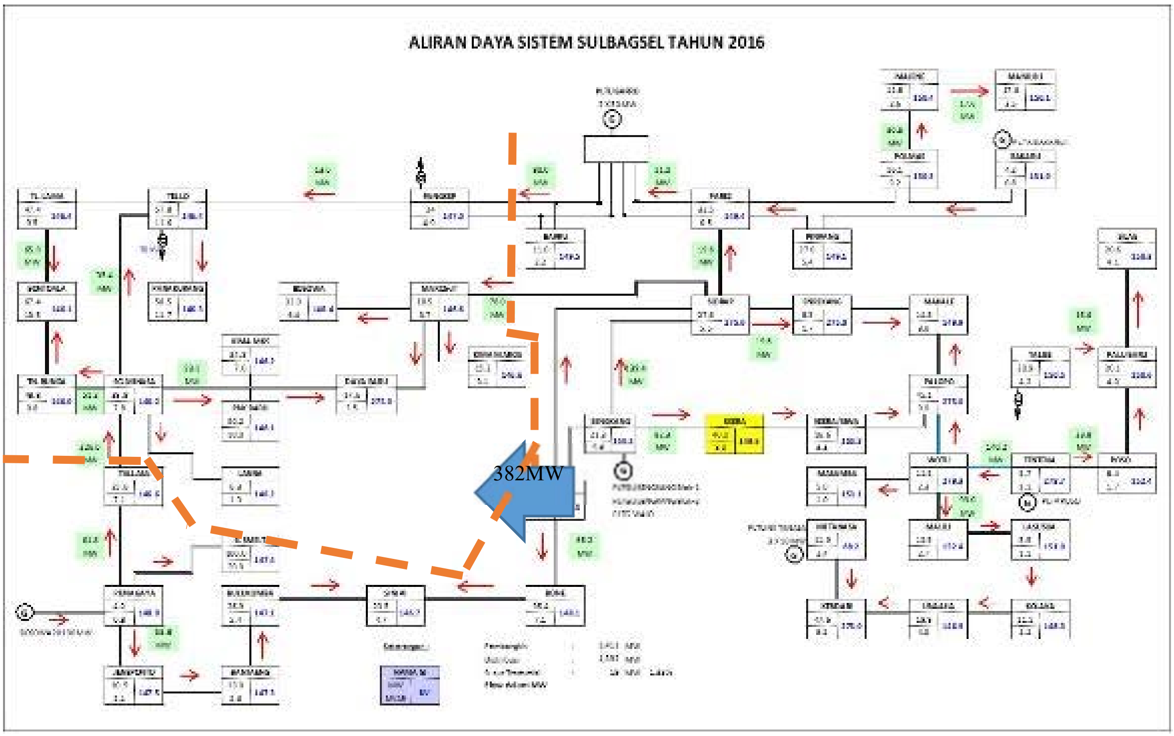
Figure 4-25 Sulawesi

4.3.1 Current System Structure & Power Flow

We cover South Sulawesi below. South Sulawesi is located on Indonesia's main island side. The transmission lines are composed of 150kV and 70kV. Some areas' transmission lines are 20kV. The below shows South Sulawesi's power flow in 2016. The power is flowing from the north area to the south area and to the center of Sulawesi.

Source: RUPTUL 2015-2024 Chapter 3

Figure 4-26 South Sulawesi



Source: PLN

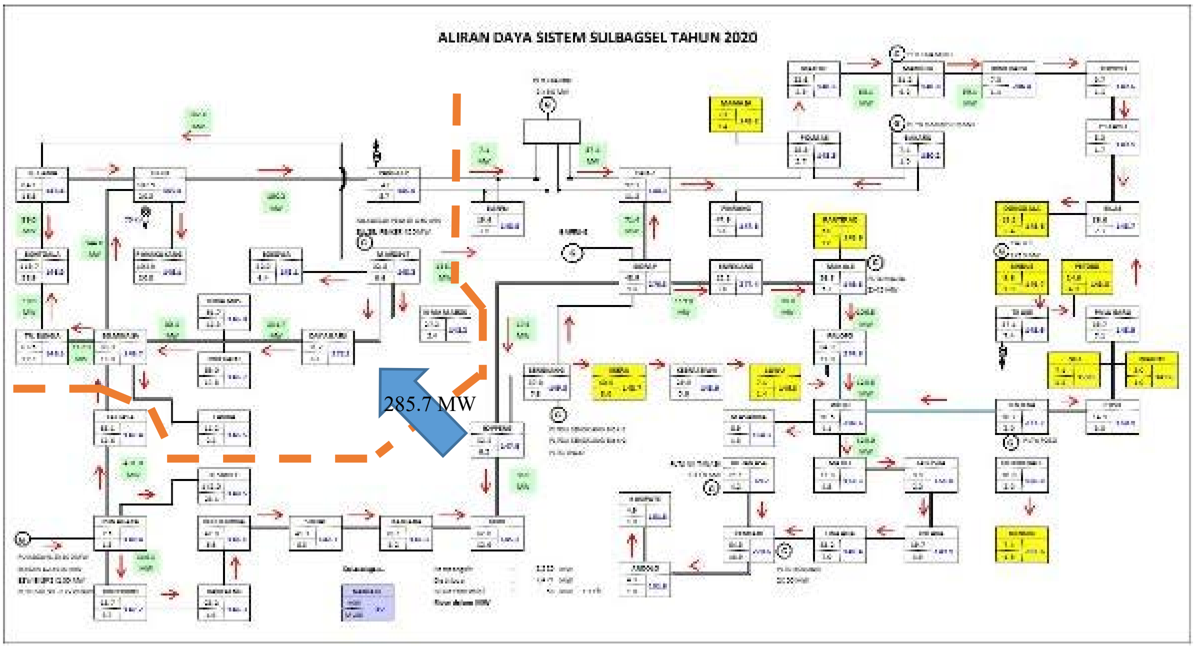
Figure 4-27 Power Flow of South Sulawesi in 2016

4.3.2 Plan

RUPTL says that South Sulawesi has a power development plan of 2,343 MW from 2013 to 2022 and that it also has plans to build transmission lines 1,817km in length, of 275 kV and 500 kV, by 2022. The below shows the power flow of South Sulawesi in 2022 (Figure 4-29) and 2024 (Figure 4-30). The power is flowing from the north area to the south area, and it can be confirmed that it is flowing to the center of South Sulawesi.

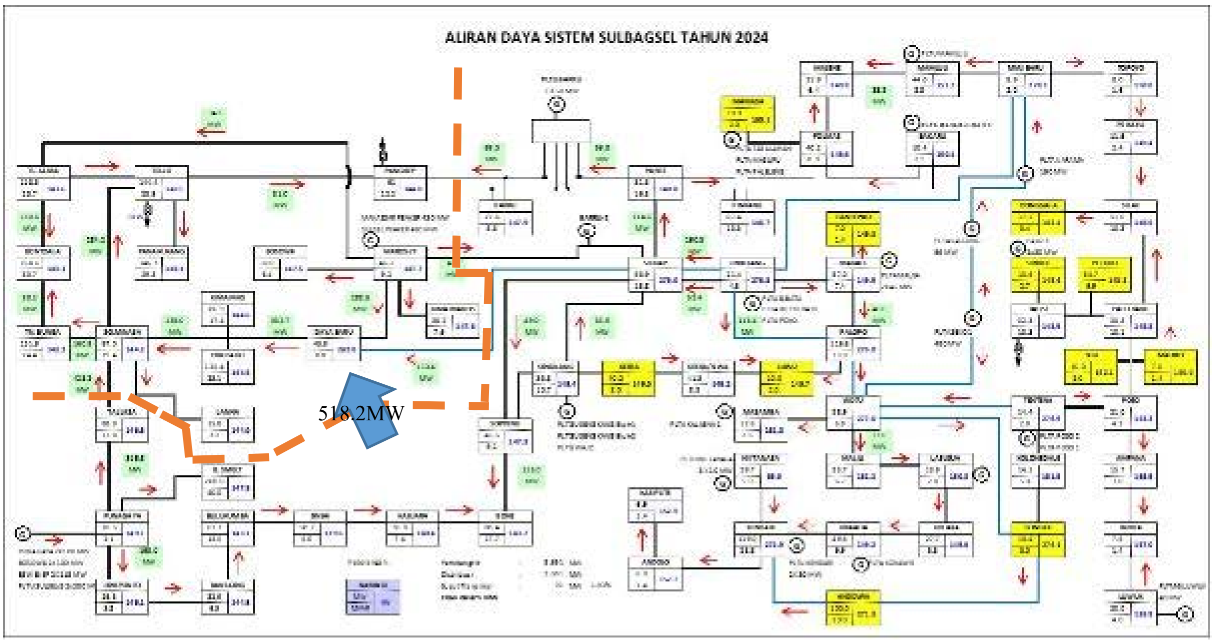
Source: 2013-2022 RUPTL Summary

Figure 4-28 Construction Plans in South Sulawesi



Source: PLN

Figure 4-29 Power Flow of South Sulawesi in 2020

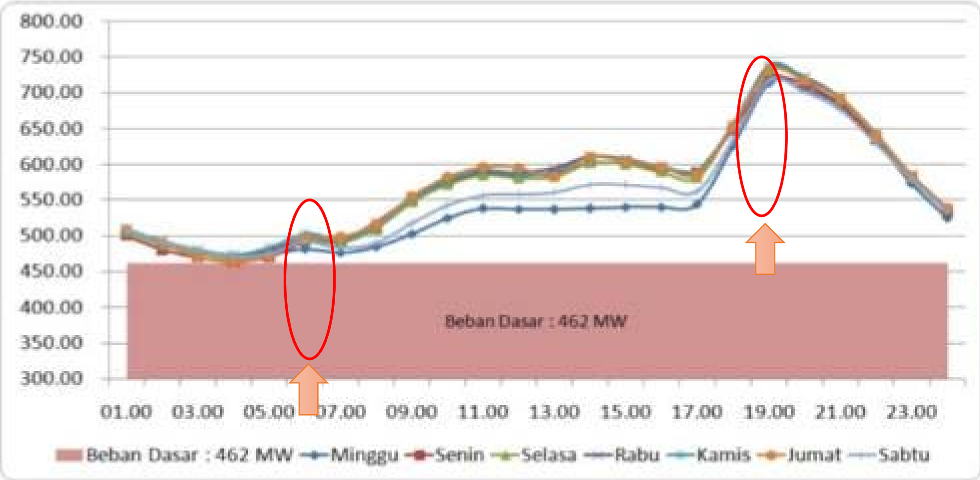


Source: PLN

Figure 4-30 Power Flow of South Sulawesi in 2024

4.3.3 Current Balance between Supply and Demand

The below figure shows the Power demand for South Sulawesi in 2013. The demand for power rises twice a day: early morning and night. There is a marked rise during the night.



Source: PLN

Figure 4-31 Daily Load curve of South Sulawesi in 2013

4.3.4 Review of Balance between Supply and Demand

RUPTL says that the reserve rate of power generation capacity to maximum demand is shown below. It is about 4%, which means that the supply and demand balance is tight. If the construction is on schedule, the reserve rate will be 80%, which means the rate of power generation capacity to demand will be 179%. However, the proportion of Hydroelectric power plant accounts for 30% of the total (Table 4-13). It is difficult for hydroelectric power generation to ensure output. We have to watch the reserve rate to the power generation in the whole of South Sulawesi.

Table 4-13 The Ratio of Power Generation to Maximum Demand

Sulawesi	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
A)Maximum Demand	MW	1,177	1,244	1,427	1,737	1,882	2,042	2,211	2,383	2,573	2,782
B)Power Generation Capacity	MW	1,421	1,591	2,028	2,826	3,311	3,800	4,012	4,276	4,536	4,976
C)Power Generation	MW	1,227	-	-	-	-	-	-	-	-	-
The ratio of B) to A)	%	121%	128%	142%	163%	176%	186%	181%	179%	176%	179%
The reserve ratio of A) to B)	%	20.7%	27.9%	42.1%	62.7%	75.9%	86.1%	81.5%	79.4%	76.3%	78.9%
The reserve ratio of A) to C)	%	4%	-	-	-	-	-	-	-	-	-

Source: JICA Team based on 2015-2024 RUPTL Chapter 3

Table 4-14 The Proportion of Hydroelectric Power Capacity in 2024

	2024
Power Generation Capacity	4,976
Hydroelectric power capacity (Calculation Again)	1,523
The proportion of Hydroelectric power accounting for Power Generation Capacity	31%

4.4 System Diagram and Power Wheeling Scheme in Indonesia

We can see in the above system diagram that there are supply and demand tightness risks in several areas of Indonesia. However, if we investigate up to future demand, it is apparent that there will be new building facilities. Power wheeling does not specify demand distribution. When power wheeling users want to connect to PLN's system, PLN will consider the effect on its system and, as a result, determine "connection good or bad" and "enhancement needed or not needed". Areas which have a grid code can enforce judgment on the necessity of connection to PLN based on the grid code. When an area which has no grid code considers building facilities for power wheeling, it can consider an individual study. Detailed information on this is noted in Chapter 7. When power wheeling is introduced by a new user and the user connects to PLN's system, the system might be enhanced. If the system requires enhancement, the issue is who should bear the enhancement expenses. We propose that this should be the user's own expense. We call this "contribution in aid of construction" and the system is very fair. Detailed information is noted in Chapter 6. As a result of the above, there is constant demand and preparation expenses for the system are low, so the number of users who want to use the power wheeling system will increase.

Chapter 5 Proposal of Calculation Formula for Wheeling Tariff Appropriate to Indonesia

5.1 Basic Concept of Calculation Formula for Wheeling Tariff Appropriate to Indonesia

Studies and discussions on wheeling tariffs have been conducted among the government, PLN, and academics in Indonesia, after establishing the legal basis for power wheeling with the submission of Government Regulation No. 14/2012.

Typical examples are the following reference papers.

- Dr. Hardv's presentation 'Prospek Bisnis Terkait Kebijakan Power Wheeling dalam Rangka Meningkatkan Penyediaan Tenaga Listrik – The Way Forward' (see Appendix3)
- Prof. Sasongko Pramono Hadi's presentation 'Power Wheeling Pemanfaatan Bersama Jaringan Tenaga Listrik (PBJT)' (see Appedix4).

As stated in Appendix3, there are two main categories for calculating formulas for wheeling tariffs in the world currently, Embedded-Cost-Based Approaches, and Marginal-Cost-Based Approaches.

Each approach is classified in certain methods, as follows.

- Embedded-Cost-Based Approaches
  - Postage Stamp Method
  - Contract Path Method
  - Distance Based MW-mile Method
  - Power Flow Based MW-mile Method
- Marginal-Cost-Based Approaches
  - Short-Run Marginal Cost (SRMC) Pricing Method
  - Long-Run Marginal Cost (LRMC) Pricing Method

A detailed explanation of each method is given in Reference.

The Postage Stamp Method is the most basic and simple method. The others tend to be considered as more sophisticated, but complicated practically.

When comparing these methods, it is required to determine what basic conditions are important for wheeling tariff calculation in Indonesia.

The following two are the most important conditions generally required.

1. To guarantee the income to continue the power transmission and distribution business stably.
   [Condition (A)]
2. To reduce useless expenses and promote efficiency.
   [Condition (B)]

If condition (A) is not satisfied, the wheeling company (i.e. PLN) goes bankrupt, and the whole country is thrown into confusion. Therefore, condition (A) cannot be excluded, but having only condition (A) makes the wheeling tariff higher, meaning that the wheeling business will not develop. This demerit of condition (A) should be compensated by condition (B).

To satisfy condition (A), the Postage Stamp Method is the most suitable and its conditions the easiest to confirm. In contrast, for the other methods, it is difficult to confirm condition (A) and to find documents explaining that they satisfy condition (A).

5.1.1 Comparison between Postage Stamp Method and MW-mile Method

The table below shows a comparison between the Postage Stamp Method and the MW-mile Method, as a representative of the other methods, which is promising in Indonesia.

In Indonesia, where the power system is not sufficiently stable, the MW-mile Method is expected to be able to reduce the problems derived from long distance and/or concentrated same-direction wheeling applications by the wheeling rate difference. This problem is controlled by introducing a rule that wheeling applicants should pay the construction costs for the equipment caused by the wheeling. Even using Postage Stamp Method, it can be more effectively controlled than with the MW-mile method.

Table 5-1 Comparison between Postage Stamp Method and MW-mile Method

	Postage Stamp Method	MW-mile Method
Guarantee of revenue	◎ (Guarantee)	△ (OK,,)
Reduction of redundant expenses and promotion of efficiency	△(Ok,,) →○(Good) : by adding incentive regulation	△(OK,,)
Control of the power flow distance/direction (Suppression of the new transmission line)	△(Ok,,) →◎(Excellent) : by adding the sharing facility construction cost rule	○(Good)
Conclusion	◎(Excellent)*	○(Good)

A simple example, such as shown in the following figure, explains that condition (A) cannot be satisfied in the MW-mile Method.

(1) In the Postage Stamp Method, the wheeling tariff is set to 100Rp/kWh. Both customers of PLN and the customer using wheeling share fairly the transmission cost.

(2) PLN can recover a total transmission cost of 5000 million Rp.

(3) The adopted MW-mile method, for example, is assumed to set wheeling tariffs of up to 100km 80Rp/kWh, up to 300km 100Rp/kWh, and up to 500km 120Rp/kWh.

Therefore, when the wheeling distance is 400km, fee collection is to exceed 100 million Rp over the total transmission cost.

(4) In case that wheeling distance is 100km, the fee collection is apparently insufficient, at 100 million Rp.

As it is not possible to determine in advance how long a distance customers using the wheeling scheme will apply for, PLN will not be guaranteed their income. Incidentally, in the Postage Stamp Method, it is clear that PLN can recover the proper transmission cost in the cases of (3) and (4).

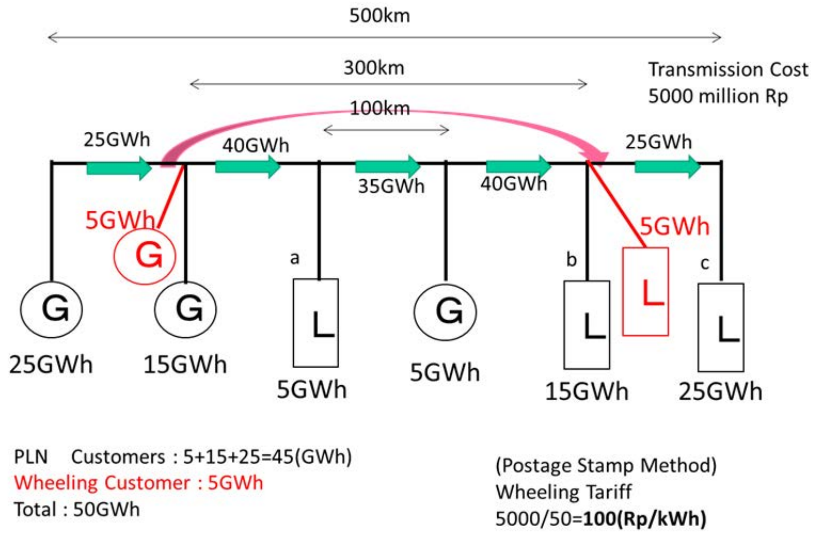


Figure 5-1 A simple example of transmission cost recovery (1)

Wheeling Tariff setting by Postage Stamp Method

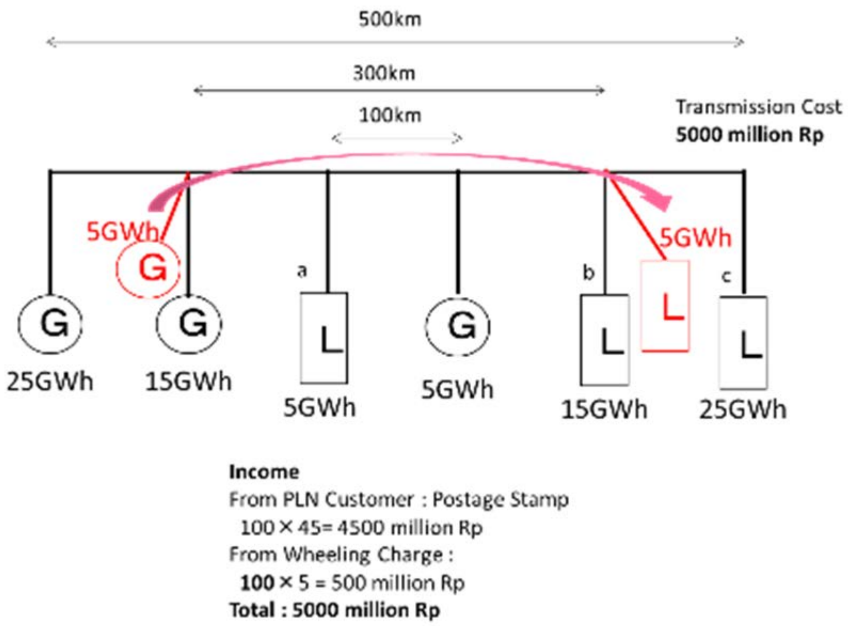


Figure 5-2 A simple example of transmission cost recovery (2)

Cost recovery under Postage Stamp Method

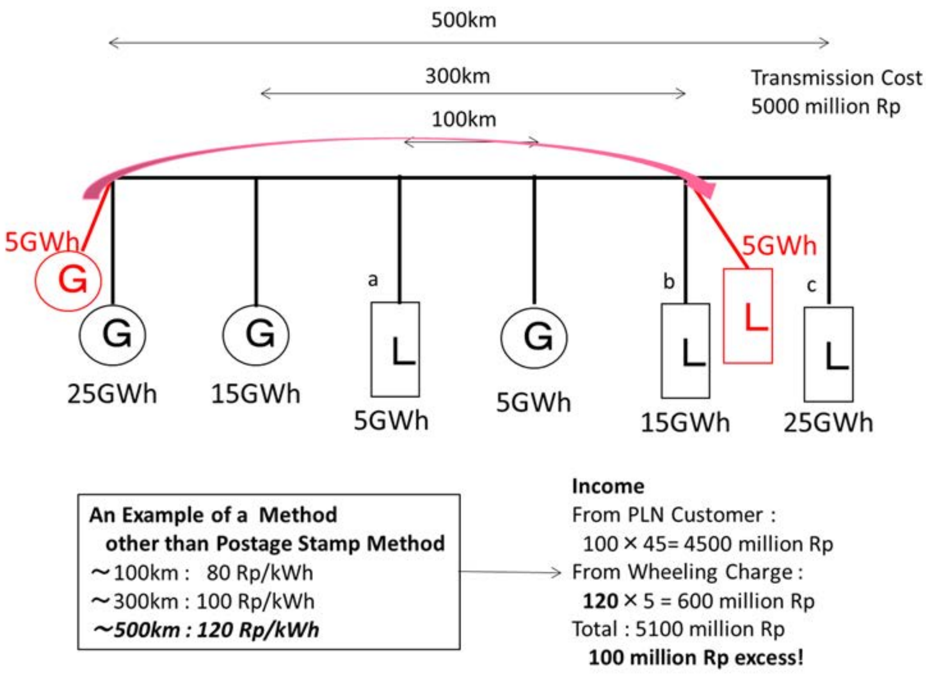


Figure 5-3 A simple example of transmission cost recovery (3)

Cost recovery under MW-mile Method in the case of 400km wheeling

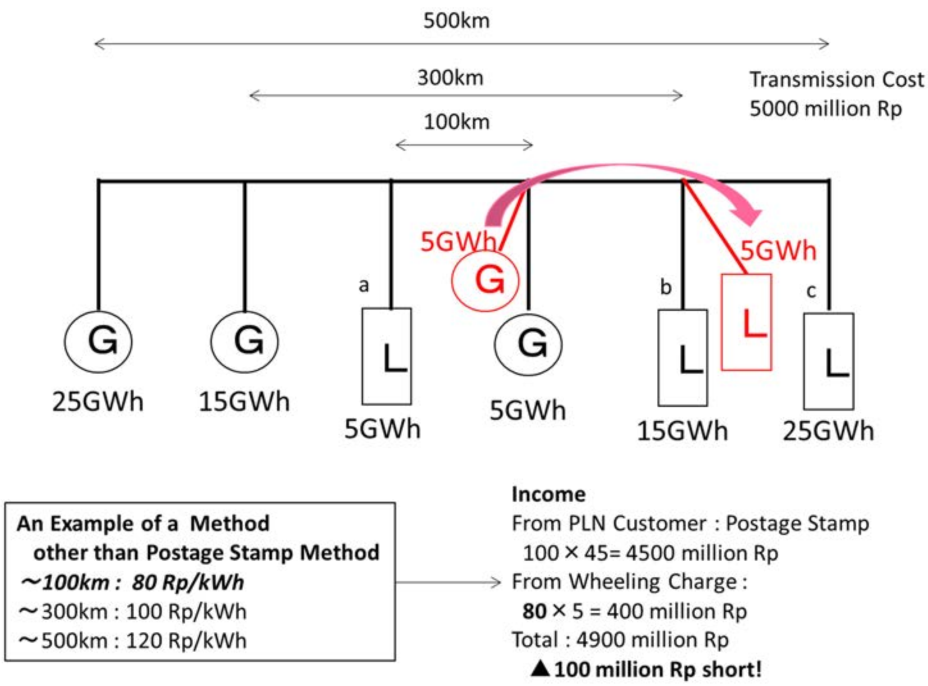


Figure 5-4 A simple example of transmission cost recovery (4)

Cost recovery under MW-mile Method in the case of 100km wheeling

Particularly at the initial stage of wheeling scheme introduction like in Indonesia, it is important that PLN can recover the cost with certainty, as shown in the figure below.

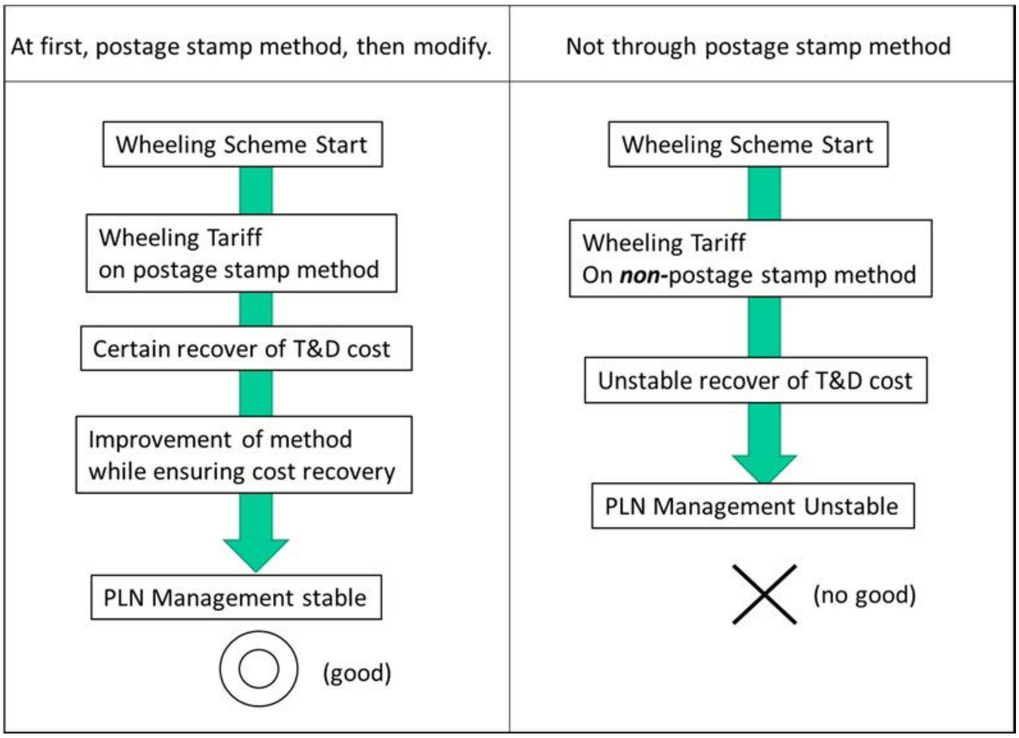


Figure 5-5 PLN management stability at the initial stage of wheeling scheme introduction

The present Indonesian electricity tariff is actually comprised of the generation part and the wheeling part. The wheeling part is already calculated by the Postage Stamp Method, because the present electricity tariff does not change due to the distance between generation and customer.

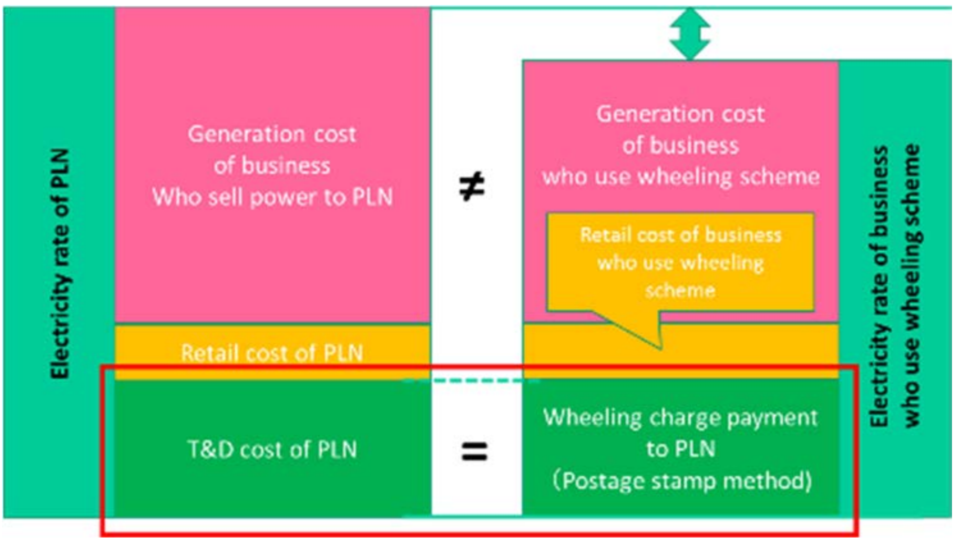


Figure 5-6 Present Electricity Rate of PLN and Wheeling Charge

Therefore, the Postage Stamp Method is considered to be appropriate to Indonesia, especially at the first stage of determining the wheeling tariff.

For the Postage Stamp Method, condition (A) is satisfied by the tariff calculation, dividing required wheeling operation expense by total energy wheeled. For satisfaction of condition (B), required wheeling operation expense should be calculated from the future ideal expense, not from past expense. The ideal expense means expense with anything unnecessary removed.

Based on the above description, the detailed calculation for wheeling by the Postage Stamp Method in Indonesia is explained in the following section.

5.2 Wheeling Cost and Wheeling Tariff Calculated by Postage Stamp Method

Wheeling tariff is derived from wheeling cost in the Postage Stamp Method. Wheeling cost means the total expense for the Transmission and Distribution (T&D) business.

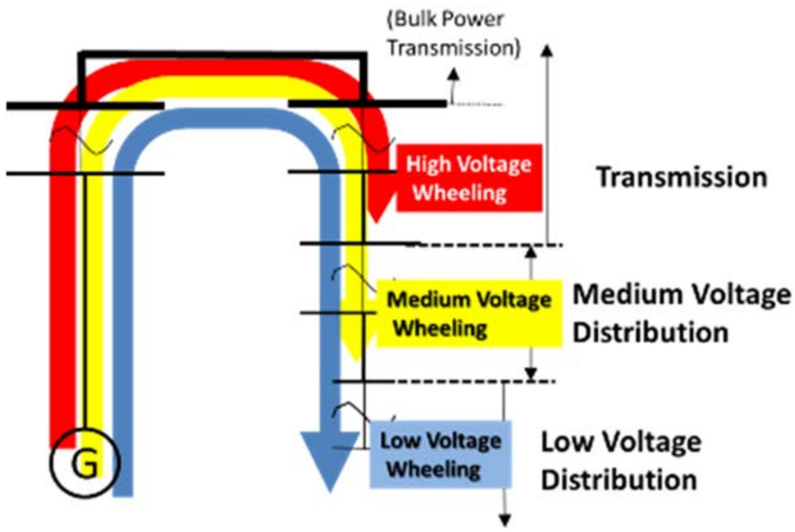


Figure 5-7 Typical Indonesian Power System and Wheeling

The major part of the wheeling cost is T&D operation expense. In PLN's current audited financial statements and statistics, operation expenses are the overall business expenses, not separated into generation expense and T&D expense. It is therefore first necessary to sort the accounting into the generation part and the T&D part. In addition, in the Indonesian power system, T&D operating expense is identified separately for transmission, medium voltage distribution, and low voltage distribution because the wheeling tariff is different between high voltage (HV) wheeling, medium voltage (MV) wheeling, and low voltage (LV) wheeling, as shown in the above figure.

Even in the Postage Stamp Method, the tariff is categorized by type of voltage in the power system. For example, the wheeling tariff for customers directly connected to the transmission system can have distribution expense removed. However, the wheeling tariff for customers connected to the distribution system should include the transmission expense, because most of the energy wheeled flows through the transmission system from major generators connected to it. Therefore, the wheeling tariff varies with the voltage connected.

Expense concerning power system operation is functionally considered to be part of the wheeling business. Power system operation is not only the operation of T&D facilities but also operation using generation control, which mainly maintains a stable system frequency. Generally, in accounting, those generation control expenses called ‘ancillary services’ are originally included in the generation operation expenses. It is required to identify the ancillary service expense and to add it to the wheeling cost.

The wheeling business uses T&D facilities. These require investment cost for construction of new facilities, and adequate profit for satisfaction of condition (A), as described in Section 5.1. This is the adequate business return.

The wheeling cost is comprised of mainly three parts: T&D operation expense, ancillary service (AS) expense, and adequate business return (ABR).

The average wheeling tariff in the Postage Stamp Method is obtained from the wheeling cost divided by total energy wheeled.

The following figure shows the procedure for calculation of the wheeling tariff by the Postage Stamp Method.

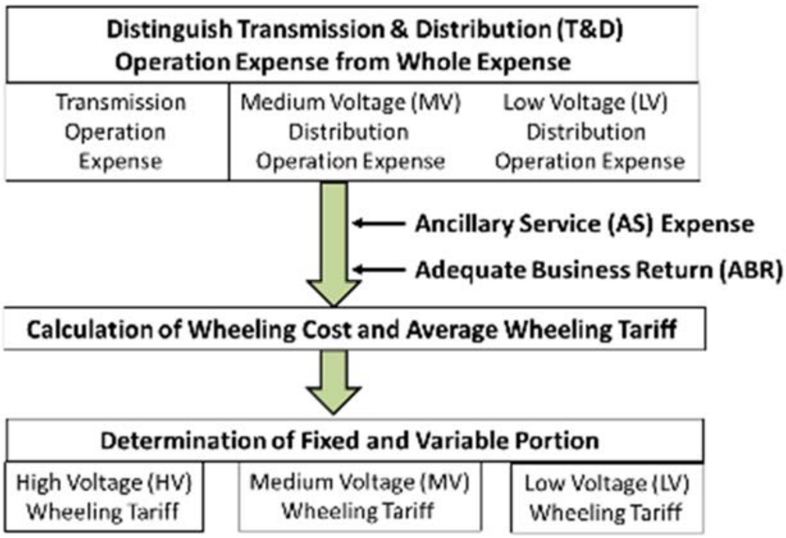


Figure 5-8 The Procedure for Wheeling Tariff Calculation by Postage Stamp Method

Electricity tariffs generally comprise fixed and variable portions. The fixed portion is usually called capacity payment, determined by the maximum wheeling power. The variable portion is called energy payment, determined by integrating the wheeling energy. For generation cost, fuel expense is in the variable portion, and expenses such as depreciation and personnel are considered to be in the fixed portion. In actual fact, T&D expense does not include fuel expense and is almost in the fixed portion, but the customer tends to pay his/her bill according to usage, and will not accept a completely fixed tariff. Therefore, the wheeling tariff should combine the fixed and variable portions.
The following sections describe these expenses one by one.

5.2.1 T&D Operation Expense

In financial statements and statistics, operation expense comprises fuel cost, maintenance cost, personnel cost, depreciation and so on. To identify T&D operation expense, it is necessary to completely remove the operation expenses unrelated to T&D business.

Customers in Indonesia's power system are distinguished by one of three types of voltage category, High Voltage (HV), Medium Voltage (MV), and Low Voltage. HV is above 30kV, the same as transmission networks. MV is 20kV, 6-7kV distribution networks. LV is 220/380V distribution lines.

HV, MV, and LV involve operation expense respectively. The relation between wheeling cost, HV operation expense, MV operation expense, and LV operation expense is shown as the following formula.

Wheeling Cost

= HV Wheeling Operation Expense (HVWOE)

  + MV Wheeling Operation Expense (MVWOE)

  + LV Wheeling Operation Expense (LVWOE)

HVWOE, MVWOE, and LVWOE are calculated by the following formula, as shown in the figure below.

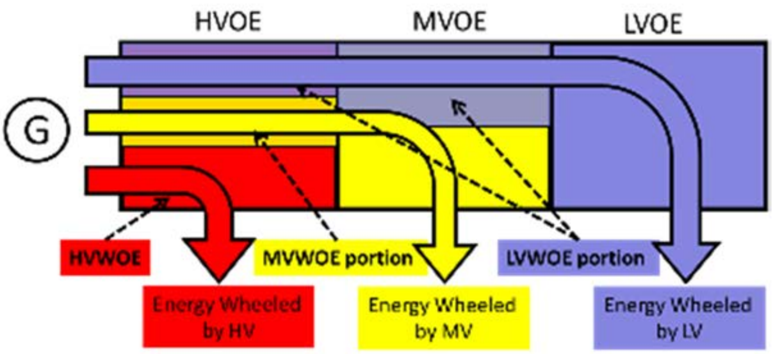


Figure 5-9 Relations between Wheeling Operation Expenses and T&D Operation Expenses

HVWOE

= HV Operation Expense (HVOE) － MVWOE portion of HVOE － LVWOE portion of HVOE

MVWOE

= MV Operation Expense (MVOE) － LVWOE portion of MVOE + MVWOE portion of HVOE

LVWOE

= LV Operation Expense (LVOE) + LVWOE portion of HVOE + LVWOE portion of MVOE

5.2.2 Ancillary Services (AS)

As already stated, expenses for generation control, which mainly maintains a stable system frequency, called ‘ancillary services’, are originally included in the generation expenses. It is required to identify the ancillary service expense in the generation expense and to add it to the wheeling cost.

How to identify the ancillary service expense depends on how PLN operates the power system. The following method is a simple one among various methods. It will be modified by studying PLN’s power system operation in the final report.

According to the Grid Code, the minimum AGC regulation is 2.5% of system load. Annually reserved energy as ancillary services is calculated as shown below.

$$\textbf{Annually reserved energy} = \int_0^{8760} \mathbf{SL(t) \times 0.025dt}$$

Where **SL(t)**: System Load at a certain time (t)

8760: annual total hours

$$= \mathbf{0.025} \int_0^{8760} \mathbf{SL(t)dt}$$

$$= \mathbf{0.025 \times (Net\ Production\ in\ GWh)}$$

AS Cost =(Average Generation Cost) × (Annually reserved energy)

= (Average Generation Cost) × 0.025 × (Net Production in GWh)

=0.025 × (Average Generation Cost) × (Net Production in GWh)

=0.025 × (Total Generation Cost)

5.2.3 Adequate Business Return (ABR)

For the determination of ABR, there are various methods. As stated in Chapter 2, three major approaches in price controls exist:

- Rate of Return (ROR),
- revenue cap and
- price cap.

Although the ROR approach is believed to have caused inefficiency, it has advantages in that the rate formulas are relatively easy to follow and the T&D business operators will not earn excessive profits. For the beginning of the wheeling business, like in Indonesia, it is an appropriate policy to start from the ROR and, afterwards, to apply revenue cap or price cap.

Using the rate to the book value of T&D assets is one of the concrete calculation methods for adequate ROR, and which is conventional. In this method, ABR is the result of multiplying the adequate rate in the book value of T&D assets. How to determine ABR will also be addressed through discussions with government-affiliated agency and PLN.

5.2.4 Calculation of Wheeling Cost and Average Wheeling Tariff

Wheeling cost and average wheeling tariff are calculated by the following formula according to voltage level.

Wheeling Cost

High Voltage (HV) Wheeling Cost
= HV Wheeling Expense + Ancillary Service (AS) Cost + Adequate Business Return (ABR)

Medium Voltage (MV) Wheeling Cost

= MV Wheeling Expense + Ancillary Service (AS) Cost + Adequate Business Return (ABR)

Low Voltage (LV) Wheeling Cost

= LV Wheeling Expense + Ancillary Service (AS) Cost + Adequate Business Return (ABR)

Average Wheeling Tariff

Average High Voltage (HV) Wheeling Tariff = HV Wheeling Cost / Energy Wheeled by HV

Average Medium Voltage (MV) Wheeling Tariff = MV Wheeling Cost / Energy Wheeled by MV

Average Low Voltage (LV) Wheeling Tariff = LV Wheeling Cost / Energy Wheeled by LV

Apparently, the above formulas can transform to the below formulas.

Average HV Wheeling Tariff
= HVOE / (Sum of Energy Wheeled by HV, Wheeled by MV and Wheeled by LV)
Average MV Wheeling Tariff
= Average HV Wheeling Tariff + MVOE / (Sum of Energy Wheeled by MV and Wheeled by LV)
Average LV Wheeling Tariff
= Average HV Wheeling Tariff + Average MV Wheeling Tariff + LVOE / Energy Wheeled by LV

5.2.5 Calculation of Fixed and Variable Portions of Wheeling Tariff

There is no established theory about the calculation of the fixed and variable portions of the wheeling tariff. Consensus among the interested parties is important. In Indonesia, consensus between PLN, the other retailers, and their customers will determine the fixed and variable portions of the wheeling tariff.

In this interim report, the weights of the fixed and variable portions are set so that they both become equal for customers with an average load factor.

5.3 Example of Wheeling Tariff Calculation
(Part 1: Estimation from the financial statements and statistical data)

Accurately separated T&D operation expense in PLN has not been declared so far. In this interim report, T&D operation expense in the whole of Indonesia and the Java system are preliminarily estimated from PLN's audited financial statements and statistics for 2014. AS cost and ABR are estimated in the same way. By the final report, the wheeling tariff will be recalculated with the data that PLN declares. And it is emphasized that the tariff should be determined from adequately expected future values of T&D operation expenses.

5.3.1 Average Wheeling Tariff for the Whole of Indonesia

T&D Operation Expense

T&D Operation Expense ≒ Total Operation Expense (Cost) – Generation Expense (Cost)

(Statistics Table 33) (Statistics Table 37)

= 37,341,955 million Rp

Table 5-2 Estimated T&D Expense

(million Rp)

	Total Operation Cost (Table 33)	Generation Cost (Table 37)	The Remainder, Estimated T&D Expense
Maintenance	20,206,661	9,605,243.54	10,601,417
Personnel	15,749,478	1,570,407.17	14,179,071
Depreciation	23,618,262	16,153,530.42	7,464,732
Others	5,488,617	391,881.94	5,096,735
T&D Expense	-	-	37,341,955

AS Cost

AS Cost = 0.025×Total Generation Cost

According to Statistics Table 37, total generation cost is 198,208,989.18 million Rp.

AS Cost = 0.025×198,208,989.18

=4,955,224.73 million Rp

ABR

'Consolidated Statements of Comprehensive Income for The Year Ended December 31, 2014' on page 3 of 'Consolidated Financial Statements' shows:

'Financial Cost' is 35,971,211 million Rp.

Total 'Book Value' at the end of 2014 is shown in Statistics Table 34,

405,910,372.38 million Rp.

Adequate ROR is assumed to be the value dividing 'Financial Cost' by 'Book Value'.

'Rate of Return' =35,971,211÷405,910,372.38=0.0886=8.86%

T&D Book Value is the total of Book Value for 'Transmission', 'Data Tele Information' and 'Distribution and UPD' in Statistics Table 34.

Transmission	**60,332,547.13**
Data Tele Information	**2,031,443.50**
Distribution and UPD	**79,271,642.88**
T&D	**141,635,633.51**

T&D Book Value is roughly estimated at 141,635,633.51 million Rp.

ABR for Wheeling is 141,635,633.51×0.0866

ABR = 12,265,646.86 million Rp

Wheeling Cost

Wheeling Cost = T&D Operation Expense + AS Cost + ABR

=37,341,955+4,955,224.73+12,265,646.86

=54,562,826.59 million Rp

Average Wheeling Tariff

Average Wheeling Tariff = Wheeling Cost / Total Energy Wheeled

Total Energy Wheeled = Total Energy Sold by PLN=198,601.78GWh

(Statistics Tables 2 and 5)

Average Wheeling Tariff = 54,562,826.59 ÷ 198,601.78

= 274.73 Rp/kWh

This average wheeling tariff includes HV, MV and LV, and it is the average wheeling tariff for the whole of Indonesia.

5.3.2 Average Wheeling Tariff in Java System

Wheeling Cost in Java
= T&D Operation Expense in Java + AS Cost in Java + ABR in Java

T&D Operation Expense in Java

T&D length in Java is almost half that of the total in Indonesia (Statistics Tables 28 and 29)

The Number of Employees in Java is almost 30% of total Indonesia (Statistics Table 40)

Table 5-3 Estimated T&D Expense in Java (million Rp)

	Total Indonesia	Ratio (%)	Java
Maintenance	10,601,417	50	5,300,709
Personnel	14,179,071	30	4.253,721
Depreciation	7,464,732	50	3,732,366
Others	5,096,735	30	1,529,020
T&D Expense	37,341,955	-	14,815,816

AS Cost in Java

Net-Production in Java is almost 75% of the total in Indonesia. (Statistics Table 2)

$4,955,224.73 \times 0.75 = 3,716,418.55$ (million Rp)

ABR in Java

T&D length in Java is almost half that of the total in Indonesia (Statistics Tables 28 and 29)

→ $12,265,646.86 \times 0.5 = 6,132,823.43$ (million Rp)

Wheeling Cost in Java

Wheeling Cost in Java = 14,815,816+3,716,418.55+6,132,823.43
= 24,665,057.98 (million Rp)

Average Wheeling Tariff in Java

Total Energy Wheeled in Java = Total Energy Sold by PLN in Java = 145,071.45GWh
(Statistics Tables 2 and 5)

Average Wheeling Tariff in Java = 24,665,057.98 ÷ 145,071.45

= **170.02 Rp/kWh**

5.3.3 Wheeling Tariff in Java According to Voltage

So far, there is no accurate data about HV operation expense (HVOE), MV operation expense (MVOE), or LV operation expense (LVOE). In the below table, HVOE, MVOE, and LVOE are assumed to be equal.

Table 5-4 Estimated Wheeling Tariff in Java (million Rp)

	Operation Expense (million Rp)	Energy Wheeled (GWh)	Wheeling Tariff in Java (Rp/kWh)
HV in Java	Total 24,665,057.98	12,349.35	56.73
MV in Java		58,763.27	*118.75
LV in Java		73,804.00	**230.15

*=56.73+62.02

**=56.73+62.02+111.40

As shown in the above table, HV wheeling tariff is estimated at 56.73 Rp/kWh.

The above is a preliminary calculation of the wheeling tariff by the Postage Stamp method. By the final report, this will be recalculated with the data that PLN declares.

5.4 Example of Wheeling Tariff Calculation
(Part 2: Estimation from T&D operating expenses in Java)

The JICA survey team got the following table detailing Java T&D operation expenses data for 2014 from PLN's Commercial Division on February 10, 2016, though it was not in the published data. The Wheeling Tariff in Java is calculated on the basis of this data.

5.4.1 Estimation of Average Wheeling Tariff in Java

In the table below, ABR is assumed to be the same as the borrowing costs, and the ancillary service cost is assumed as 3.49Rp/kWh, the same as Section 5.3. The average wheeling tariff in Java is determined by the below formula. Energy Wheeled, referred to in Table 2 of the statistical data, is 145,071.45GWh.

Average Wheeling Tariff = 14,647,794,749,439/145,071.45+3.49

= 104.46 (Rp/kWh)

Table 5-5 Java T&D operation expenses data for 2014 from PLN Commercial Division

		a. Transmisi	b. Tele Informasi Data	c. Distribusi	d. Unit Pengatur Distribusi	Total
Total		4,082,802,931,110	240,222,167,057	9,911,633,060,671	413,136,590,601	14,647,794,749,439
	Biaya Pinjaman (borrowing cost)	576,135,015,604	16,822,009,636	797,320,726,765	33,848,149,477	1,424,125,901,482
Beban Pemeliharaan (Maintenance Coat)	Pemakaian Material (material cost)	148,540,624,500	15,426,436,843	535,321,340,075	7,281,762,011	706,570,163,429
	Jasa Borongan (wholesale service)	588,808,567,054	28,912,794,979	1,944,369,508,813	75,096,258,166	2,637,187,129,012
Beban Kepegawaian	Gaji dan Lainnya (Salary and Others)	647,545,859,073	45,468,258,168	1,962,980,446,800	89,745,982,126	2,745,740,546,167
	Cuti Dan Lainnya (Leave and Others)	263,748,032,035	29,634,249,628	935,977,265,638	48,223,186,343	1,277,582,733,644
	Diklat dan Lainnya (Education & Training)	9,354,935,298	1,511,524,007	23,273,659,798	1,109,899,577	35,250,018,680
Beban Administrasi (Administration Cost)		90,941,001,323	31,407,683,305	1,390,192,831,056	83,997,632,779	1,596,539,148,461
Beban Penyusutan (Depreciation)		1,757,728,896,224	71,039,210,491	2,322,197,281,727	73,833,720,122	4,224,799,108,563

5.4.2 Estimation of HV Wheeling Tariff in Java

If item "a. Transmisi" and 50% of item "b. Tele Infomasi Data" is assumed to be transmission operational expense, that is, HV wheeling operational expense, HV wheeling tariff can be estimated as shown in the following table.

Table 5-6 The concept of HV Wheeling Tariff

		a. Transmisi	b. Tele Informasi Data	c. Distribusi	d. Unit Pengatur Distribusi	Total
Total		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]4,749,439
Biaya Pinjaman (borrowing cost)		576,135,015,604	16,8[illegible]009,636	797,320,726,765	33,848,149,477	1,424,125,901,482
Beban Pemeliharaan (Maintenance Coat)	Pemakaian Material (material cost)	148,540,624,500	15,426[illegible]	[illegible]	[illegible]	[illegible]29
	Jasa Borongan (wholesale service)	588,808,567,054	28,91[illegible]	[illegible]	[illegible]	[illegible]12
Beban Kepegawaian	Gaji dan Lainnya (Salary and Others)	647,545,859,073	45,468,258,168	1,962,980,446,800	89,745,982,126	2,745,740,546,167
	Cuti Dan Lainnya (Leave and Others)	263,748,032,035	29,634,249,628	935,977,265,638	48,223,186,343	1,277,582,733,644
	Diklat dan Lainnya (Education & Training)	9,354,935,298	1,511,524,007	23,273,659,798	1,109,899,577	35,250,018,680
Beban Administrasi (Administration Cost)		90,941,001,323	31,407,683,305	1,390,192,831,056	83,997,632,779	1,596,539,148,461
Beban Penyusutan (Depreciation)		1,757,728,896,224	71,039,210,491	2,322,197,281,727	73,833,720,122	4,224,799,108,563

HV(Transmission) | MV and LV(Distribution)

Transmisi and A Part of Tele infomasi Data
of Borrowing Cost
= HV(Transmission) ABR in Java

Transmisi and A Part of Tele infomasi Data
Except Borrowing Cost
= HV(Transmission) Operation Expense in Java

Table 5-7 Estimation of HV Wheeling Tariff in Java

		New Estimation	Interim Report
①	HV(Transmission) Operation Expense(OE)(Rp.)	3,618,367,994,217	5,462,478,000,000
②	ABR (Rp.)	584,546,020,422	2,261,126,000,000
③	HV Wheeling OE(HVWOE) ①+②(Rp.)	4,202,914,014,639	7,723,604,000,000
④	Energy Wheeled Statistics Table 2 (GWh)	155,034.48*	145,071.45**
⑤	Unit Cost of HVWOE ③/④(Rp./kWh)	27.11	53.24
⑥	Unit Cost of AS*** (Rp./kWh)	3.49	3.49
⑦	HV Wheeling Tariff ⑤+⑥(Rp./kWh)	**30.60**	**56.73**

*Send to Distribution, **Energy Consumption
***Overall average of Indonesia

The Java T&D operation expenses data for 2014, obtained from PLN's Commercial Division on February 10, 2016, was divided into data for each of the four regions of West Java, Jakarta, Central Java, and East Java. HV wheeling tariffs for the respective four regions can be estimated as shown in the table below. In this table, however, power flows across the region are not taken into consideration. The most expensive tariff is 30.72Rp/kWh in West Java; the most inexpensive tariff is 30.41Rp/kWh in Jakarta. The difference between them is 0.31Rp/kWh.

Table 5-8 Estimations of HV Wheeling Tariffs in each region of Java

		West Java	Jakarta	Central Java	East Java
③	HV Wheeling OE(HVWOE) (Million Rp.)	1,485,574	1,195,619	637,401	884,321
④	Energy Wheeled Statistics Table 2* (GWh)	54,557	44,416	23,491	32,525
⑤	Unit Cost of HVWOE ③/④(Rp./kWh)	27.23	26.92	27.13	27.19
⑥	Unit Cost of AS** (Rp./kWh)	3.49			
⑦	HV Wheeling Tariff ⑤+⑥(Rp./kWh)	**30.72**	**30.41**	**30.62**	**30.68**
		Max	**Min**		
		Difference **0.31**			

*Send to Distribution
**Slide 12

Chapter 6 Case Study

6.1 Concept of Case Study

Case study 1 compares charges for electricity purchased from PLN to electricity supply costs including the expected wheeling charge. We estimated the wheeling charge based on data acquired from other Indonesian IPP companies, then compared these data with each voltage level.
Case study 2 explains two polices investigating ways to avoid the power wheeling, such as exceeding the power transmission capacity, due to the power supply being stable - in particular, the Distance Based MW-mile Method, which is calculated according to the distance, and construction cost allocation for interconnection facilities. These two methods are explained below. We then verify the economic burden from power wheeling.

6.2 Case Study 1

In the first study, we verify connected voltage class. Therefore, we used typical types of power generation cost published by PLN in the past. The below shows the power generating costs.

Table 6-1 Power Generating Costs for case study 1

	Power Generation type	$US ¢ /kWh	Rp/kWh
1	Hydropower 180MW-1175MW	2.2	275.0
2	Hydropower 180MW-1175MW	4.2	525.0
3	Geothermal Power generation 10-110MW	4.3	537.5
4	Geothermal Power generation 10-110MW	6.0	750.0
5	(Coal) Thermal power generation >600MW	6.3	787.5
6	Geothermal Power generation 10-110MW	6.3	787.5
7	(Coal) Thermal power generation >600MW	6.5	812.5
8	Gas turbine Thermal power generation 40MW-300MW	6.5	812.5
9	(Coal) Thermal power generation >600MW	7.0	875.0
10	(Coal) Thermal power generation 100MW-300MW	7.0	875.0
11	Geothermal Power generation 10-110MW	7.0	875.0
12	Geothermal Power generation 100MW-300MW	7.5	937.5
13	Geothermal Power generation >600MW	8.0	1,000.0
14	Geothermal Power generation 100MW-300MW	8.0	1,000.0
15	Geothermal Power generation <25MW	8.0	1,000.0
16	Gas turbine Thermal power generation 40MW-300MW	8.0	1,000.0
17	Hydropower 180MW-1175MW	8.0	1,000.0
18	(Coal) Thermal power generation <25MW	8.1	1,012.5
19	Gas turbine Thermal power generation 40MW-300MW	8.2	1,025.0
20	Geothermal Power generation 10-110MW	9.3	1,162.5

Source: JICA Team

6.2.1 Power Generation Costs for Case Study 1

Table 6-2 below shows electric charges from PLN. The Normal Electric charge includes a subsidy. Therefore, the low voltage electric charge is inexpensive.

Table 6-2 Electric Charges of PLN (including Subsidy)

Voltage class	Electric Charge of PLN (including Subsidy)
High Voltage (70 kV - 150 kV)	1,191 Rp/kWh
Middle Voltage	1,115 Rp/kWh
Low Voltage	972 Rp/kWh

Source: PLN Annual Report

The below does not include the Electric Charges of PLN. The Low and Middle voltage electric charges are lower than the High voltage electric charge. This is in order to introduce a subsidy. In this case, we use electric charges including the subsidy and compare the power wheeling and electric charges.

Table 6-3 Electric Charges of PLN (not including subsidy) [April 2016]

Voltage class	Electric Charge of PLN (not including Subsidy)
High Voltage (70 kV - 150 kV)	925 Rp/kWh
Middle Voltage	1,033 Rp/kWh
Low Voltage	1343 Rp/kWh

Source: PLN Commercial Division

We compared electric charges including subsidies and power wheeling costs. The High voltage power wheeling cost is from 40 to 100Rp; the Middle voltage power wheeling cost is from 90 to 150Rp, and the Low voltage power wheeling cost is from 170 to 230Rp. These results are shown in Table 6-4. The red areas of Table 6-4 signify power wheeling costs more expensive than PLN's electric charges. The blue areas signify power wheeling costs that are lower.

6.2.2 Economic Analysis of Case Study 1

In the case of PLN's electricity charge, there is no differentiation by electricity charge for each voltage, because PLN's electricity charge includes a subsidy. The electricity charge tends to be expensive for high voltage. In the high voltage case, if you utilize a power wheeling scheme you can reduce the burden on the electricity charge. In the Middle voltage case, if you utilize a power wheeling scheme, it is difficult to obtain economic benefit. To obtain benefit, you need power that is more inexpensive than the average unit price. In the low voltage case, if you utilize a power wheeling scheme, you cannot obtain economic benefit. To obtain benefit, you have to apply the lowest cost of power. This results of this case are confirmed by Table 6-4. In the high voltage case, it is better to utilize a power wheeling cost from 40 to 100Rp, because the power wheeling cost is lower than the electricity charge. In the Middle voltage case, it is better to utilize a power wheeling cost of about 90Rp. Almost all power generation of the power wheeling cost is lower than the electricity charge. However, the cases in which the power wheeling cost is from 120 Rp to 150Rp are lower than the electricity charge, with the exception of those for the high power cost. In contrast, for low voltage, except for the low cost power generation case, the power wheeling cost is higher than the electricity charge. The power wheeling scheme also adopts power generator cost, power wheeling cost and retail cost. The economic benefits of power wheeling are illustrated in Table 6-4 below. There is economic benefit in the high voltage supply, but not in the low voltage supply.

Table 6-4 Power Supply Costs of Power Wheeling Scheme by Power Generation and Voltage

			High Voltage Supply			Middle Voltage Supply			Low Voltage Supply		
			40Rp/kWh	70Rp/kWh	100Rp/kWh	90Rp/kWh	120Rp/kWh	150Rp/kWh	170Rp/kWh	200Rp/kWh	230Rp/kWh
1	Hydropower 180MW−1175MW	C	315.0	345.0	375.0	365.0	395.0	425.0	445.0	475.0	505.0
2	Hydropower 180MW−1175MW	A	565.0	595.0	625.0	615.0	645.0	675.0	695.0	725.0	755.0
3	Geothermal power generation 10−110MW	D	577.5	607.5	637.5	627.5	657.5	687.5	707.5	737.5	767.5
4	Geothermal power generation 10−110MW	B	790.0	820.0	850.0	840.0	870.0	900.0	920.0	950.0	980.0
5	(Coal) Thermal power generation 600MW	A	827.5	857.5	887.5	877.5	907.5	937.5	957.5	987.5	1,017.5
6	Geothermal power generation 10−110MW	A	827.5	857.5	887.5	877.5	907.5	937.5	957.5	987.5	1,017.5
7	(Coal) Thermal power generation> 600MW	D	852.5	882.5	912.5	902.5	932.5	962.5	982.5	1,012.5	1,042.5
8	Gas turbine Thermal power generation 40MW−300MW	C	852.5	882.5	912.5	902.5	932.5	962.5	982.5	1,012.5	1,042.5
9	(Coal) Thermal power generation >600MW	C	915.0	945.0	975.0	965.0	995.0	1,025.0	1,045.0	1,075.0	1,105.0
10	(Coal) Thermal power generation 100MW−300MW	B	915.0	945.0	975.0	965.0	995.0	1,025.0	1,045.0	1,075.0	1,105.0
11	Geothermal power generation 10−110MW	C	915.0	945.0	975.0	965.0	995.0	1,025.0	1,045.0	1,075.0	1,105.0
12	(Coal) Thermal power generation 100MW−300MW	A	977.5	1,007.5	1,037.5	1,027.5	1,057.5	1,087.5	1,107.5	1,137.5	1,167.5
13	(Coal) Thermal power generation >600MW	B	1,040.0	1,070.0	1,100.0	1,090.0	1,120.0	1,150.0	1,170.0	1,200.0	1,230.0
14	(Coal) Thermal power generation 100MW−300MW	C	1,040.0	1,070.0	1,100.0	1,090.0	1,120.0	1,150.0	1,170.0	1,200.0	1,230.0
15	(Coal) Thermal power generation <25MW	A	1,040.0	1,070.0	1,100.0	1,090.0	1,120.0	1,150.0	1,170.0	1,200.0	1,230.0
16	Gas turbine Thermal power generation 40MW−300MW	A	1,040.0	1,070.0	1,100.0	1,090.0	1,120.0	1,150.0	1,170.0	1,200.0	1,230.0
17	Hydropower 180MW−1175MW	B	1,040.0	1,070.0	1,100.0	1,090.0	1,120.0	1,150.0	1,170.0	1,200.0	1,230.0
18	(Coal) Thermal power generation <25MW	B	1,052.5	1,082.5	1,112.5	1,102.5	1,132.5	1,162.5	1,182.5	1,212.5	1,242.5
19	Gas turbine Thermal power generation 40MW−300MW	B	1,065.0	1,095.0	1,125.0	1,115.0	1,145.0	1,175.0	1,195.0	1,225.0	1,255.0
20	Geothermal power generation 10−110MW		1,202.5	1,232.5	1,262.5	1,252.5	1,282.5	1,312.5	1,332.5	1,362.5	1,392.5

(1$⇒125Rp) Source: JICA Team

6.3 Case Study 2

Case study 2 explains two polices investigating ways to avoid the power wheeling, such as exceeding the power transmission capacity, due to the power supply being stable - in particular, the Distance Based MW-mile Method, which is calculated according to the distance, and construction cost allocation for interconnection facilities. These two methods are explained below. We then verify the economic burden from power wheeling.

【Assumed case】

Power Wheeling：100 MW

Annual Power Wheeling ：700 GWh (Load Factor: 80%)

Voltage level：150 kV (High Voltage)

A new transmission line is constructed in the case below. One case features enhancement of the transmission grid; the other one establishes a new transmission line for connection to PLN's grid.

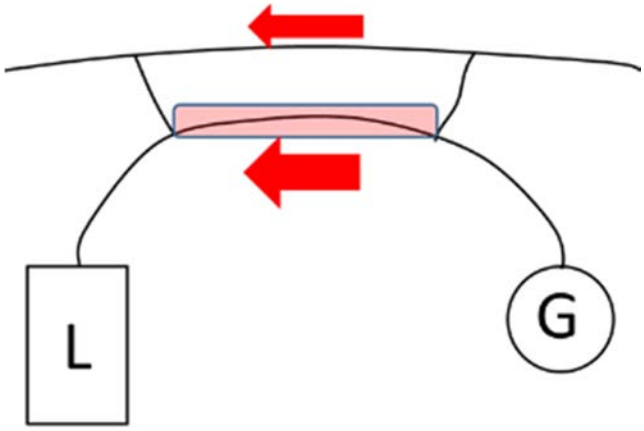


Figure 6-1 Example of Transmission Line Enhancement by Power Wheeling

Source: JICA Team

6.3.1 Distance Based MW-mile Method

In the case of PLN's grid having no margin of power, it would adopt the Postage Stamp Method. As a result, the enhancement of PLN's grid would not be able to keep pace with the increase in power wheeling for long distances, threatening its stable management. If it adopts the Distance based MW-mile Method, it would set up a high power wheeling high cost and get incentives for new generators. In other words, having new generators avoids long distance power wheeling. We verify this case using the present electricity charges in Indonesia. PLN's high voltage electricity charge is 1,191Rp. We calculated the expansion of power wheeling of more than 100Rp based on the results of case 1, high voltage power supply cost. As a result, a power wheeling cost of up to 300Rp is lower than PLN's electricity charge. For the Distance Based MW-mile Method, in order to avoid wheeling with long-distance transmission line enhancement, we considered the range in which the difference between the power wheeling cost and electricity charge is possible. 10Rp/kWh is the limit in Java because the power wheeling cost for high voltage supply is about 100Rp/kWh. If you want to make a difference of 100Rp/kWh in the power wheeling cost and electricity charge, the short distance power wheeling cost is too inexpensive. This case will not be able to recover its costs. As a result, PLN will go bankrupt.

Table 6-5 Power Wheeling Cost Expanded to more than 100Rp in High Voltage Supply of Case Study 1

High Voltage Supply

			40Rp	70Rp	100Rp	150Rp	200Rp	250Rp	300Rp	350Rp
1	Hydropower 180MW-1175MW	C	315.0	345.0	375.0	425.0	475.0	525.0	575.0	625.0
2	Hydropower 180MW-1175MW	A	565.0	595.0	625.0	675.0	725.0	775.0	825.0	875.0
3	Geothermal power generation 10-110MW	D	577.5	607.5	637.5	687.5	737.5	787.5	837.5	887.5
4	Geothermal power generation 10-110MW	B	790.0	820.0	850.0	900.0	950.0	1,000.0	1,050.0	1,100.0
5	(Coal) Thermal power generation 600MW	A	827.5	857.5	887.5	937.5	987.5	1,037.5	1,087.5	1,137.5
6	Geothermal power generation 10-110MW	A	827.5	857.5	887.5	937.5	987.5	1,037.5	1,087.5	1,137.5
7	(Coal) Thermal power generation >600MW	D	852.5	882.5	912.5	962.5	1,012.5	1,062.5	1,112.5	1,162.5
8	Gas turbine Thermal power generation 40 MW-300MW	C	852.5	882.5	912.5	962.5	1,012.5	1,062.5	1,112.5	1,162.5
9	(Coal) Thermal power generation >600MW	C	915.0	945.0	975.0	1,025.0	1,075.0	1,125.0	1,175.0	1,225.0
10	(Coal) Thermal power generation 100MW-300MW	B	915.0	945.0	975.0	1,025.0	1,075.0	1,125.0	1,175.0	1,225.0
11	Geothermal power generation 10-110MW	C	915.0	945.0	975.0	1,025.0	1,075.0	1,125.0	1,175.0	1,225.0
12	(Coal) Thermal power generation 100MW-300MW	A	977.5	1,007.5	1,037.5	1,087.5	1,137.5	1,187.5	1,237.5	1,287.5
13	(Coal) Thermal power generation >600MW	B	1,040.0	1,070.0	1,100.0	1,150.0	1,200.0	1,250.0	1,300.0	1,350.0
14	(Coal) Thermal power generation 100MW-300MW	C	1,040.0	1,070.0	1,100.0	1,150.0	1,200.0	1,250.0	1,300.0	1,350.0
15	(Coal) Thermal power generation <25MW	A	1,040.0	1,070.0	1,100.0	1,150.0	1,200.0	1,250.0	1,300.0	1,350.0
16	Gas turbine Thermal power generation 40MW-300MW	A	1,040.0	1,070.0	1,100.0	1,150.0	1,200.0	1,250.0	1,300.0	1,350.0
17	Hydropower 180MW-1175MW	B	1,040.0	1,070.0	1,100.0	1,150.0	1,200.0	1,250.0	1,300.0	1,350.0
18	(Coal) Thermal power generation <25MW	B	1,052.5	1,082.5	1,112.5	1,162.5	1,212.5	1,262.5	1,312.5	1,362.5
19	Gas turbine Thermal power generation 40MW-300MW	B	1,065.0	1,095.0	1,125.0	1,175.0	1,225.0	1,275.0	1,325.0	1,375.0
20	Geothermal power generation 10-110MW	E	1,202.5	1,232.5	1,262.5	1,312.5	1,362.5	1,412.5	1,462.5	1,512.5

Source: JICA Team

6.3.2 Method of Contribution in Aid of Construction

The Java construction cost is as below.

- 500kV 7,000 million Rp (560,000US$)/km
- 150kV 2,500 million Rp (200,000US$)/km

In the power wheeling scheme, for construction of a 20km, 500kV transmission line the contribution in aid of construction is 140,000 million Rp. In terms of the difference in power wheeling cost, it is worth an increase of 20Rp/kWh (10 years). For construction of a 20km, 150kV transmission line the contribution in aid of construction is 50,000 million Rp. In terms of the difference in power wheeling cost, it is worth an increase of 7Rp/kWh (10 years). Incrementing of the power wheeling is necessary to recover the construction costs and distance for the new transmission line. These cases are shown below.

Table 6-6 Incrementing of Power Wheeling Necessary to Recover the Construction Costs and Distance for New Transmission Line

km	500 kV	150 kV
20	20 Rp/kWh	7 Rp/kWh
40	40 Rp/kWh	14 Rp/kWh
60	60 Rp/kWh	21 Rp/kWh
80	80 Rp/kWh	29 Rp/kWh
100	100 Rp/kWh	36 Rp/kWh
120	120 Rp/kWh	43 Rp/kWh
140	140 Rp/kWh	50 Rp/kWh
160	160 Rp/kWh	57 Rp/kWh

Source: JICA Team

6.4 Imposing Contribution in Aid of Construction

There are two basic stances on cost burden in Japan.

- Cost for construction of power line: Generator underwrites full amount, on polluter-pays-principle.
- Cost for non-construction of power line: basically a benefit principle.

However this isn't suitable for Indonesia, which has increasing power demand and is increasing the power grid. Therefore, the cost for non-construction of the power line case is suited to the polluter-pays-principle. In particular, when multiple generators or blast furnaces destabilize the power flow, PLN determines the connection propriety. As a result, PLN determines enhancement of the transmission line, and receives the polluter-pays-principle. These costs do not necessarily include the power wheeling charge. Generators who want to connect with PLN's grid have to pay the polluter-pays-principle to PLN. Emergency cases are the same.

6.4.1 Comparison of the Two Cases

In the cases of 6.3.1 and 6.3.2, power wheeling which has a low cost and competitive power generator will be a success. However, PLN should select the polluter-pays-principle before introducing the power wheeling scheme, because if it selects the Distance Based MW-mile Method its recovery cost would be delayed. The polluter-pays-principle is more advantageous.

6.5 Summary of Case Study

In summary of cases 1 and 2, if you secure competitive power you will be able to suppress the cost by using the power wheeling cost. Particularly in the case of high voltage this trend is high. It can also be confirmed that the polluter-pays-principle scheme has a higher economic benefit than the distance based MW-mile method.

Chapter 7 Recommendation of Measures for Effectiveness of Electric Power Wheeling Scheme & ODA Cooperation

7.1 Mid and Long Term Simple Roadmap

The arrangement of the power wheeling scheme in the Indonesian power sector is mentioned in the ADB programmatic approach report. The ADB's report gives the following arrangements.

(Source: Report and Recommendation of the President to the Board of Directors, Project Number: 49043-001, September 2015, Proposed Programmatic Approach and Policy-Based Loans for Subprogram 1, Republic of Indonesia: Sustainable and Inclusive Energy Program Distribution)

- The government has now established the basis for wheeling arrangements. It will set up rates and settlement rules and the basis for cross-border trade.
- Two power wheeling agreements by PLN are to be signed by 2019.
- The arrangement of the power wheeling scheme is planned as follows, according to the subprogram of facilitating the delivery of projects in the energy sector to promote markets enabled for private participation

○ Subprogram 1 (Accomplishments)

Government-enabled greater private sector participation in the electricity sector, including in the transmission sector.

ADB's Stepping Up Investments for Growth Acceleration Program (SIGAP) TA is providing technical assistance to the Investment Coordinating Board (BKPM)

○ Subprogram 2 (by 2017)

MEMR establishes wheeling charges as stipulated under Permen ESDM 1/2015.

○ Subprogram 3 (by 2019)

MEMR allows cross-border electricity trading as stipulated under Law 30/2009.

○ Medium-term directions and expected results (2019 to 2023)

Development of private generation to supply domestic industrial consumers, thereby reducing the amount of PLN investment required. (This is desirable due to the financial covenants PLN faces on its commercial debt, which limit its ability to borrow.)

Development of IPPs for cross-border power export would improve the country's balance of payments.

Based on the discussion with MEMER and PLN and this ADB programmatic approach the simple road map is set out as follows.

<Draft Simple Power Wheeling Road Map>

Continuous revision of wheeling tariff system will be required according to the change in its situation for all the following steps.

By the end of 2017

MEMR enacts wheeling tariff

- MEMR makes wheeling rules, which state All Power Wheeling Contract shall satisfy system reliability criteria, and guidelines under the grid code criteria specified by MEMR.
- Draft Wheeling Contract to be submitted, and MEMR. MEMR approves it.
- PLN determines the specifications of the energy measurement system and installs them for power wheeling to detect power balance between power generation and its consumption.
- Network service center (described later) is established in PLN.
- PLN conduct three obligations for power wheeling, (1) Prohibition of Utilization of information other than for Intended Purposes (2) Prohibition of Discriminatory Treatment of Power Wheeling applicants (3) Separate Accounting

Starting in 2018

- Several contracts are made between private companies who have “Wilayah Usaha” and PLN and power wheeling is started.
- Conditions for receiving “Wilayah Usaha” are modified for its clear acquisition
- Feasibility study is done on using PLN’s power wheeling scheme for power import and export as cross-boundary trade.

From 2019 to 2050

- Large independent power retailers, such as new industrial zones or commercial areas who have “Wilayah Usaha”, become able to select freely their power suppliers. National economic efficiency is improved.
- Work for PLN’s obligation of electric power balancing is increased. The portion of private power generation contributing to ancillary services for power adjustment is sold and bought
- The Project using PLN’s power wheeling scheme is realized for power import and export as cross-boundary trade.

7.2 Proposals of Required Measures for Improvement of Power Wheeling Scheme in Indonesia

7.2.1 Necessary Amendments to Laws and Regulations

7.2.1.1 Necessary License for Power Wheeling and its Legal Framework

As summarized in section 3.3, “Necessary Government Approval and Business Rights for Electricity Supply Business Using Power Wheeling Scheme”, a new retail business entity must obtain an IUPTL from MEMR, and a Wilayah Usaha from the corresponding authority, state/local government or MEMR. The current legal framework already includes a fundamental power wheeling scheme and authority for this is given to MEMR. However, actual operational rules and procedures, such as the power wheeling tariff calculation formula and its approval process, have not been defined nor disclosed yet.

In order to introduce the Indonesian power wheeling scheme in a fair manner, MEMR must develop actual operational rules for power wheeling, and examine their adequacy by examining operational cases and procedures with actual power wheeling application.

7.2.1.2 Criteria for the Entitlement of Business Area (Wilayah Usaha) for New Business Entities, and Simplification of Application Procedures

In order to achieve electrification throughout Indonesia and the expansion of a reliable transmission grid by introducing a power wheeling scheme, many new retail business entities and reliable and cost-efficient independent power producers (IPPs) are necessary. The retailers must also obtain Wilayah Usaha from PLN, owner of the majority of Wilayah Usaha in Indonesia, via an order by MEMR to re-distribute the business area to them. Thus, MEMR amended their regulations relating to Wilayah Usaha approval, and enabled the power division to form a technical study team to determine the Wilayah Usaha entitlement, which was formerly proposed by PLN. Therefore, MEMR's internal procedures and criteria for Wilayah Usaha entitlement shall be developed and disclosed in public hearings to provide fair and legitimate decisions on Wilayah Usaha re-distribution.

7.2.1.3 Transparency in Power Wheeling Conditions and MEMR's Policy

As discussed in Section 2, governments in other countries utilizing power wheeling schemes establish managerial entities to monitor open and fair power wheeling markets, healthy and fair operation of transmission business entities, fair tariff systems, and standardized supply conditions.

The introduction of the power wheeling scheme in Indonesia can be slightly different to that of other countries, because it must be enacted while total electricity demand is continuously and sharply increasing. Thus, MEMR must have strong authority in monitoring fair trade and fair execution of the power wheeling scheme while maintaining sufficient electricity generation capacity, and authority in revising power wheeling policy with changes in electricity demand trends, the power wheeling business situation, and the economic situation.

Thus, the pricing system shall be approved by MEMR for the whole country, and MEMR must approve single power wheeling conditions, which all power wheeling businesses must follow for the sake of fair and equal opportunity for all retail and IPP business entities.

In addition, PLN's transmission business unit must be isolated from other PLN businesses by new MEMR laws and regulations, to achieve fair business treatment for all market entities. Then, the transmission business unit must be strengthened in terms of technical capability, work resources, and operational systems such as the network control center for better network control with the increased number of market players under MEMR's audit.

7.2.2 Technical Requirements required for Introduction of Power Wheeling

A balancing measurement between power generation companies and power consumers is required. Thus, unified management is needed via the development of meters, their installation and telecommunication. This kind of work will be carried out by Network Service Center.

In addition, the need for new connections to generators, and the new installation of power transmission and distribution facilities or its impact of increasing power output to the system, must be technically studied. This kind of work will also be carried out by Network Service Center.

7.2.3 Power Wheeling Tariff System in Future

The wheeling tariff system currently proposed in this report is the initial one for Indonesia, based on the cost recovery method via a unified tariff in a certain region that has the same concept as the current electric tariff system in Indonesia under consideration, with its main purpose of ensuring revenue for clear and certain recovery of the cost of PLN's power transmission and distribution business.

In order to activate the utilization of the power wheeling system, the power wheeling tariff must be continuously reviewed in the future, analyzing the usage situation of power wheeling such as the case of politically controlling the degree of new entrants in a certain regions or a certain power grid. It is necessary to establish a system to allow PLN to collect the installation fee that should be charged to power generation companies, such as the construction cost of PLN's facilities required for new grid connection or the increase in power outputs of generators, calculated as shown in the abovementioned section. As described in Chapter 2, the power wheeling schemes have been reviewed from time to time in foreign countries. A review of the power wheeling tariff system will be required for Indonesia in consideration of the regional pricing or the elaboration of the business return for a transmission company that are applied in some of the countries that have advanced the progress of the power wheeling system, such as Western countries.

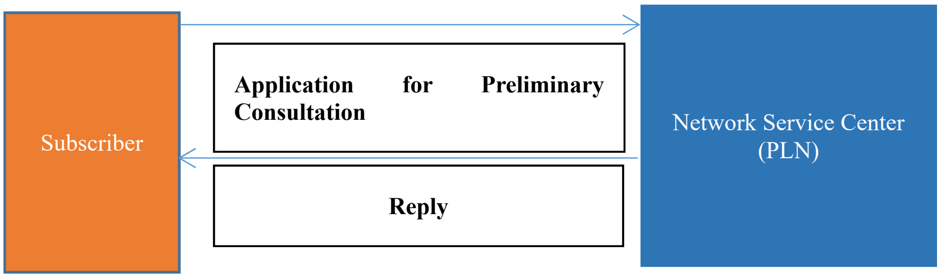
7.2.4 Incentives to Encourage Investment in Power Demand – Supply - Tight Areas

The government or PLN can provide incentives to encourage investment in tight power demand-supply areas by controlling the power wheeling tariff. For example, subsidies in the wheeling tariff may encourage private companies to participate in the business in the target area.

7.2.5 Organization of PLN

PLN will take on the role of power wheeling; however, PLN also carries out power generation business through its subsidiary companies. In order to deal fairly with power wheeling users that are power generation companies and retailers, some of the power wheeling roles, such as technical investigations of feasibility of grid connections or estimating their costs, should be carried out in organizations independent of PLN's generation and retail departments. Thus, the Network Service Center is proposed to be established in PLN, as an organization independent of others, to take on the role of examining power wheeling corresponding to applications from the expected power wheeling users that are power generation companies and retailers.

<Before Signing Contract>



<After Signing Contract>

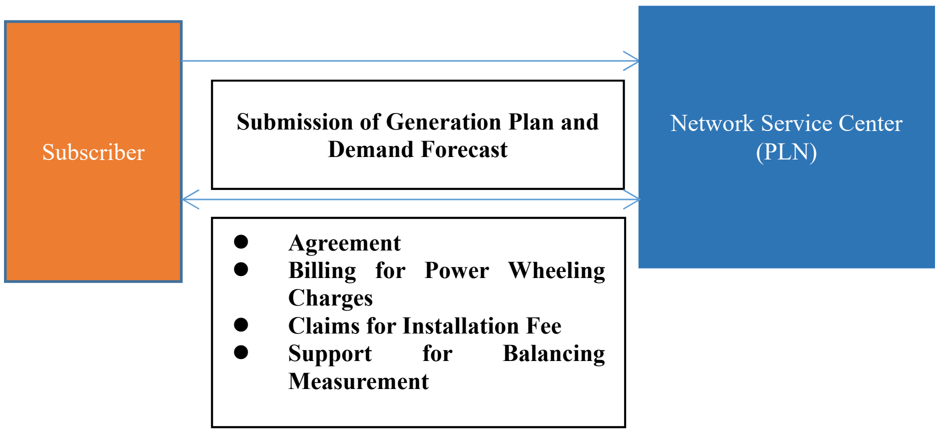


Figure 7-1 Concept of Work for PLN's Network Service Center

7.3 Proposal for Standard Operational Procedure (SOP) for Power Supply Business Utilizing Power Wheeling

This section describes the proposed Standard Operational Procedure (SOP) for a new electricity retail business entity that utilizes the wheeling scheme to start its power supply business based on the current regulatory framework and the power wheeling scheme studied in this project. Since SOP must be designed to comply with the current regulatory framework, it must be reviewed and revised whenever relevant laws, regulations, and relevant ministries' internal standard procedures are enacted and/or amended in order to introduce a power wheeling system to the Indonesian electricity market. This SOP revision shall be initiated by MEMR with the consultation of relevant ministries and stakeholders whenever necessary.

7.3.1 Necessary Licenses and Approvals for New Electricity Retail Business with Power Wheeling

As summarized in section 3.3, the new retailer must obtain an IUPTL from MEMR, and a Wilayah Usaha from the corresponding authority, such as MEMR, or state/local government, depending on its geographical supply area.

7.3.2 Procedure for License and Approval Acquisition

The new supply business applicant must satisfy network operational criteria to secure overall reliability of the Indonesian Power grid for the public's sake, and undergo an assessment of the necessary financial information, such as investment for interconnection facilities and necessary power system upgrades, to evaluate their retail business's feasibility. An application for power wheeling starts with a request for this grid impact study and interconnection facility cost evaluation, prior to the actual application for the IUPTL license and Wilayah Usaha approval. After PLN's report on technical feasibility and the applicant's business prospects, the actual application will be submitted through BKPM's one-stop service as shown in the flow-chart below.

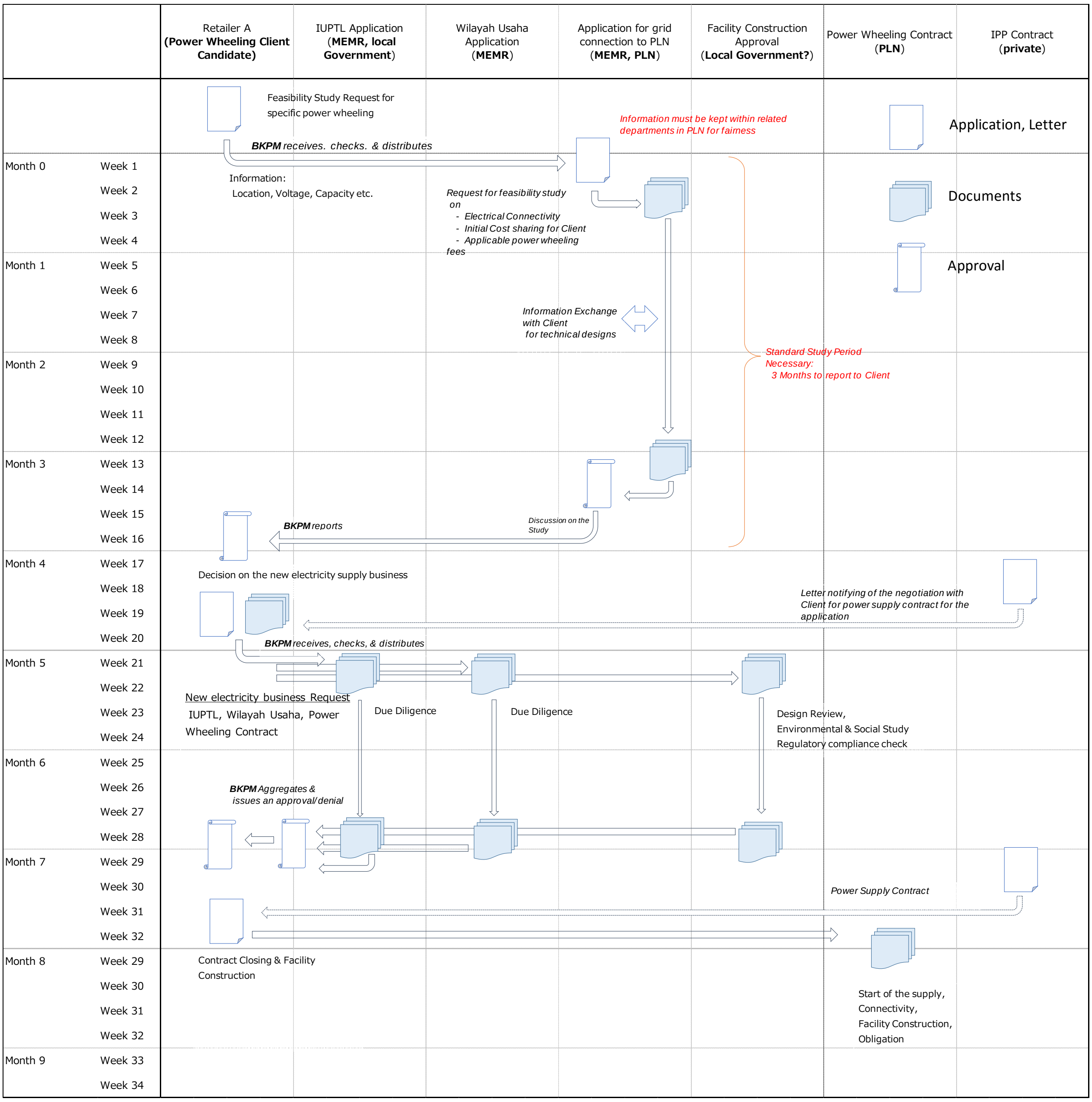


Figure 7-2 Flowchart of Standard Operational Procedure proposed

7.3.3 Application Processing Times

MEMR Ministerial Regulation No. 1/2015 specifies application processing times for the Power Wheeling Scheme: "IUPTL and Wilayah Usaha holder must submit the application for power wheeling to the power transmission business entity, and the power transmission business entity must reply with acceptance or rejection for the application within 5 business days, and negotiation shall be started within 30 days after the reply. If the negotiation ends successfully, the Minister of MEMR or the state governor will issue the permission/denial for the power wheeling pricing within 30 days after the pricing proposal's submission."

This regulation assumes power wheeling proposals are submitted by IUPTL and Wilayah Usaha holders, thus the processing times specified are not applicable to cases where a new retailer without IUPTL nor Wilayah Usaha seeks business opportunities in power wheeling and succeeds in acquiring an IUPTL and Wilayah Usaha. In addition, the system impact study for new power wheeling applications proposed by this study cannot be implemented within the 5 days as specified in the MR because of the technical complexity of the study and the shortage of PLN's human resources in power system planning and system analysis.

Thus, this study assumes the system impact study will take approximately three (3) weeks, which is the Japanese standard for such studies, and also assumes the subsequent approval procedure will take three (3) weeks as a standard duration. In particular cases where detailed power system analysis is necessary to determine the power wheeling feasibility and its cost evaluation, the power transmission business entity can issue the applicant an advance notice of extra study duration soon after receiving the application.

7.3.4 Authority for Power Wheeling Scheme Approval

Section 3.3, "Necessary Government Approval and Business Rights for Electricity Supply Business Using Power Wheeling Scheme", summarizes the authority for the fundamental licenses necessary for the power wheeling scheme: IUPTL and Wilayah Usaha. MEMR can award an IUPTL to a new electricity business, and Wilayah Usaha can be approved by MEMR, state government, or local government depending on the new business's supply area.

In addition, the system impact study must be implemented by a transmission business entity, in most cases PLN, and MEMR must monitor PLN's study results to ensure its fair treatment to all retail and IPP applicants.

It should also be considered that this SOP assumes BKPM to be the interface for all applicants for the one-stop service, and BKPM also monitors the adequacy of the entire approval process for all power wheeling applications.

7.3.5 Draft Wheeling Contract

Appendix 5 shows the draft wheeling contract expected to be applied for the power sector in Indonesia. An outline is given as follows.

- Requirements of subscribers are described as follows.
  - Power supply should be possible in accordance with the change in the power demand of their consumers.
  - Both power producers and power consumers should be connected to the power grid by technically appropriate methods complying with the grid code.
  - Subscribers, power producers and power consumers must obey the directives of the power dispatchers at PLN.
  - Subscribers, power producers and power consumers must comply with this contract.
- Subscribers apply for study of their grid connection to PLN. PLN gives notice about the results of the

study to subscribers.

- Wheeling tariff consists of the following two categories.
  - Wheeling service charge
    - The charge collected for the wheeling service
  - Charge for load fluctuation-linked power
    - The charge applied for the electricity used to supplement the portion of a shortfall caused by the imbalance between the electric energy received for each 30-minute period and the adjusted supplied electric power by loss factor.
- Installation fee for supply facilities required for grid connections is defined.
- It is defined that PLN may constrain electricity generated by power producers or consumed by consumers, and order power producers to change the scheduled days of periodic inspections or rehabilitation, when there are necessities due to the supply-demand situation or power system operation constraints for security reasons.

It is necessary to consider the provisions of compensation for damage while maintaining the integrity between Indonesian conventions and other laws. Regarding termination of the contract, it should not be the case that PLN can cancel the contract unilaterally. It should be designed so that PLN can't cancel the contract except when it has no liability.

7.3.6 System Impact and Facility Connection Study Done by PLN and Applicant

As discussed in 7.3., the system impact study plays an important role in the applicant's decision for new business based on the financial feasibility study, because the necessary cost share for the facilities and grid system expansions for the proposed power wheeling can easily increase the project cost and may result in a delay in commissioning if large scale network expansion is necessary to cater for the new retailer's facility for power wheeling. Thus, this system impact and facility connection study process is proposed prior to actual licensing work in the study team's proposal.

Once the new applicant decides to start the new business, the applicant starts preparing the necessary documentation and submission, and PLN initiates a detailed design study for the connection facilities and system expansion to evaluate the precise shared cost.

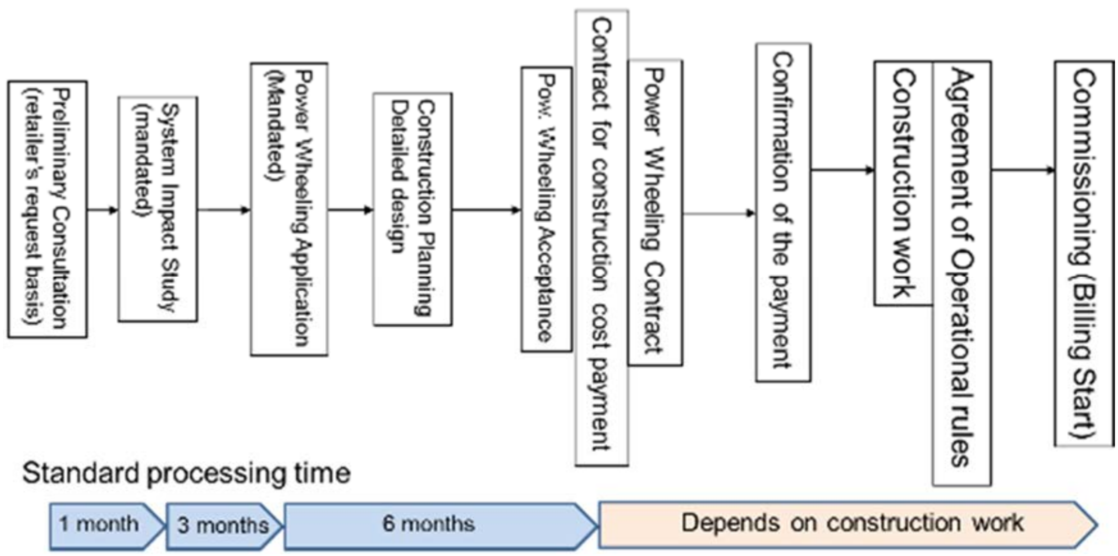


Figure 7-3 Procedure for new power wheeling from a retailer's viewpoint

7.4 Possibility of ODA Cooperation

The following projects can be expected as ODA cooperation for promoting utilization of power wheeling.

○ Support for establishment of Network Service Center in PLN

As mentioned before, PLN does not currently have sufficient Network Service Center functions. Thus, a new institutional organization is required in PLN. This support includes technology transfer regarding the procedure for grid connection study, Network Service Center work, methodologies for balancing the measurement of energy between generation companies and retailers for calculation of wheeling charges, and the methodology for procurement of ancillary services for power frequency control.

○ Feasibility study regarding the projects for power import and export using power wheeling scheme and new development of industrial zones

One of the targets expected to be achieved through arrangement of the power wheeling scheme that is suggested by ADB's program and the road map proposed in this section is the promotion of power import and export with neighboring countries, with the aim of stimulating the national economy. For example, cases can be considered whereby PLN carries out power wheeling for direct power selling to neighboring countries from power generation companies in Indonesia. Malaysia, for example, can be considered as a candidate neighboring country. Their feasibility is studied in this project.

○ Technical cooperation project for introducing power wheeling in Indonesia

Including support for establishment of the Network Service Center, the Technical cooperation project can be considered as ODA cooperation supporting comprehensively the introduction of power wheeling. The following gives an idea of the content.

- Application for Power Wheeling Service & Enactment and Revision of Ordinance for the Contract Procedures
  - Definition of obligations of transmission operator and retailer regarding power wheeling
  - SOP for grid connection study request and discussion on the necessary lead time
  - Reflection of method into RUPTL
- Power Wheeling Charges' Structure and Calculation
  - Determination of the power wheeling charges formula and charges structure, Development of ordinance draft
  - Development of MEMR's power wheeling charges formula guidelines
  - Development of PLN's separate accounting rules
  - Support for the power wheeling charges calculation
- Enactment of Power Wheeling Provision
  - Enactment of the power wheeling provision (Review of articles, Development of regular Indonesian version)
  - Preparation of Grid code

- Support for Establishment of Network Service Center
  - Establishment of Network Service Center's organization and institution
  - Technology licensing of Network Service Center business
    - Grid connection method
    - Preparation of contract
    - Determination of the energy measurement system specifications
    - Enactment of billing for installation fee for grid connections and power wheeling charges

Appendix1
Power Wheeling Project
Discussion Material

JICA Data Collection Survey on New Power Supply Scheme By Using Power Wheeling in Indonesia

April 2016

Tokyo Electric Power Company, Inc.

Tokyo Electric Power Services Co., Ltd.

The background of power wheeling in Indonesia

■ The background of power wheeling MEMR and PLN

【MEMR】

- 35GW power generation development necessary by 2019
- Development of private generation to supply domestic industrial consumers
- Build new industrial zones in rural area & remote islands (industry enhancement, rural electrification)

【PLN】

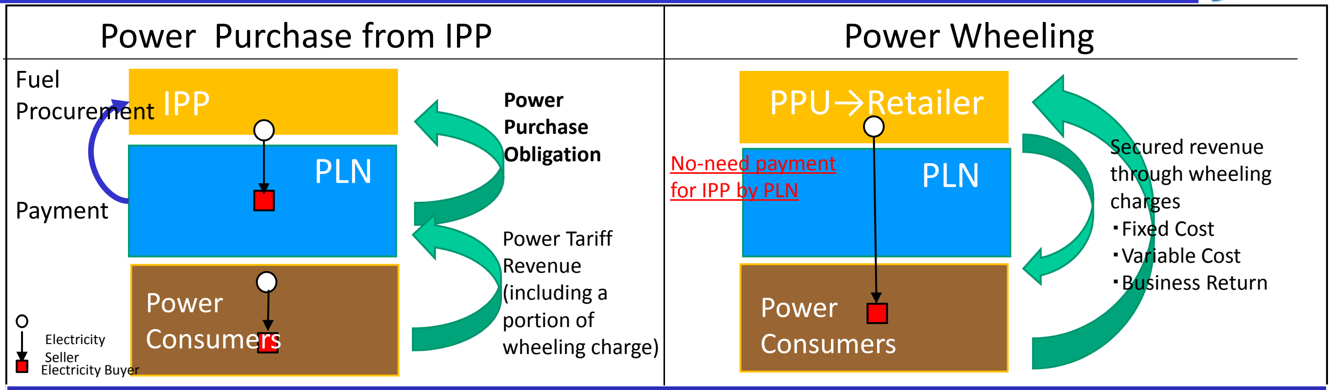
- Less power purchase obligation including fuel supply
- Less debt on the balance sheet as IPP generators
- Less initial investment for distribution facility (if PLN allows private company to do so)
- Build new industrial zones in rural area & remote islands (industry enhancement, rural electrification)
- Reduce the Congested Power Flow to Jakarta by encouraging local generation &consumption

■ Introduction Purpose of Power wheeling Scheme

Power wheeling scheme can be designed to enable:

- IPP to exercise a new business arrangement
- T&D companies to earn wheeling fee by lending their T&D facility for other entity's power supply.
- customers to select their electricity supplier

The Advantage of Power Wheeling in each positons



Advantage	
Power Consumers	• Increasing alternatives for power producers
Power Generator	• No need IPP bidding • Increasing alternatives for investment
PLN	• Securing revenues through firm/controllable wheeling charge collection • Reducing the burden of power purchase obligation • Mitigating the risks of fuel procurement for Indonesia
Indonesia	• Increasing power supply to Industrial zones • Stabilizing power system by encouragement of Local power production for local consumption

Legal Basis for Power Wheeling in Indonesia

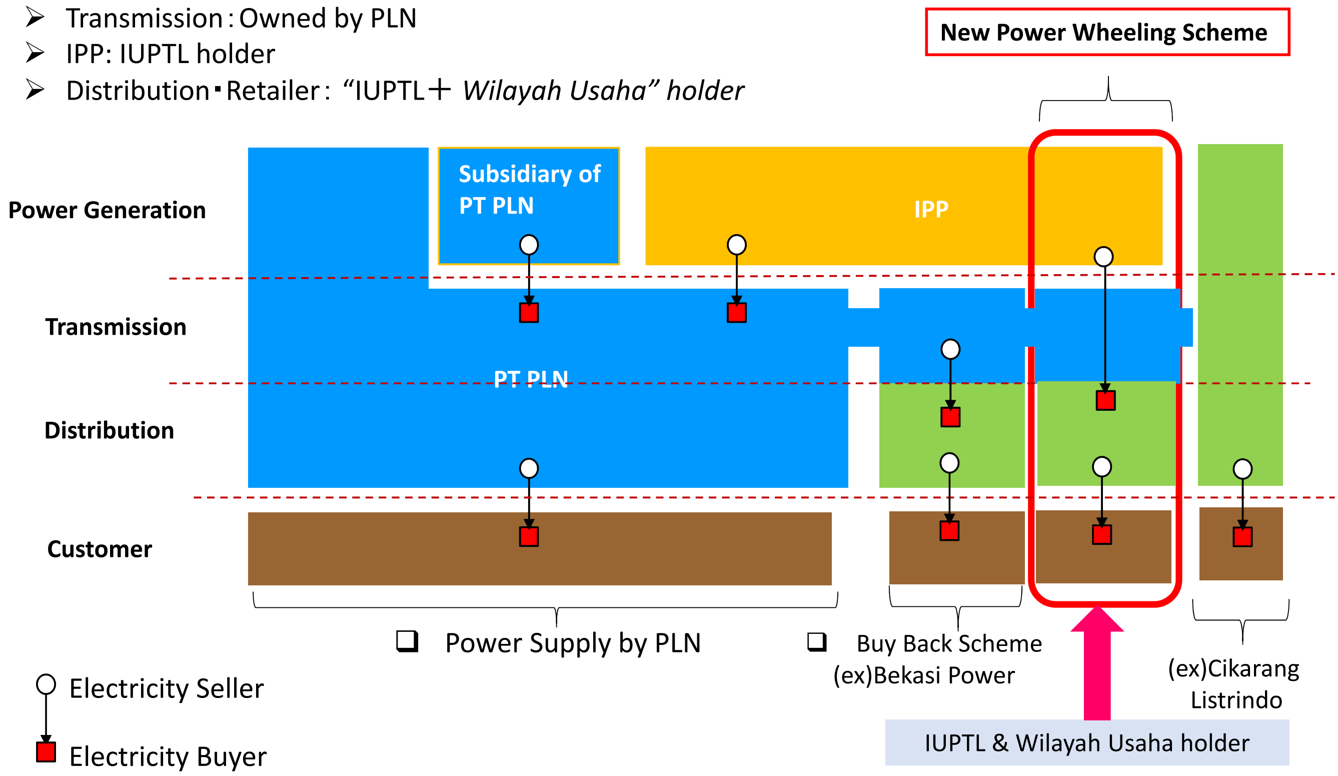
- All electricity supply business entities must acquire an electricity supply business license, an *IUPTL*, from the local government or MEMR, as MEMR's regulation stipulates.
- If the electricity supply business entity distributes electricity to public customers, the entity must be approved by MEMR to supply electricity to a particular business area, termed a *Wilayah Usaha*.
- Most business areas now belong to PLN with some exceptions
- Based on this business area ownership situation, if a new business entity developing a new industrial zone newly acquires a business zone, the business zone approval can only be obtained in the following circumstances, as MR No.28/2012 stipulates. MEMR can assign a technical team to assess the technical feasibility of the establishment of business zone.(MRM No.07/2016)

Revision

a. Such area has not been reached by the existing business area holder
b. The existing holder of the business area is incapable of providing the electric power or an electric power distribution network with of good quality and reliability; or
c. The existing holder of the business area returns, in part or in whole, the business area to the Minister of MEMR.

Power Wheeling Scheme Currently Considered

Requirements
- Transmission：Owned by PLN
- IPP: IUPTL holder
- Distribution･Retailer：“IUPTL＋ *Wilayah Usaha” holder*



Necessary MEMR’s Regulatory Framework

MEMR mandates PLN to be Obliged to the followings to maintain fairness in power wheeling scheme

- Prohibition of Utilization of information other than for Intended Purposes. For example, applicant’s identity shall not be disclosed even in internal departments in PLN.
- Prohibition of Discriminatory Treatment of Power Wheeling applicants
- Separate Accounting (separate trans. & distribution from other business components) for P.W. tariff calculation

Regal framework and Necessary Contracts in Indonesia

**Law No.30/2009
GR No.14/2012&23/2014,
MR No.01/2015**

・Including wheeling scheme

- **License (*IUPTL*)** → One-stop standard procedure for power wheeling
  - MR No35/2013:Procedure
- ***Wilayah Usaha***
  - MR No.28/2012:Application Procedure,No.1: Supply Coordination
- **PPA** → Add Power Wheeling Pricing
  - MR No.1/2015: Joint Utilization of Electric Power Network price
- **Electricity Tariff**
  - MR No.3/2015:Tariff of electric power of PLN
- **Wheeling Rules** → Contract Template
- **Grid Code** ↔ Contract Template: *Complementary document for technical spec.*

■ **Should make it clear Regal of Wheeling Rules.**

Confirmation item of Power Wheeling Scheme in Indonesia

Item	Discussion
■ Typical wheeling scheme and Retailer's role ■ Establish Network Service Center – Balancing Rules – Consideration cost allocation for interconnection facility	Discussion 2
■ Main Contract for power Wheeling Services – Connect transmission service charge – Load fluctuates electricity charge	Discussion 3
■ Method of Calculation Power Wheeling Tariff	Discussion 4
■ Standard Procedures of Power Wheeling Scheme	Discussion 5
■ Draft Power wheeling Road Map	Discussion 1

Draft Simple Power Wheeling Road Map

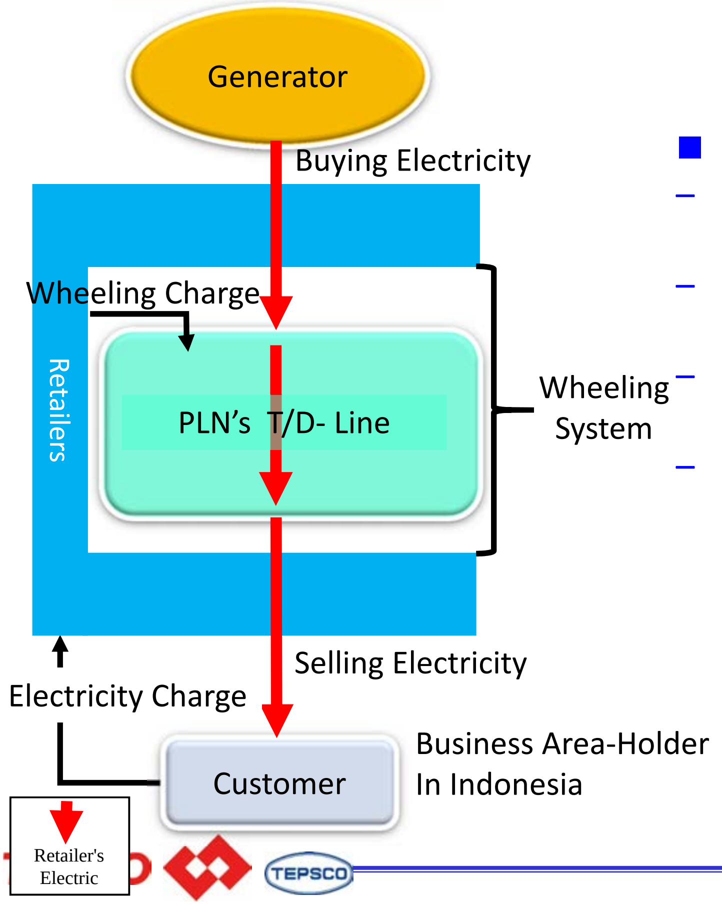
Discussion 1

Continuous revise of wheeling tariff system will be required accordingly based on the change in its situations for all the following steps.

- **End of up to 2017**
  - MEMR enacts **wheeling tariff**
  - MEMR's Power wheeling regulations enact to oblige PLN to follow fair treatment (three components in the slide 6) in power wheeling.
  - MEMR makes wheeling contract and wheeling rules, **which state** All Power Wheeling Contract shall satisfy N-1 Criteria, and guidelines under the grid code criteria specified by MEMR
  - draft **Wheeling Contract** to be submitted , and MEMR. MEMR approves it.
  - PLN determines the specifications of the **energy measurement system** and installs them for power wheeling to detect power balance between power generation and its consumption.
  - Network service center is established in PLN
- **Starting 2018**
  - Several contracts are made between private companies who have "Wilayah Usaha" and PLN and power wheeling is started.
  - Conditions for receiving "Wilayah Usaha" are modified for its clear acquisitions
  - Feasibility study is done about using PLN's power wheeling scheme for power import and export as cross boundary trade.
- **From 2019 to 2030**
  - Large independent power retailers selling such as new industrial zones or commercial area who has "Wilayah Usaha" become to able to select freely their power suppliers. National economic efficiency is improved.
  - Works for PLN's obligation of electric power balancing is increased. The portion of private power generation contributing to ancillary service for power adjustment is sold and bought
  - The Project using PLN's power wheeling scheme is realized for power import and export as cross boundary trade.

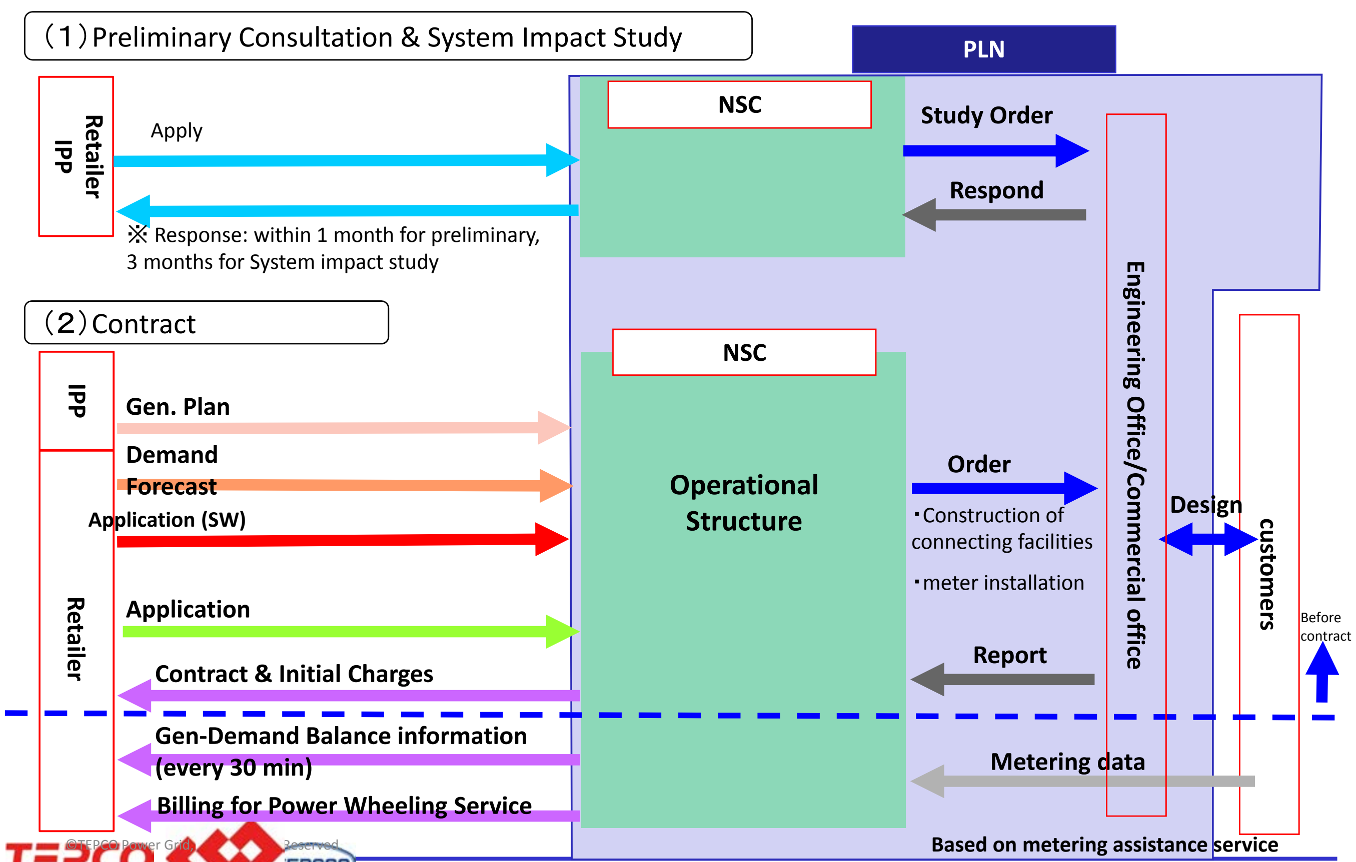
Discussion 2

Typical wheeling scheme and Retailer's Role

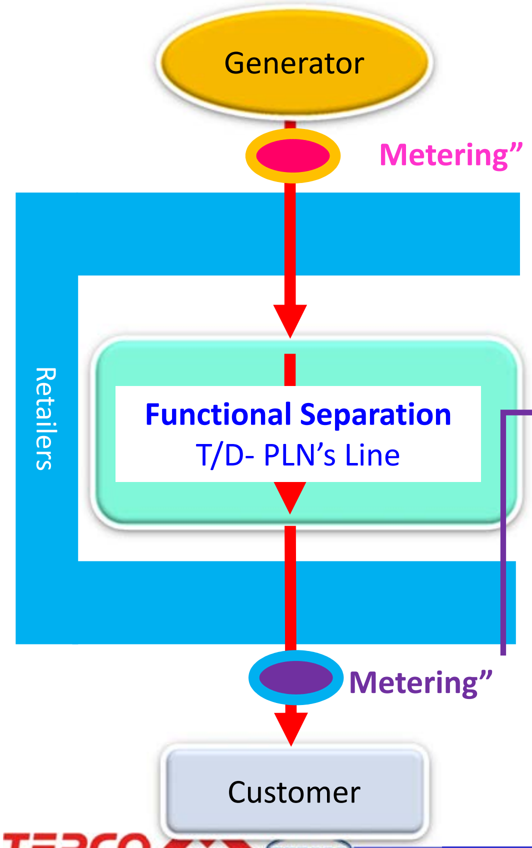


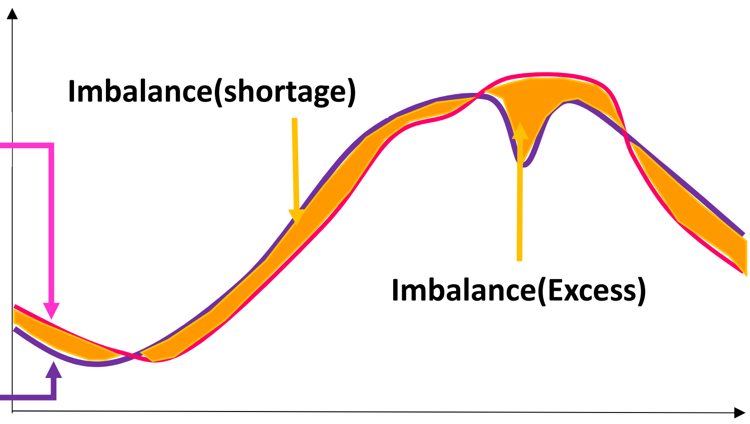
- Retailer:
  - supplies electricity directly to customers (similar to Wilayah Usaha)
  - purchases electricity from power producers (IPPs & PLN)
  - does not necessarily own facilities for its customers
  - Future Retail competition (need to change the electricity law)

Establish Network service center



Necessary Balancing Rules in Indonesia

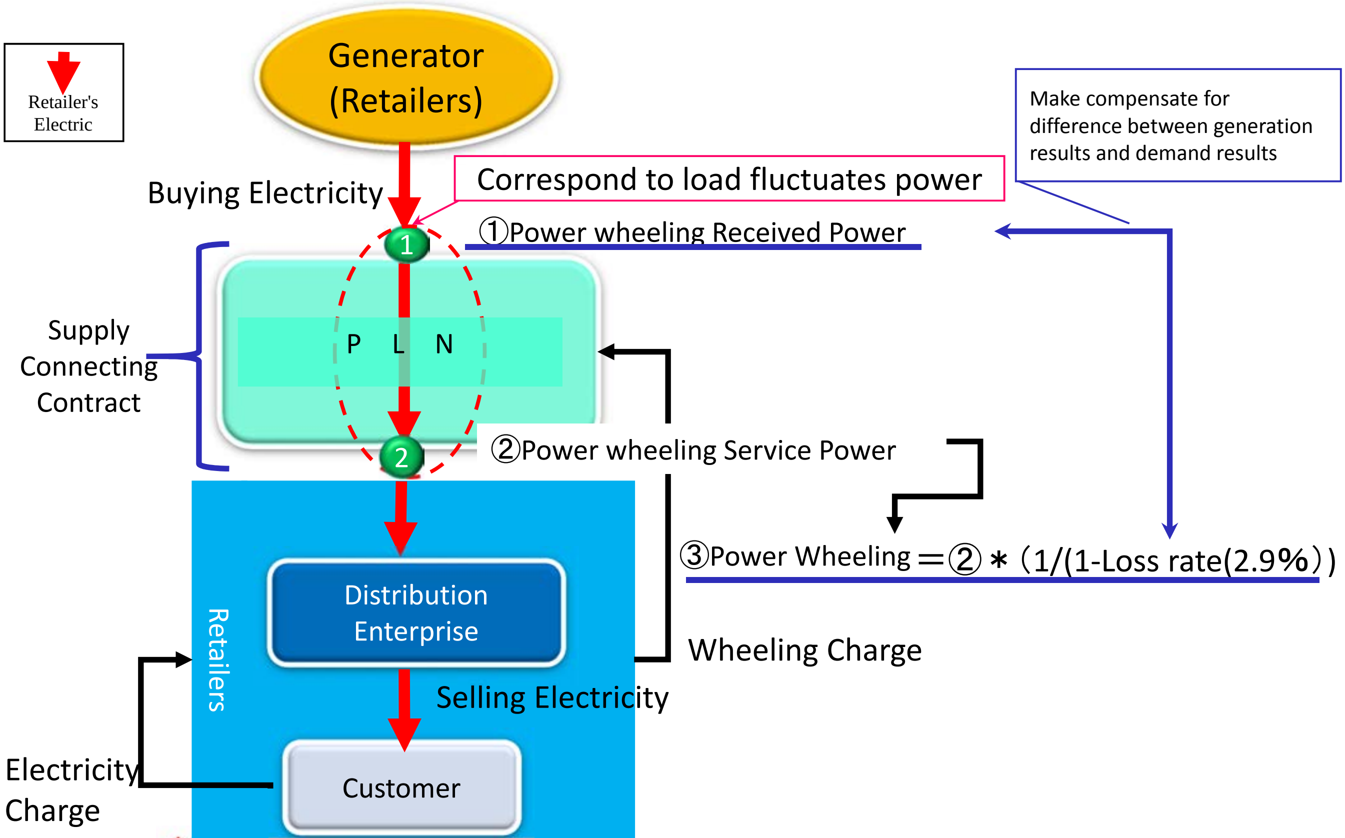




Balancing Rules

- Retailers must pay fee PLN for Imbalance (shortage: L>G)
- Retailers get compensated from PLN for Imbalance (excess: G>L)
- Imbalance charge tariff (shortage & excess) should be designed to incentivize retailers to follow the demand.

Necessary Balancing Rules in Indonesia



Construction cost allocation for interconnection facility

- Source transmission line shall be sorely borne by the IPP, single user of the TL
- Other components' cost are allocated based on cost-benefit-basis

4. Negative impact on the network shall also

Basic stance of cost burden in Japan which have two of basic types.

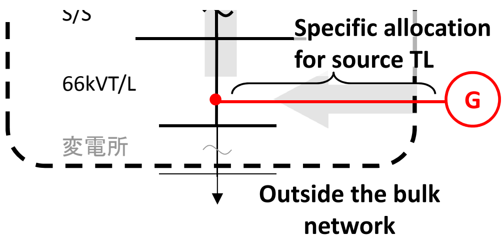
- **Cost of construction of power line: Generator underwrite full amount, reason of polluter-pays-principle.**
- **Cost of non-construction of power line: it is basic a benefit principle.**

However it isn't suitable for Indonesia which is extending the power demand and increasing power grid. Therefore cost of non-construction of power line case is suitably polluter-pays-principle.

The maximum general cost allocation is defined by OCCTO, and the excess shall be borne as specific allocation.

3. Payment of the general cost allocation from general electric utilities

Fees for interconnection to neighboring system shall be adjusted with the cost allocation.



Discussion 3

Power Wheeling Main Contracts in Indonesia

Wheeling Service provisions — Main Contract for power Wheeling Services

Wheeling contract — Contract between PLN (transmission) and a Retailer

- Connect transmission service charge:
  Received from the power station to the demand place
- Load fluctuates electricity charge :
  Make compensate for difference between generation results and demand results

Items of Wheeling Contract

1. **General Provisions**

1-1.Scop of Power wheeling service

1-2.Regulatory Application and Revision of this Terms and Conditions for Power Wheeling Service Agreement

1-3.Definitions and Interpretation

1-4.Nomination of Representative Contractor(among multiple related contracts)

1-5.Contract person for Power Wheeling Service Agreement, Contract information management

1-6.A Unit and rounding in calculation of contract values

1-7.Implementation details:(to be mutually arranged)

2. **Application of Power Wheeling Service**

2-1.Contracts Conditions

2-2.Techinical feasibility study mandated prior to the application of the Service

2-3.Contract Period, and conditions for contract values

2-4.Start of Power Wheeling Service

2-5.Necessary Provision of Convenience
e.g. Spaces for utility's facilities, working areas for facility installation

2-6.Power Supply Scheme, voltage , and frequency

2-7. Definition of one generation facility and single customer's facility

2-8.Supply arrangement in single contract:
(single power supply scheme, single incoming line, and single metering)

2-9. Termination condition for power wheeling service

3. **Tariffs**

3-1. Types of Power Wheeling Service Tariffs

3-2. Transmission and wheeling Tariffs

3-3. Imbalance supply Tariff

Items of Wheeling Contract

4. Billing Conditions

4-1. Start of billing
(usu. = day of the contract agreement)

4-2. Standard billing period

4-3.Metering

4-4.Transmission and distribution losses included

4-5. Fee adjustment in shorter billing period

4-6.Payment Conditions(monthly payment, within 30 days after invoice)

4-7. Payment method

4-8.Deposit

4-9. Joint liability in case of multiple service users

5. Conditions and Requirements for Electricity Supply

5-1.Technical Requirements for electricity supply
(e.g. demand & supply balancing in 30 min.)

5-2. Load Dispatching Order (including compensation for generation curtail in an emergency case)

5-3. Customer's obligation for the management of electricity consumption in the contract

5-4.Customer's contract excess price

5-5. Customer's obligation for the management of power factor

5-6. Authorized trespassing in customer's premises for maintenance

5-7. Facility investments necessary to maintain power network's supply quality

5-8. Conditions for the termination of power wheeling service

5-9. Conditions for the restart of the terminated power wheeling service

5-10. Fee adjustment during the power wheeling service termination

5-11. Penalties for breach of contract

5-12. Power Wheeling Servicer's Indemnity for power supply termination

5-13. Compensation for damaged Power Wheeling Servicer's facilities caused by customer's trouble intentionally or by negligence

6. Alteration of Contract, termination of Power Wheeling Service

6-1. Procedure for contract alteration

6-2. Change of the customer for same facility
(e.g. as a result of M&A)

6-3. Cancellation of the service

6-4. Additional Charges for the termination and alteration during one-year period after contract engagement

6-5. Termination of the service

6-6. Obligations for the terminated customer

Items of Wheeling Contract

7. receive and supply scheme, and facility construction

7-1. receive and supply scheme

7-2. standard connection with overhead transmission facilities

7-3. conditions for underground facilities, and customer's cost bearing

7-4. schemes for sharing single facility with multiple customers

7-5. construction of supply facility by service supplier

7-6. metering facilities

7-7. telecommunication facilities

7-8. supply facility specialized for single customer and the customer' cost bearing

8. sharing facility construction cost

8-1. customer's obligation for the costs for transmission facility from generation end to the existing grid

8-2. customer's share for the costs for receiving facility

8-3. Payment of construction costs on customers

8-4. Construction of other facilities without the receiving facility(only High Voltage and Extra High Voltage facilities) In this case of the costs, it will consider in Indonesia.

9. Operation and Maintenance

9-1. Service provider's responsibility of O&M of the facilities

9-2. Obligation of customers for O&M activities

Discussion 4

Calculation Formula for Wheeling Tariff

- **Studies and discussions on wheeling tariffs in Indonesia**
  - Embedded-Cost-Based Approaches
    - Postage Stamp Method
    - Contract Path Method
    - Distance Based MW-mile Method
    - Power Flow Based MW-mile Method
  - Marginal-Cost-Based Approaches
    - Short-Run Marginal Cost (SRMC) Pricing Method
    - Long-Run Marginal Cost (LRMC) Pricing Method
- **Reference**
  - Dr. Hardv 'Prospek Bisnis Terkait Kebijakan Power Wheeling dalam Rangka Meningkatkan Penyediaan Tenaga Listrik – The Way Forward'
  - Prof. Sasongko Pramono Hadi 'Power Wheeling Pemanfaatan Bersama Jaringan Tenaga Listrik (PBJT)'

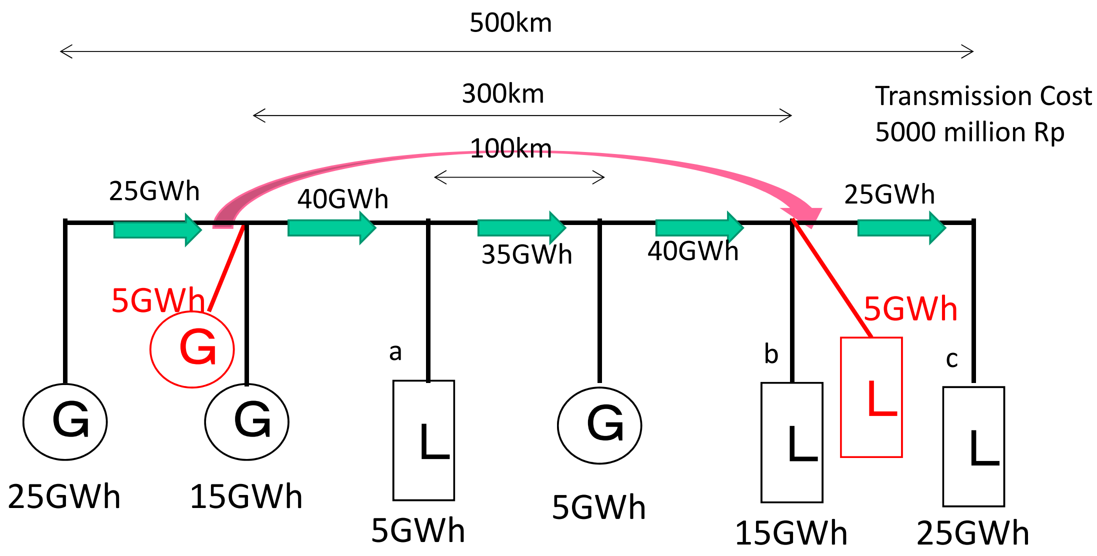
Current Situations for Application of Power Wheeling in Indonesia

Comparison between Postage Stamp Method and MW-mile Method

	Postage Stamp Method	MW-mile Method
Guarantee of revenue	**◎ (Excellent)**	**△（OK）**
Reduction of reduntant expenses and promotion of efficiency	**△(Ok,,)** **→○(Good)** : by adding incentive regulation	**△(Ok,,)**
Control of the power flow distance/direction (Suppression of the new transmission line)	**△(Ok,,)** **→○(Good)** : by adding the specific allocation regulation	**○(Good)**
Conclusion	**◎(Excellent)***	**○(Good)**

Better to start with postage stamp method

Recover of T&D cost (1)



PLN Customers : 5+15+25=45(GWh)
Wheeling Customer : 5GWh
Total : 50GWh

(Postage Stamp Method)
Wheeling Tariff
5000/50=**100(Rp/kWh)**

Why is The Postage Stamp Method Appropriate?

- **The most important conditions of wheeling tariff**
  1. **To guarantee the income to continue the power transmission and distribution business stably. [Condition (A)]**
  2. **To reduce useless expenses and promote efficiency. [Condition (B)]**
- **The Postage Stamp Method is the most suitable and the easiest to satisfy condition (A).**
- **For satisfaction of condition (B), required wheeling operation expense should be calculated from the future ideal expense, not from past expense. The ideal expense means expense with anything unnecessary removed.**

Procedure of Wheeling Tariff Calculation by Postage Stamp Method

Distinguish Transmission & Distribution (T&D) Operation Expense from Whole Expense

Transmission Operation Expense	Medium Voltage (MV) Distribution Operation Expense	Low Voltage (LV) Distribution Operation Expense

← **Ancillary Service (AS) Expense**

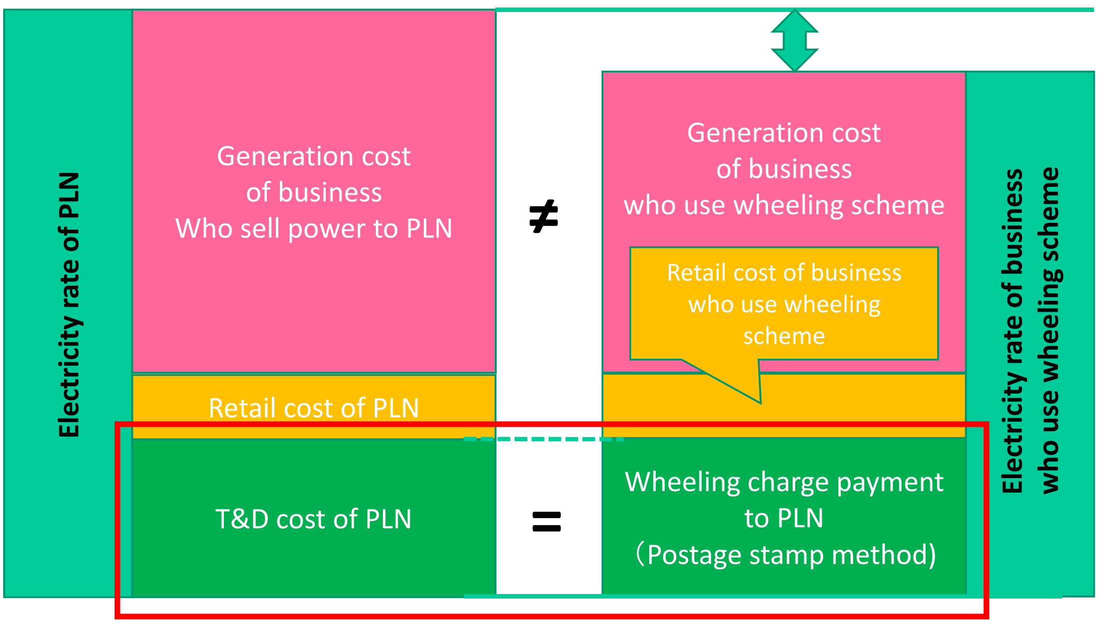
← **Adequate Business Return (ABR)**

Calculation of Wheeling Cost and Average Wheeling Tariff

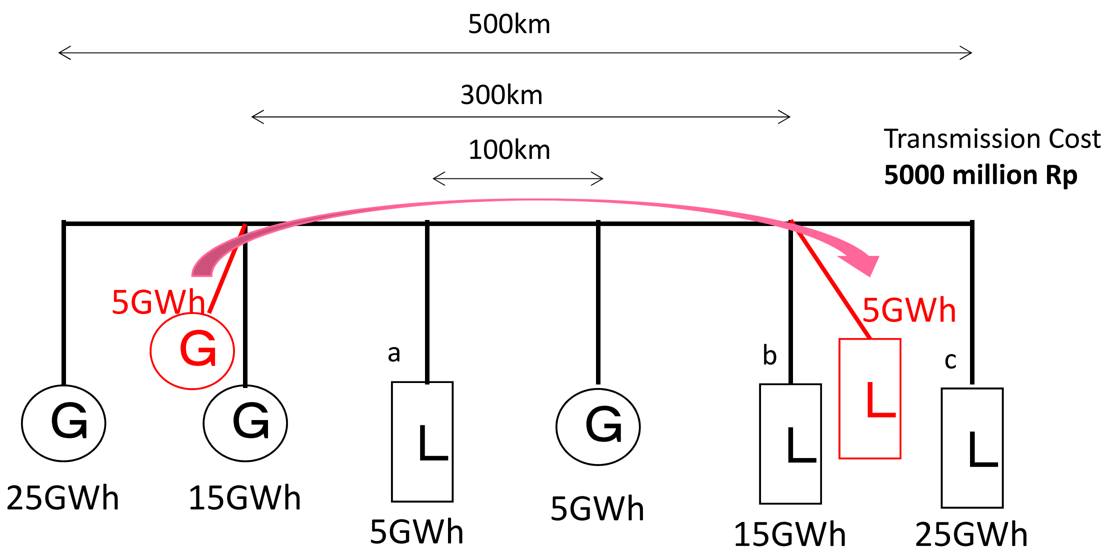
Determination of Fixed and Variable Portion

High Voltage (HV) Wheeling Tariff	Medium Voltage (MV) Wheeling Tariff	Low Voltage (LV) Wheeling Tariff

Relation between PLN Electricity Rate and Wheeling Charge

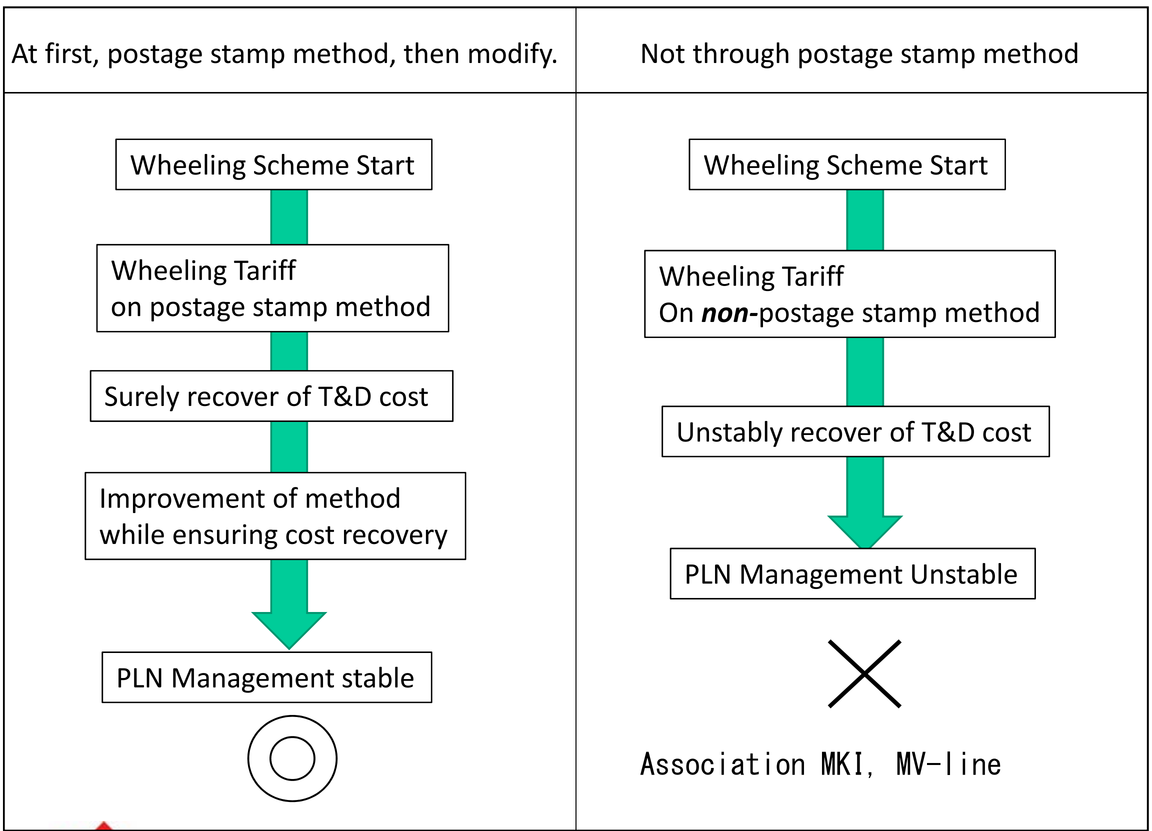


Recover of T&D cost (2)

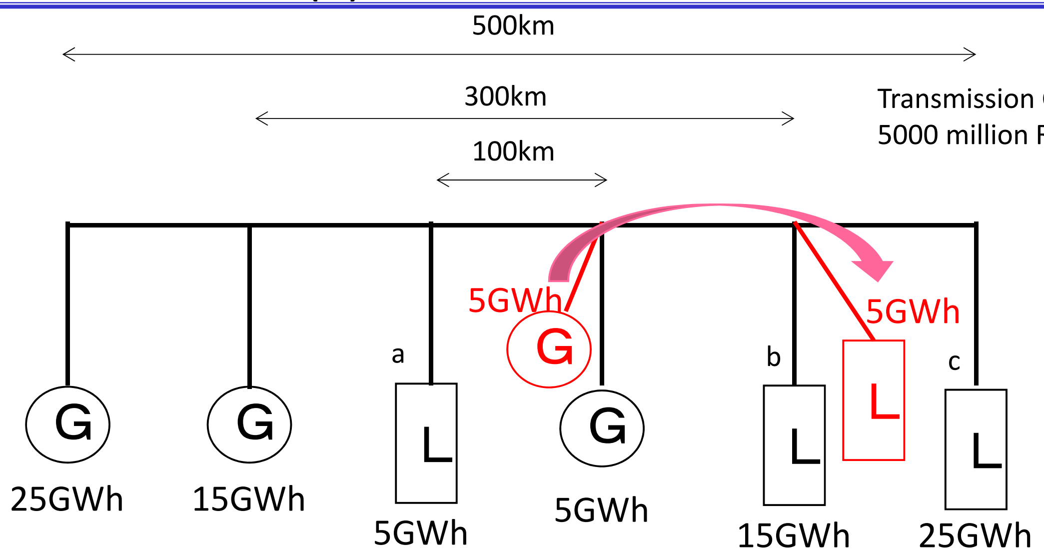


Income
From PLN Customer : Postage Stamp
100 × 45= 4500 million Rp
From Wheeling Charge :
100 × 5 = 500 million Rp
Total : 5000 million Rp

Problem if not through postage stamp method



Recover of T&D cost (3)

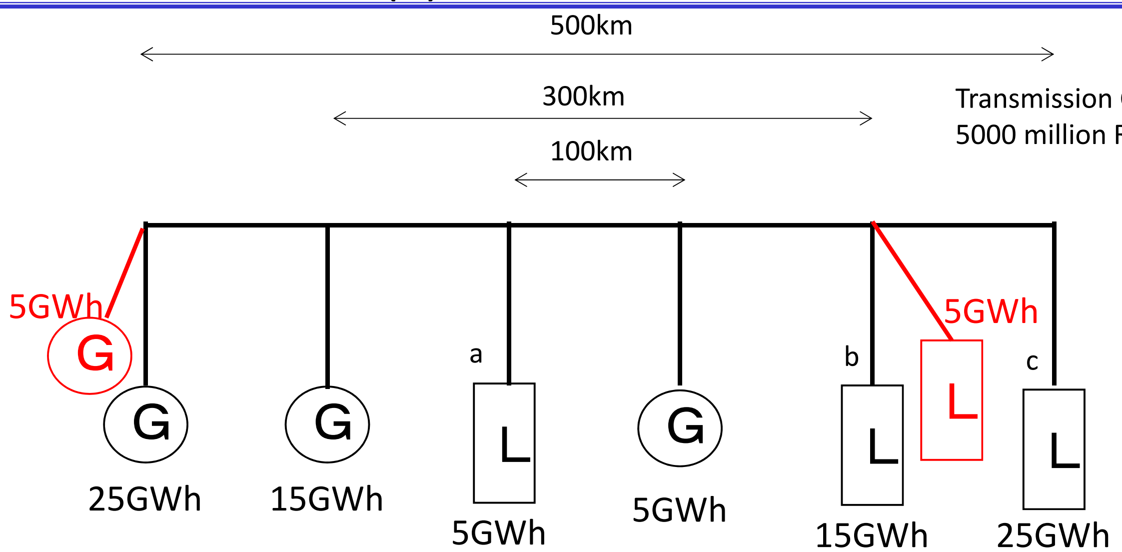


Transmission Cost
5000 million Rp

An Example of The Method other than Postage Stamp Method
~100km : 80 Rp/kWh
~300km : 100 Rp/kWh
~500km : 120 Rp/kWh

Income
From PLN Customer : Postage Stamp
100 × 45= 4500 million Rp
From Wheeling Charge :
80 × 5 = 400 million Rp
Total : 4900 million Rp
▲100 million Rp short!

Recover of T&D cost (4)



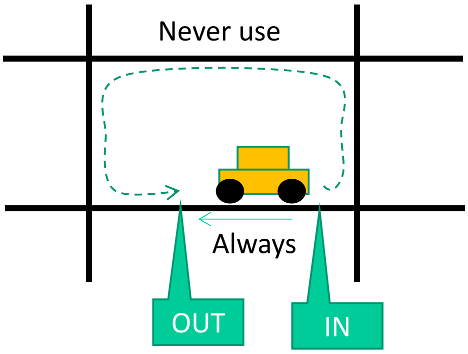
Transmission Cost
5000 million Rp

An Example of The Method other than Postage Stamp Method
~100km : 80 Rp/kWh
~300km : 100 Rp/kWh
~500km : 120 Rp/kWh

Income
From PLN Customer :
100 × 45= 4500 million Rp
From Wheeling Charge :
120 × 5 = 600 million Rp
Total : 5100 million Rp
100 million Rp excess!

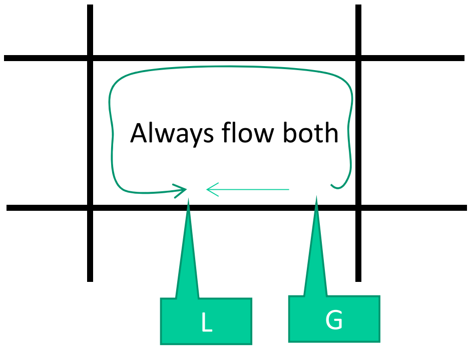
Difference between Highway Charge and Wheeling Charge(1)

Highway



Able to be charged according to distance between IN and OUT

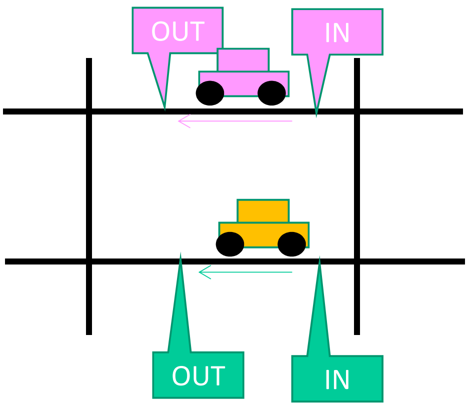
Power System



Not able to be charged according to distance between G and L

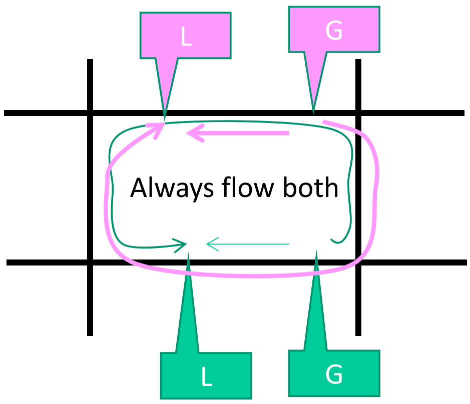
Difference between Highway Charge and Wheeling Charge(2)

Highway



Each route is independent
→ Able to be charged according to distance between IN and OUT

Power System



Routes are influenced each other
→ Not able to be charged according to distance between G and L

Distinguish Operation Expense (2)

T&D	Operation Cost
Maintenance	OOO
Personnel	OOO
Depreciation	OOO
Others	OOO

Regional Unbundling

Java	Operation Cost
Maintenance	OOO
Personnel	OOO
Depreciation	OOO
Others	OOO

Sumatra	Operation Cost
Maintenance	OOO
Personnel	OOO
Depreciation	OOO
Others	OOO

....

OOO	Operation Cost
Maintenance	OOO
Personnel	OOO
Depreciation	OOO
Others	OOO

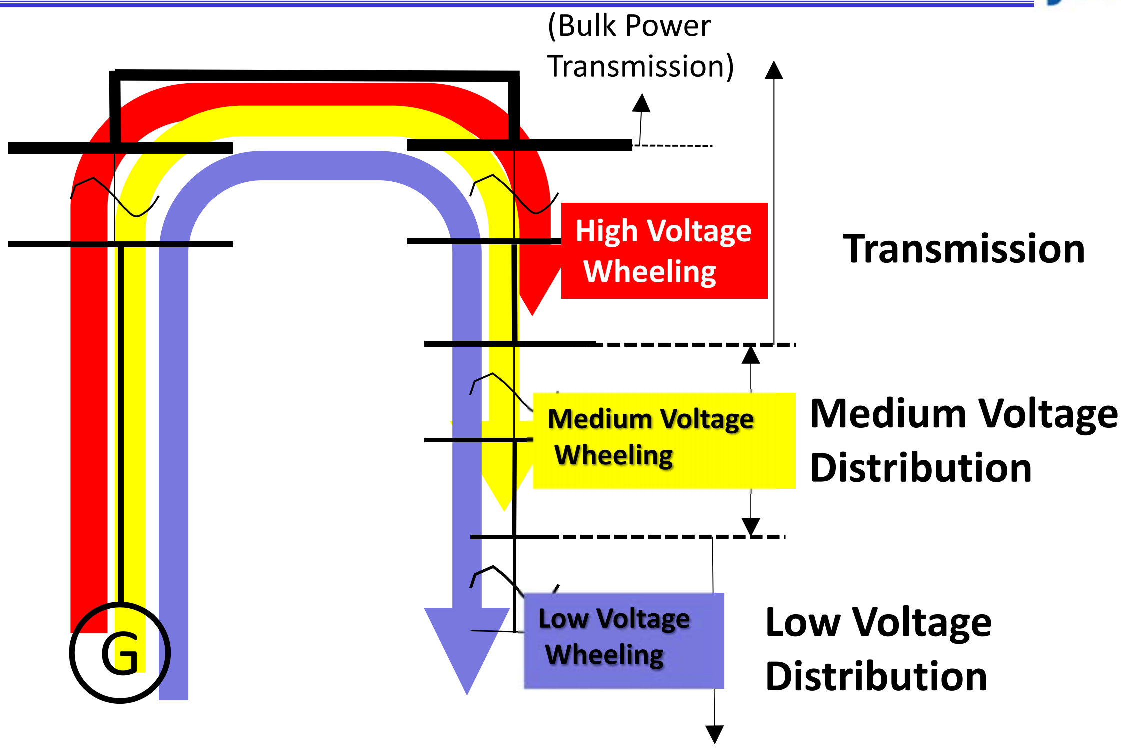
Voltage Level Unbundling

HV	Operation Cost
Maintenance	OOO
Personnel	OOO
Depreciation	OOO
Others	OOO

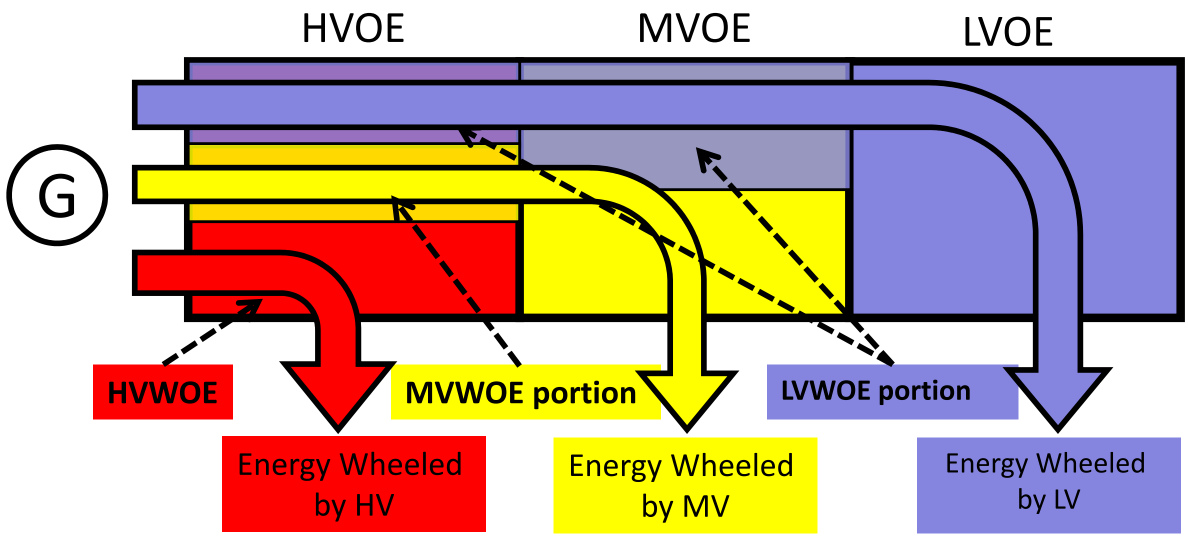
MV	Operation Cost
Maintenance	OOO
Personnel	OOO
Depreciation	OOO
Others	OOO

LV	Operation Cost
Maintenance	OOO
Personnel	OOO
Depreciation	OOO
Others	OOO

Typical Indonesian Power System and Wheeling

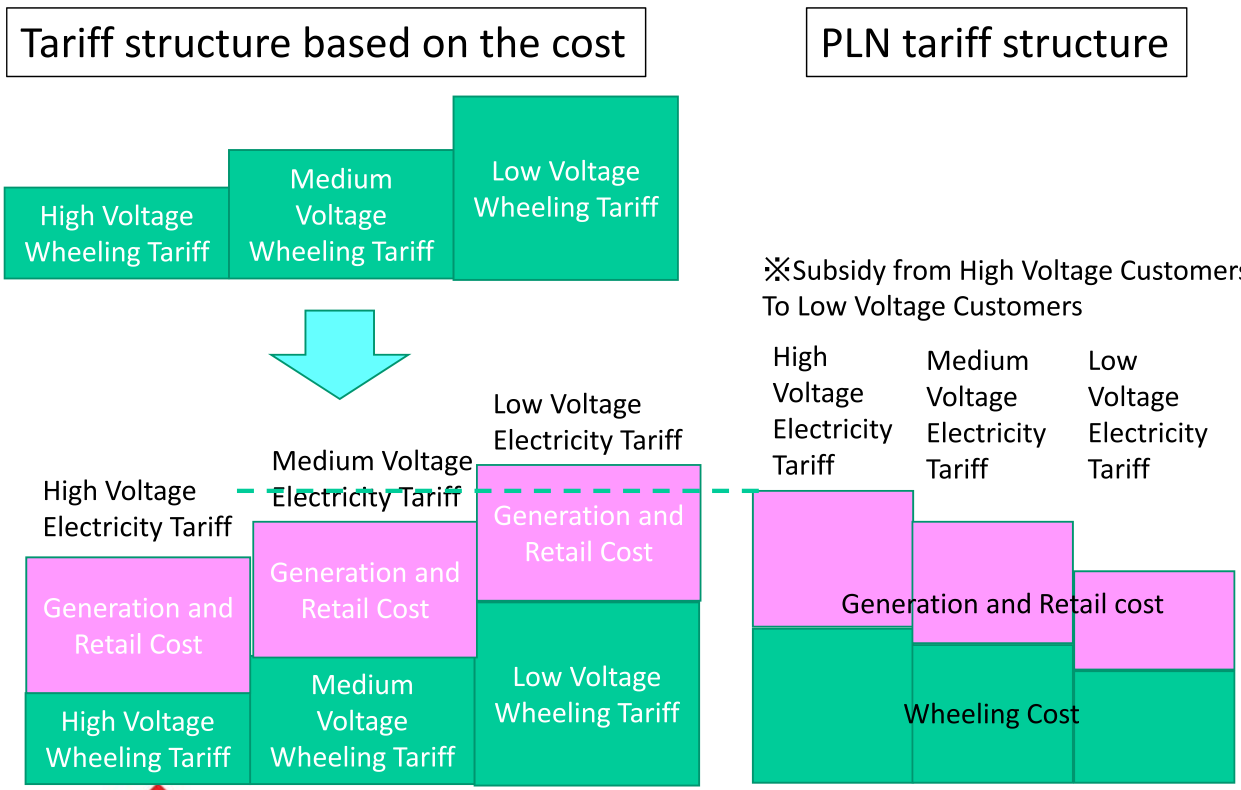


Wheeling Cost in Java according to voltages



Wheeling Operation Expense (WOE)
= High Voltage Operation Expense (HVOE)
+ Medium Voltage Operation Expense (MVOE)
+ Low Voltage Operation Expense (LVOE)

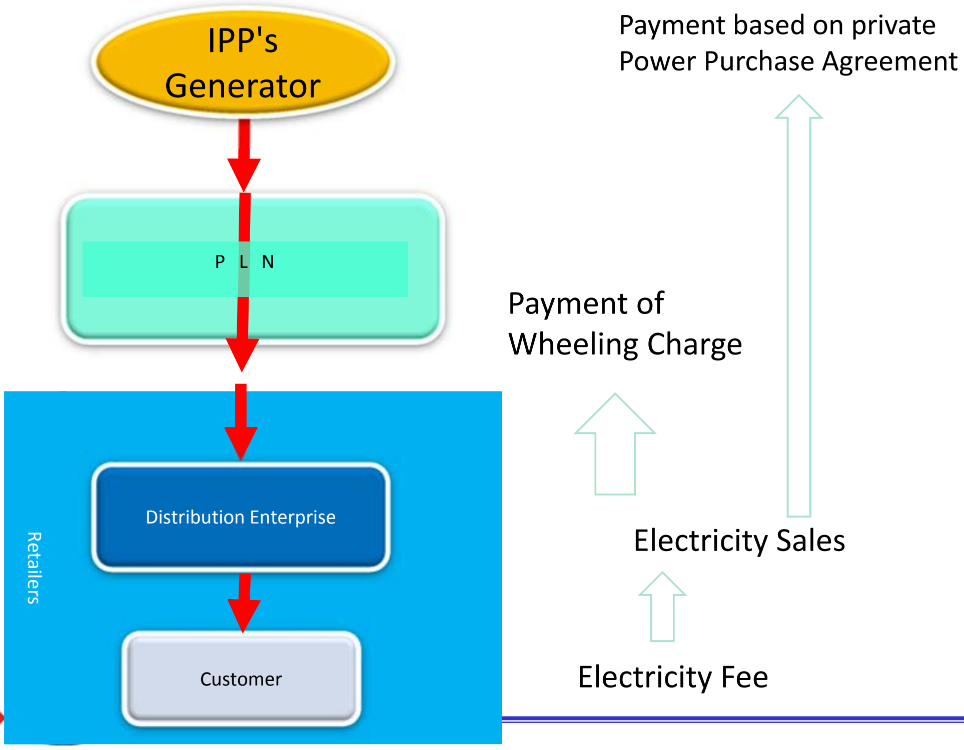
Tariff Structure



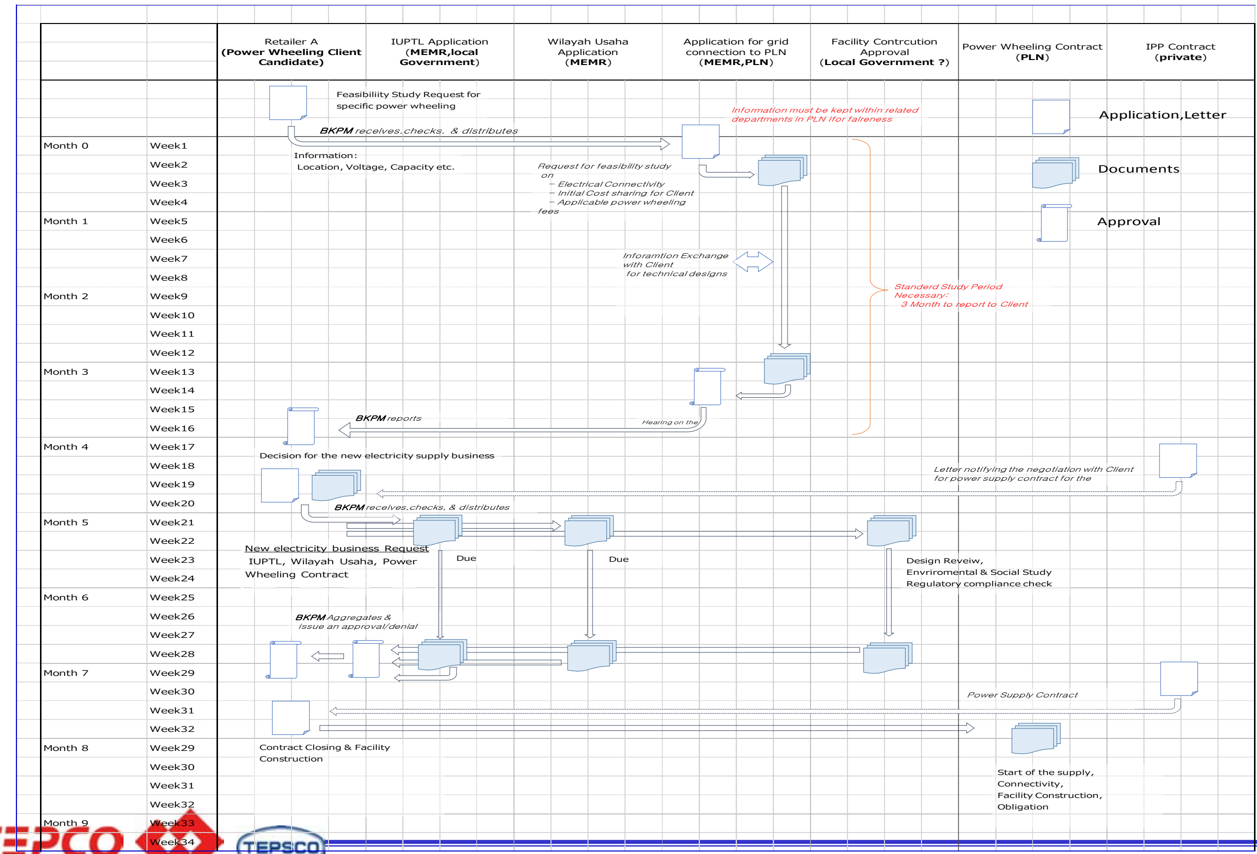
Discussion 5

Draft Simple Scheme in Indonesia

Assumption: "A" retailer wants to supply an industrial zone by purchasing "B" company's (IPP) electricity and PLN's power wheeling



Draft Wheeling SOP(Standard Operating Procedure) in Indonesia

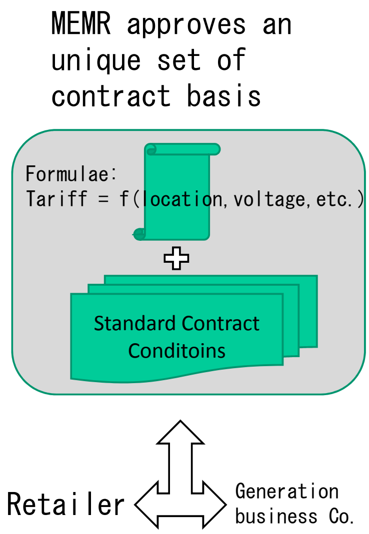


Wheeling System Policy

(Study Team's Proposal)

All legal authority for wheeling system belongs to <u>MEMR.</u>

- **Wheeling Tariff (= approval of tariff calculation formula)**
  - **Unique set of calculation formulae for wheeling tariff shall be applied to all wheeling scheme users for its fairness**
  - **PLN, other IUPTL holders can propose the reform of the applied calculation formulae, MEMR rejects/approves after public hearings and technical, financial, and political investigations.**
- **Power Wheeling Contract**
  - **Standard Contract Conditions for power wheeling shall be approved by MEMR in advance**
  - **Power Wheeling Contract shall be closed between retailer and Power generation company based on the standard contract condition with additional contract conditions.**
  - **All power wheeling contract shall be examined by MEMR to secure its fairness**
  - **Carrying out the public hearing**
  - **PLN, other IUPTL holders can propose the amendment of the standard contract conditions, MEMR rejects/approves after public hearings and technical, financial, and political investigations.**



Appendix2
Cost Abstraction Method for Power Wheeling

(Unit : 100 million Yen)

Total Cost
56,783

Pending Cost
7,802

Separate 9 Department Accounting

Hydro	Thermal	Nuclear	Renewable	Transmission	Substation	Distribution	Sales	Administrative and General	Total
889	27,841	4,438	15	3,194	1,470	4,880	1,289	4,966	48,981

Allocating by ABC(Activity Based Costing)

Separate 8 Department Accounting

	Hydro	Thermal	Nuclear	Renewable	Transmission	Substation	Distribution	Sales	Administrative and General	Total
Direct Allocation	239	547	585	16	598	308	790	168	▲3,250	0
Cost Allocation	54	229	341	3	215	117	438	319	▲1,716	0
Administrative and General	294	775	926	19	813	425	1,228	487	▲4,966	0

	Hydro	Thermal	Nuclear	Renewable	Transmission	Substation	Distribution	Sales	Administrative and General	Total
Administrative and General	294	775	926	19	813	425	1,228	487	▲4,966	0
Other	889	27,841	4,438	15	3,194	1,470	4,880	1,289	4,966	48,981
Total	1,182	28,616	5,363	33	4,007	1,895	6,108	1,776	0	48,981

A/S(Hydro)	A/S(Thermal)
63	257
Other	Other
1,119	28,359

※A/S…Ancillary Service Cost

Receiving Substation	Customer Cost	Dispatching Cost
1,160	1,052	167
Distributing Substation	HV Distribution Cost	Customer Cost
735	3,736	1,007
	LV Distribution Cost	Sales
	1,320	602

Dispatching (Network)
159
Dispatching (Retailer)
7

	A/S(Hydro)	A/S(Thermal)	Transmission	Receiving Substation	Distributing Substation	HV Distribution Cost	Dispatching (Network)	Customer Cost	Total
Owned facilities	63	257	4,007	1,160	735	3,736	159	2,059	12,177
Other	—	—	▲1	—	—	—	—	—	▲1
Total	63	257	4,006	1,160	735	3,736	159	2,059	12,176

↓

Fixed Cost	63	257	3,957	1,156	734	3,727	158	—	10,052
Variable Cost	—	—	49	4	1	9	1	—	65
Costomer Cost	—	—	—	—	—	—	—	2,059	2,059

Allocate Ratios

	Fixed Cost Allocate Ratio		Variable Cost Allocate Ratio		Costomer Cost Allocate Ratic	kWh Ratio
LV	44.24%	(69.13%)	37.30%	(51.58%)	99.14%	36.45%
HV	34.53%	(30.87%)	35.01%	(48.42%)	0.85%	35.27%
Extra HV	21.23%		27.69%		0.01%	28.28%
	↑①	↑②	↑③	↑④	↑⑤	↑⑥

(Unit : 100 million Yen)

Extraction of Extra HV & HV Cost

F…Fixed Cost
V…Variable Cost
C…Costomer Cost

	A/S(Hydro)	A/S(Thermal)	Transmission	Receiving Substation	Distributing Substation	HV Distribution Cost	Dispatching(T&D)	Customer Cost	Total
LV F	28	114	1,750	511	507	2,576	70	—	5,557
HV F	① 22	① 89	① 1,366	① 399	② 227	② 1,151	① 55	—	3,308
Ex HV F	13	55	840	245	—	—	34	—	1,187
Total Fixed Cost	63	257	3,957	1,156	734	3,727	158	—	10,052
LV V	—	—	18	1	④ 1	④ 5	1	—	26
HV V	—	—	③ 17	③ 1	1	5	③ 0	—	24
Ex HV V	—	—	14	1	—	—	0	—	15
Total Variable Cost	—	—	49	4	1	9	1	—	65
LV C	—	—	—	—	—	—	—	1,965	1,965
HV C	—	—	—	—	—	—	—	82	82
Ex HV C	—	—	—	—	—	—	—	13	13
Total Costomer Cost	—	—	—	—	—	—	—	2,059	2,059
Total	63	257	4,006	1,160	735	3,736	159	2,059	12,176

Customer Cost

	Customer facilities	Other
LV C	977	987
HV C	73	⑤ 8
Ex HV C	13	0
Total Costomer Cost	1,063	996

Pending Cost

(Unit : 100 million Yen)

F…Fixed Cost
V…Variable Cost
C…Costomer Cost

	Promotion of Power-resources Development tax	Nuclear cost(Fuel reprocessing)	Inter Connecting Facilitie Charge	Inter Connecting Adjustment Charge	Grid Loss Cost	Subtotal	Allocate Ratio	System impact Study Charge
Total	1,091	294	▲28	▲3	8	1,362	—	▲0
LV F	—	—	▲12	—	—	▲12	55.32%	▲0
HV F	—	—	① ▲9	—	—	▲9	32.90%	▲0
Ex HV F	—	—	▲6	—	—	▲6	11.78%	▲0
Total Fixed Cost	—	—	▲27	—	—	▲27	100.00%	▲0
LV V	398	110	▲0	▲1	3	509	36.77%	—
HV V	⑥ 385	③ 103	③ ▲0	③ ▲1	③ 3	489	35.30%	—
Ex HV V	308	81	▲0	▲1	2	391	27.93%	—
Total Variable Cost	1,091	294	▲1	▲3	8	1,389	100.00%	—
LV C	—	—	—	—	—	—	95.41%	—
HV C	—	—	—	—	—	—	3.96%	—
Ex HV C	—	—	—	—	—	—	0.63%	—
Total Costomer Cost	—	—	—	—	—	—	100.00%	—

F…Fixed Cost
V…Variable Cost
C…Costomer Cost

	Allocate Ratio	Other imcome	A/S charge	Allocate Ratio	Tax	Transfer account	Subtotal	Total
Total		▲123	▲5	—	157	▲0	1,392	13,568
LV F	55.32%	▲50	—	55.34%	65	▲0	2	5,560
HV F	32.90%	▲30	▲3	32.89%	38	▲0	▲4	3,304
Ex HV F	11.78%	▲11	▲2	11.77%	14	▲0	▲4	1,183
Total Fixed Cost	100.00%	▲91	▲5	100.00%	117	▲0	▲6	10,046
LV V	36.77%	▲5	—	36.77%	6	▲0	510	536
HV V	35.30%	▲5	—	35.30%	6	▲0	490	515
Ex HV V	27.93%	▲4	—	27.93%	5	▲0	392	407
Total Variable Cost	100.00%	▲13	—	100.00%	17	▲0	1,393	1,458
LV C	95.41%	▲18	—	95.41%	23	▲0	5	1,970
HV C	3.96%	▲1	—	3.96%	1	▲0	0	82
Ex HV C	0.63%	▲0	—	0.63%	0	▲0	0	13
Total Costomer Cost	100.00%	▲19	—	100.00%	24	▲0	5	2,064

	Fixed Cost	Variable Cost	Costomer Cost	Total
Extra HV	1,183	407	13	1,603
HV	3,304	515	82	3,900

Allocating by ABC(Activity Based Costing)

	Allocation Factors	Hydro	Thermal	Nuclear	Renewable	ransmissio	Substation	Distribution	Sales	Administrative and General	Total	Account
Direct Allocation	－	239	547	585	16	598	308	790	168	▲3,250	0	All
Cost Allocation	Ratio of Number of Employee	19	42	81	1	56	48	123	109	▲478	0	Salaries allowance/Training Cost etc
	Ratio of floor space	30	46	234	1	139	61	281	193	▲986	0	Rent/Maintenance etc
	Ratio of Book Value	6	141	25	0	21	8	34	17	▲252	0	Depreciation/Business Return etc
	Subtotal	54	229	341	3	215	117	438	319	▲1,716	0	
Total	－	294	775	926	19	813	425	1,228	487	▲4,966	0	

※Set in accordance with the actual situation

Ratio of Number of Employee

	Hydro	Thermal	Nuclear	Renewable	ransmissio	Substation	Distribution	Sales	Total
Number of Employee	1,296	2,830	5,527	84	3,773	3,241	8,323	7,384	32,458
Ratio	4%	9%	17%	0%	12%	10%	26%	23%	100%

Ratio of floor space

	Hydro	Thermal	Nuclear	Renewable	ransmissio	Substation	Distribution	Sales	Total
floor space(㎡)	6,427	10,065	50,861	298	30,123	13,305	60,961	41,934	213,974
Ratio	3%	5%	24%	0%	14%	6%	28%	20%	100%

Ratio of Book Value (Unit : 100 million Yen)

	Hydro	Thermal	Nuclear	Renewable	ransmissio	Substation	Distribution	Sales	Total
Book Value	1,566	39,038	6,931	46	5,721	2,246	9,526	4,729	69,803
Ratio	2%	56%	10%	0%	8%	3%	14%	7%	100%

Calculation of Ancillary Cost

	Total	Variable Cost	Fixed Cost	
Hydro	1,182	23	1,160	A

↓

Facility with ancillary functions	981	B=A*①

↓

Ancillary Cost	63	B*②

	Total	Variable Cost	Fixed Cost	
Thermal	28,616	24,581	4,035	C

↓

Facility with ancillary functions	3,979	D=C*①

↓

Ancillary Cost	257	D*②

Book value ratio of Hydro Facility with ancillary functions
(Unit : 100 million Yen)

		Book value	
with ancillary functions	plant A	185	
	plant B	185	
	plant C	185	
	plant D	185	
	plant E	185	
	plant F	185	
	plant G	215	
	Subtotal	1,325	
non ancillary functions	plant H	50	
	plant I	50	
	plant D	141	
	Subtotal	241	
Hydro		1,566	
Book value ratio		84.6%	①

Book value ratio of Hydro Facility with ancillary functions
(Unit : 100 million Yen)

		Book value	
with ancillary functions	plant A	5,000	
	plant B	5,000	
	plant C	5,000	
	plant D	5,000	
	plant E	5,000	
	plant F	5,000	
	plant G	8,495	
	Subtotal	38,495	
non ancillary functions	plant H	150	
	plant I	150	
	plant D	243	
	Subtotal	543	
Thermal		39,038	
Book value ratio		98.6%	①

MW ratio for maintaining the frequency

Maximum Peak demand	56800	MW
Frequency bandwidth	5%	
Hydro Power Generation Output with Frequency bandwidth	7128	MW
Thermal Power Generation Output with Frequency bandwidth	36823	MW
MW ratio for maintaining the frequency	6.46%	②

Substation Cost Allocation

	Allocation Factors	Non-Distribution Substation	Distribution substation	Total	Account
Direct Allocation	–	4	1	5	All
Cost Allocation	Ratio of Number of Facilities	345	401	746	Salaries allowance/Training Cost etc
	Ratio of Book Value	811	333	1,144	Depreciation/Business Return etc
	Subtotal	1,156	734	1,890	
Total	–	1,160	735	1,895	

※Set in accordance with the actual situation

Ratio of Number of Facilities

	Non-Distribution Substation	Distribution substation	Total
Number of Facilities	2,115	2,462	4,576
Ratio	46.2%	53.8%	100%

Ratio of Book Value (Unit : 100 million Yen)

	Non-Distribution Substation	Distribution substation	Total
Book Value	1,592	654	2,246
Ratio	70.9%	29.1%	100%

Distribution Cost Allocation

	Allocation Factors	Customer Cost	Exclude Customer Cost	Total	Account
Direct Allocation	–	652	21	673	All
Cost Allocation	Number of Employee	400	5,035	5,435	Salaries allowance/Training Cost etc
Total	–	1,052	5,056	6,108	

※Set in accordance with the actual situation

Ratio of Number of Employee

	Customer Cost	Exclude Customer Cost	Total
Number of Employee	612	7,711	8,323
Ratio	7.4%	92.6%	100%

Exclude Customer Cost

	Exclude Customer Cost		Total
	HV	LV	
Cost Allocation	3,736	1,320	5,056

Ratio of Construction cost (Unit : 100 million Yen)

	Exclude Customer Cost		Total
	HV	LV	
Construction cost	34,851	12,307	47,158
Ratio	73.9%	26.1%	100%

Sales Cost Allocation

	Allocation Factors	Dispatching Cost	Customer Cost	Sales	Total	Account
Direct Allocation	–	42	518	43	602	All
Cost Allocation	Number of Employee	88	343	392	823	Salaries allowance/Training Cost etc
	floor space(㎡)	37	146	167	351	
Total	–	167	1,007	602	1,776	

※Set in accordance with the actual situation

Ratio of Number of Employee

	Dispatching Cost	Customer Cost	Sales	Total
Number of Employee	789	3,081	3,515	7,384
Ratio	10.7%	41.7%	47.6%	100.0%

Ratio of floor space (Unit : 100 million Yen)

	HV	LV		Total
floor space(㎡)	4,479	17,495	19,961	41,934
Ratio	10.7%	41.7%	47.6%	100.0%

Dispatching Cost

	Dispatching Cost		Total
	Retailer	T&D	
Cost Allocation	7	159	167

Ratio of Number of Employee

	Dispatching Cost		Total
	Retailer	T&D	
Number of Employee	67	1,433	1,500
Ratio	4.5%	95.5%	100%

Pending Cost

	Fixed Cost	Variable Cost	Costomer Cost	Total
Nuclear cost(Fuel reprocessing)		294		294
Promotion of Power-resources Development tax		1,091		1,091
Inter Connecting Facilitie Charge	▲ 27	▲ 1		▲ 28
Inter Connecting Adjustment Charge		▲ 3		▲ 3
Grid Loss Cost		8		8
System impact Study Charge	▲ 0			▲ 0
Other imcome	▲ 91	▲ 13	▲ 19	▲ 123
Tax	117	17	24	157
Transfer account	▲ 0	▲ 0	▲ 0	▲ 0
A/S charge	▲ 5			▲ 5
Non-Related HV&MV T&D Cost				6,410
Total				7,802

Appendix3
Prospek Bisnis Terkait Kebijakan Power Wheeling dalam Rangka Meningkatkan Penyediaan Tenaga Listrik-The Way Forward

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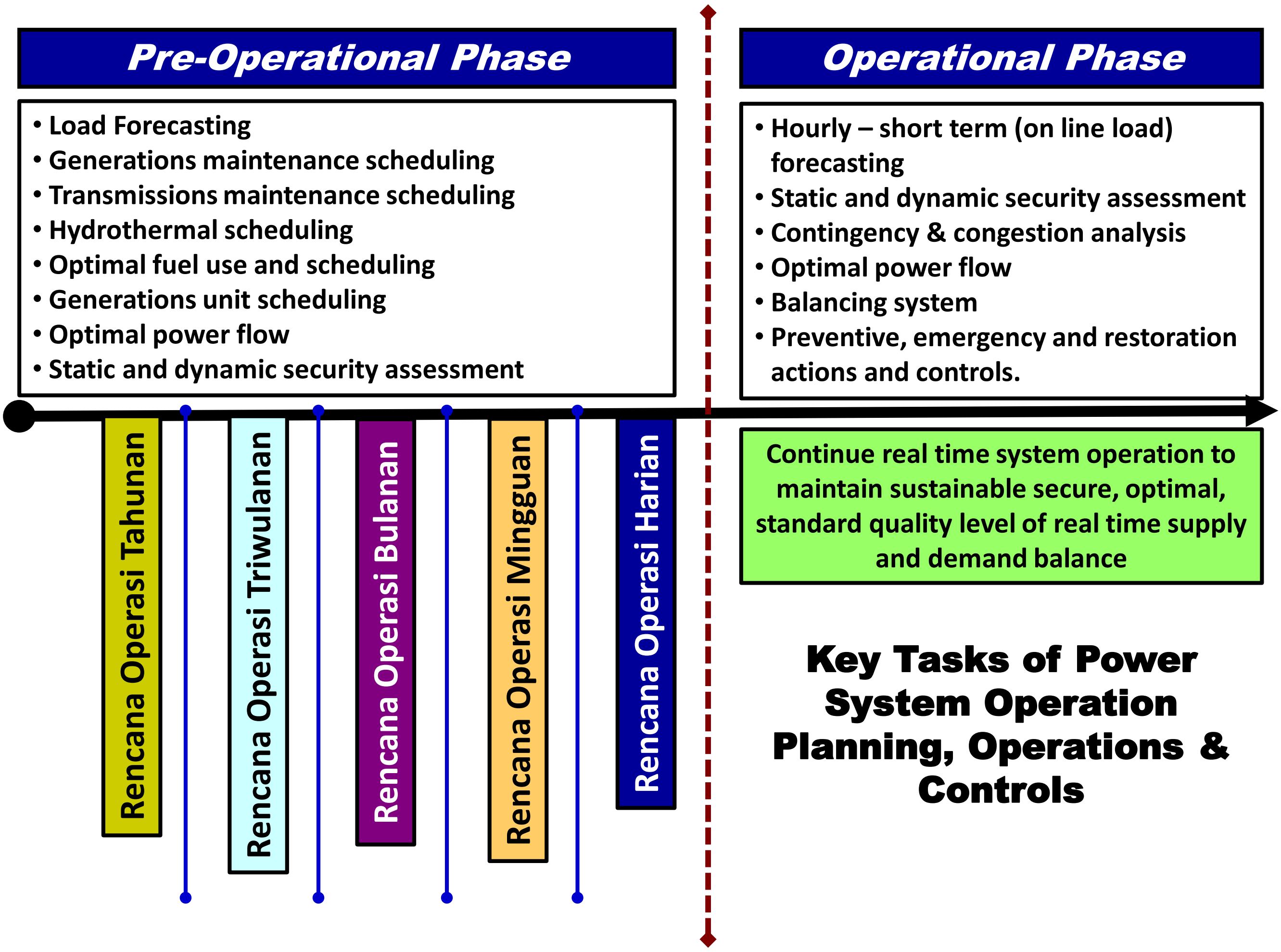
Prospek Bisnis Terkait Kebijakan *Power Wheeling* dalam Rangka Meningkatkan Penyediaan Tenaga Listrik – *The Way Forward*

Coffee Morning - Short Discussion
Kantor Direktorat Jenderal Ketenaga Listrikan
Jl. H.R. Rasuna Said Blok X-2, Kav. 7-8, Kuningan
Jakarta Selatan

Dr. Hardv Harris Situmeang
Indonesian National Committee - World Energy Council
ASIA PACIFIC Research Centre (APERC) Advisory Board Member

4 Basic Models for Industry Structure [1,2]

Key Items	Model 1	Model 2	Model 3	Model 4
Characteristic	Vertically Integrated Monopoly	Single Buyer	Wholesale Competition	Retail Competition
Definition	Monopoly at all levels	Competition in generation	Competition in generation and choice for DITSCOs	Competition in generation and choice for final consumers
Competing Generators	Tidak	Ya	Ya	Ya
Choice for Retailers?	Tidak	Tidak	Ya	Ya
Choice for Final Customers?	Tidak	Tidak	Tidak	Ya
Note	• No one may buy from independent generator. • All final customers are supplied by the incumbent utility	• Only the existing integrated monopoly in the assigned area is permitted to buy from IPP (the competing generators). • The design of PPAs is a major feature.	• DITSCOs are given the right to buy direct from IPPs, but they retain a local franchise over retailers customers. • IPP will need access to the transmission network through trading arrangement for the network.	• Permits all customers to choose their suppliers & are given the right to buy from IPP. • Access to transmission and distribution network are required.



Wheeling – Direct Access [3,4]

- Wheeling is the conveying of electric power from a seller to a buyer through a third-party-owned transmission network (i.e. Utility to utility; Utility to private customer; Private generator to utility; Private generator to private user)
- In the deregulated markets, the objective of pricing the transmission service are economic efficiency, revenue sufficiency (achieve financial objective), ease of implementation/monitoring, and efficient regulation. In contrast to the traditional regulated market, the knowledge of costs is used to set prices, not just to minimize the total cost of building, operating and maintaining transmission lines.
- The two critical elements determining the wheeling rates are the prices determined in relation to the real-time situation and those determined through market-based competition. The components of cost are operating cost, existing system cost, opportunity cost and reinforcement cost.

Transmission Open Access (TOA) [3,4]

- Since open access, entities that did not own transmission lines were granted the right to use the transmission system.
- The aim of TOA is to introduce competition into the traditional cost-of-service regulated utilities without giving up the existing regulating structure and at the same time obtain reliable and economic electric service.
- There are two big issues concerning the implementation of TOA: i) Economic issues – marginal pricing with a supplement for revenue incentives is an economically efficient option. The different kinds of allocations are rolled-in allocation, contract path allocation, incremental cost allocation and megawatt mile allocation, and ii) Operational issues – the three different considerations are before the fact, real-time and after the fact.

Some of Associated Transmission Access Issues [5,6,7]

Institutional Issues: the evolving industry structure; Industry Structure: Relationships between business functions, Transmission rights, Operating systems, Pricing models, etc.

Planning Issues: Reliability under TOA; Parallel paths/loop flows; Network capacity evaluation; Reserves; Responsibilities & obligations.

Operation Issues: Scheduling; Dispatch and Controls: Balancing challenges, Keeping voltages & frequency at appropriate level, Guaranteeing system security, and Restoration planning, as well as covering transmission losses; System monitoring & reporting;

Analytical Issues: How to evaluate the impact of a wheeling transaction; How to determine if a transaction is making unauthorized use of the transmission system; How much is a system's reliability degraded due to a transaction, and What's a "fair" price to charge for use of a transmission system.

Economic Issues: Costs of transmission services; Cost of wheeling methodologies; Contract path versus actual power flows; Formation of transmission region.

Asset Management Issues: Safety, reliability and sustainability; Planning and controlling financing and expenditures; Optimizing maintenance activities.

Key Associated Issues of Appropriate Transmission Pricing Framework [4]

- What transmission services will be provided?
- How much do these services cost?
- What are the reasonable revenue requirements for the transmission service provider?
- What methods are most appropriate for charging transmission customers (generators, distribution business, large high-voltage customers)?

Transmission Pricing Process

Transmission Costing- annual Revenue Requirement → Computation of Costs for Various Network Users → Transmission Tariff Design

Annual Revenue Requirement

- Annual Depreciation Expenses.
- O & M Expenses.
- Return on Net Fixed Assets.
- Losses.

In addition to meeting revenue requirements, some key issues need to be addressed: Promote efficient day-to-day operation of the bulk power market; Encourage investment and determine location of generation and transmission lines; Compensate owners of transmission assets; and be fair and practical to implement.

Transaction Cost Allocation [3,8]
(Contoh)

The rules can be divided into 2 main categories:

- ❑ **Embedded-Cost-Based Approaches, and**
- ❑ **Marginal-Cost-Based Approaches.**

Embedded-Cost-Based Approaches

1. **Postage Stamp Method**: this transmission pricing method allocates transmission charges (existing or rolled-in) based on the magnitude of the transacted power. The main justification for using this pricing method has been that the entire transmission system is considered as a centrally operated integrated system. The simplicity of this approach is also one of its strongest selling points. Since this method ignores the actual operation, it is likely to send incorrect economic signal to transmission customers.
2. **Contract Path Method**: in this method a specific path between the points of delivery and receipt is selected for a wheeling transaction. This path is called the "contract path" and is selected by the utility company and the wheeling customer usually without performing a power flow study to identify the transmission facilities that are actually involved in the transaction. A portion or all charges associated with transmission facilities in the contract path is then allocated to be the wheeling customer. If new transmission facilities are to be built as a result of the wheeling transaction, they usually included in the contract path. This method also ignore the actual system operation.

Transaction Cost Allocation [3,8]
(Contoh)

3. **Distance Based MW-mile Method**: This method allocates the existing or rolled-in transmission charges to wheeling customers based on the magnitude of the transacted power and the aerial distance between the transacted power delivery and receipt points.

   This method also neglects the actual system operation. The aerial distance does not indicate the actual transmission facilities involved in the transaction or the reinforcements required to accommodate the transaction. Hence, wheeling customers are likely to receive and act upon incorrect economic signal.

3. **Power Flow Based MW-mile Method**: The power flow based MW-mile method allocates the charges for each transmission facility to transmission transactions based on the extent of use of that facility by these transactions. The allocation charges are then added up over all transmission facilities to evaluate the total price for use of transmission system. For this reason, this method is also called facility-by-facility method.

   Since this method allocates transmission charges facility by facility based on maximum use of each facility, it emulates the actual transmission planning process for system reinforcements which is based on local consideration rather than coincident peak condition for the overall system.

Transaction Cost Allocation [3,8]
(Contoh)

Marginal-Cost-Based Approaches

1. **Short-Run Marginal Cost (SRMC) Pricing Method**: In this pricing method, the marginal operating cost of the power system due to a transmission transaction is calculated first. Marginal operating cost is the cost of accommodating a marginal increase in the transacted power. The marginal operating cost per MW of transacted power can be estimated as the difference in the optimal cost of power at all points of delivery and receipt of that transaction. The marginal operating cost is then multiplied by the magnitude of the transacted power to yield the SRMC for the transmission transaction. SRMC prices for a transmission transaction are normally calculated with the transaction included in the base case. As a result SRMC prices are higher than the actual operating cost of accommodating the transaction. It has been proposed that this extra "profit" be accumulated by the wheeling utility to fund future transmission expansions.

   In addition, SRMC prices my not closely follow a transmission transaction actual operating cost if the magnitude of the transacted power large compared to the magnitude of native load in the transmission system. Finally, "profit" collected through this pricing methodology generally fall far short of the cost of lumpy transmission reinforcements. Hence, SRMC prices may discourage the host utility from expanding its transmission system. In fact, should the host utility make any expansion in its transmission system, the SRMC prices will decrease dramatically reducing the possibility of recovering transmission reinforcement costs.

Transaction Cost Allocation [3,8]
(Contoh)

Marginal-Cost-Based Approaches

2. **Long-Run Marginal Cost (LRMC) Pricing Method**: In this pricing method, the marginal operating and reinforcement costs of the power system are used to determine the prices for a transmission transaction.

   Over a "long' time horizon of several years, all transmission expansion projects are identified and costed. This cost is then divided over the total power magnitude of all new planned transactions to calculate the marginal reinforcement cost.

   The reinforcement cost component of a transmission transaction can be evaluated based on the changes caused in long-term transmission plans due to the transmission transaction. Although the concept of reinforcement cost is straightforward, its evaluation is very difficult as it involves solving the least cost transmission expansion problem. There are concerns related to allocation of the reinforcement costs among multiple transactions that collectively cause such costs.

The Way Forward

- **Identification of resource requirements of each alternative transmission pricing methods, such as: i) Metering Equipment, ii) Billing/collection system, iii) Required software/hardware, iv) Required associated staff, and v) Training requirement.**
- **Analyze and evaluation of potential transmission pricing methods, with evaluation criteria, such as:**
  - **Economic efficiency: Cost/Usage reflective; Loss reflective; Congestion reflective.**
  - **Pricing objective: Meeting revenue requirement; Fairness; Stable & predictable.**
  - **Ease of implementation: Resource requirements; Complexity.**
- **Recommendation of the most appropriate methods. Advance the methodology in phases (if exists in this option) which is in line with the power sector situations, and establish the implementation plan consistent with sector migration process.**
- **Recommend procedures and its associated required steps, required resource, and its time frame in line with the recommended implementation plan.**

References

1. Sally Hunt and Graham Shuttleworth, *Competition and Choice in Electricity*, John Wiley & Sons, Inc, 1996.
2. Sally Hunt*, Making Competition Work in electricity*, John Wiley & Sons, Inc, 2002.
3. Loi Lei Lai, City University, London, UK, *Power System Restructuring and Deregulation – Trading, Performance and Information Technology*, John Wiley & Sons, Inc, 2001.
4. Hagler Bailly Service Inc, *The Development of a Transmission Pricing Framework for the Java-Bali Power System*, Presentation to the Steering Committee, Jakarta, 16-17 December 1997.
5. Thong Vu Van, Mark Norton, Chavdar Ivanov, Marko Delimar, Nikos Hatziargyriou, Jon Stromsather, Antonio Iliceto, Carlos Lianos, and Patric Panciatici, *Organic Growth – Toward a Holistic Approach to European Research and Innovation*, IEEE Power & Energy, Volume 13, Number 1, January/February 2015.
6. Power Technologies, Inc, *Wheeling Transmission Access*, 1990.

References

7. A. F. Vojdani, C. F. Imparato, N. K. Saini, B. F. Wollenberg, and H. H. Happ, *Transmission Access Issues*, Presented at IEEE 1994 Winter Power Meeting Panel on Transmission Access Issues.
8. Darius Shirmohammadi, Pacific Gas and Electric Company, San Francisco, California, Xisto Vieira & Boris Gorenstin, CEPEL, Rio de Janeiro, Brazil, Mario V.P. Pereira, Power System Research, Rio de Janeiro, Brazil, *Some Fundamental Technical Concepts about Cost Based Transmission Pricing*, 95 SM 577-7 PWRS, Presented at the 1995 IEEE/PES Summer Meeting, July 23-27, 1995, Portland, OR.
9. Lei Wang, and Kip Morison, *Implementation of Online Security Assessment – Tools for Reducing the Risk of Blackouts*, IEEE Power & Energy, Volume 4, Number 5, September/October 2006.
10. Mohammad Shahidehpour, and Yong Fu, Benders decomposition – applying Benders decomposition to power systems, IEEE Power & Energy, Volume 3, Number 2, March/April 2005.
11. Hardiv Harris Situmeang, *Sekuriti Sistem Tenaga Listrik – Pengendalian Darurat*, Seminar Nasional Peran Teknik Kendali dalam Dunia Industri, Masyarakat Sistem Kendali Indonesia, 19 Juli 1997.

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Thank You

Appendix4
POWER WHEELING
PEMANFAATAN BERSAMA JARINGAN TENAGA LISTRIK(PBJT)

POWER WHEELING
PEMANFAATAN BERSAMA JARINGAN TENAGA LISTRIK (PBJT)

Disampaikan pada Seminar : Peluang Bisnis Ketenagalistrikan Indonesia
Jakarta, 17 Desember 2015

Latar Belakang

• Pertumbuhan industri yang pesat mendorong kenaikan permintaan pasokan listrik di kawasan industri yang tidak bisa dipenuhi oleh kecepatan pertumbuhan pasokan saat ini.
• Kemampuan dan kemauan para pelaku industri untuk membeli listrik pada harga premium guna mendapatkan jaminan kapasitas dan keandalan pasokan.
• Ketersediaan energi primer yang terpisah cukup jauh dari pusat beban
• Adanya kapasitas tak terpakai (idle) pada jaringan transmisi maupun keterbatasan investasi pembangkit oleh PLN.

Dasar Hukum

Permen ESDM No. 01 2015
Tentang Kerjasama Penyediaan Tenaga Listrik dan Pemanfaatan Bersama Jaringan Tenaga Listrik

Pasal 5

(1) Usaha Transmisi Tenaga Listrik sebagaimana dimaksud dalam Pasal 4, wajib membuka kesempatan pemanfaatan bersama jaringan transmisi tenaga listrik.

(2) Pemanfaatan bersama jaringan transmisi tenaga listrik sebagaimana dimaksud pada ayat (1) dilaksanakan sesuai dengan kemampuan kapasitas jaringan transmisi tenaga listrik dan aturan jaringan transmisi tenaga listrik.

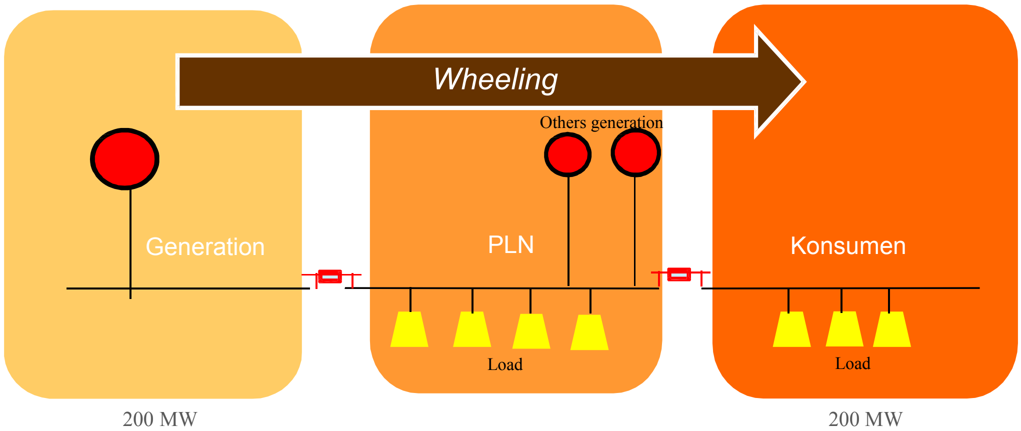
Power Wheeling

Definisi :

Proses pengiriman energi listrik dari suatu titik pembangkitan selaku penjual ke beban selaku pembeli melalui Sistem Saluran Transmisi milik pihak ketiga.

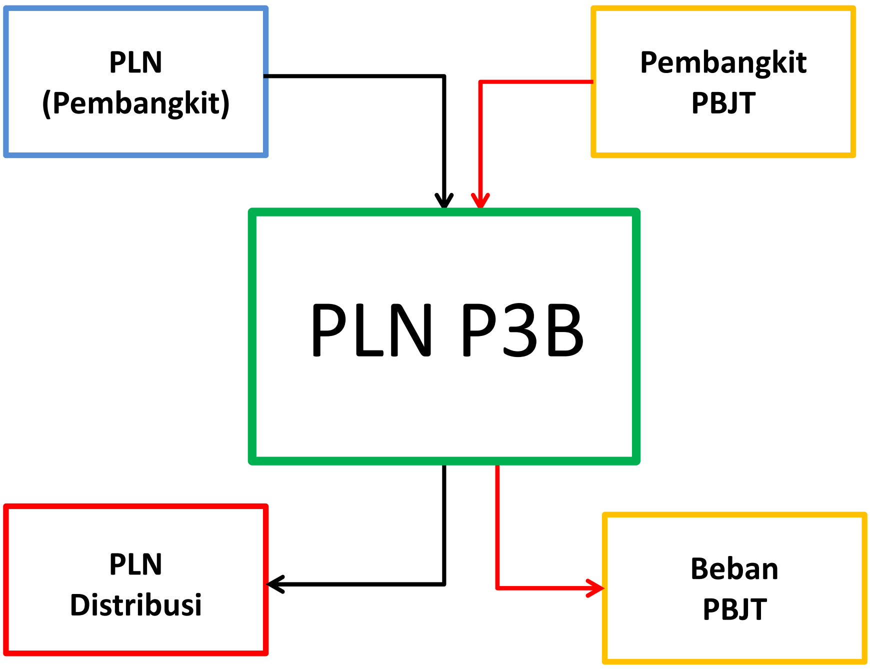
Power Wheeling

Konsep Power Wheeling



Prinsip PBJT

Ilustrasi PBJT



Prinsip PBJT

Prinsip PBJT

- Simple & transparan
- Me-recovery biaya. Revenue tarif harus cukup mengganti semua biaya termasuk investasi
- Mendorong efisiensi (insentif terhadap efisiensi)
- Independen. Fair dan terjustifikasi
- Mendorong investasi. Pengembalian investasi harus member insentif bagi investasi infrastruktur baru.

Simple & transparan

- Mendorong pelaku PBJT
- Adil
- Tarif sewa transmisi PBJT cenderung stabil
- Jelas dan mudah untuk diterapkan

Cost recovery

- Menjamin untuk cost recovery. Revenue tarif harus cukup mengganti semua biaya termasuk investasi.
- Tarif PBJT mencakup

1. Biaya investasi jaringan
2. Biaya Konjesti
3. Biaya rugi-rugi jaringan
4. Biaya karena pengoperasian jaringan

Mendorong efisiensi (insentif terhadap efisiensi)

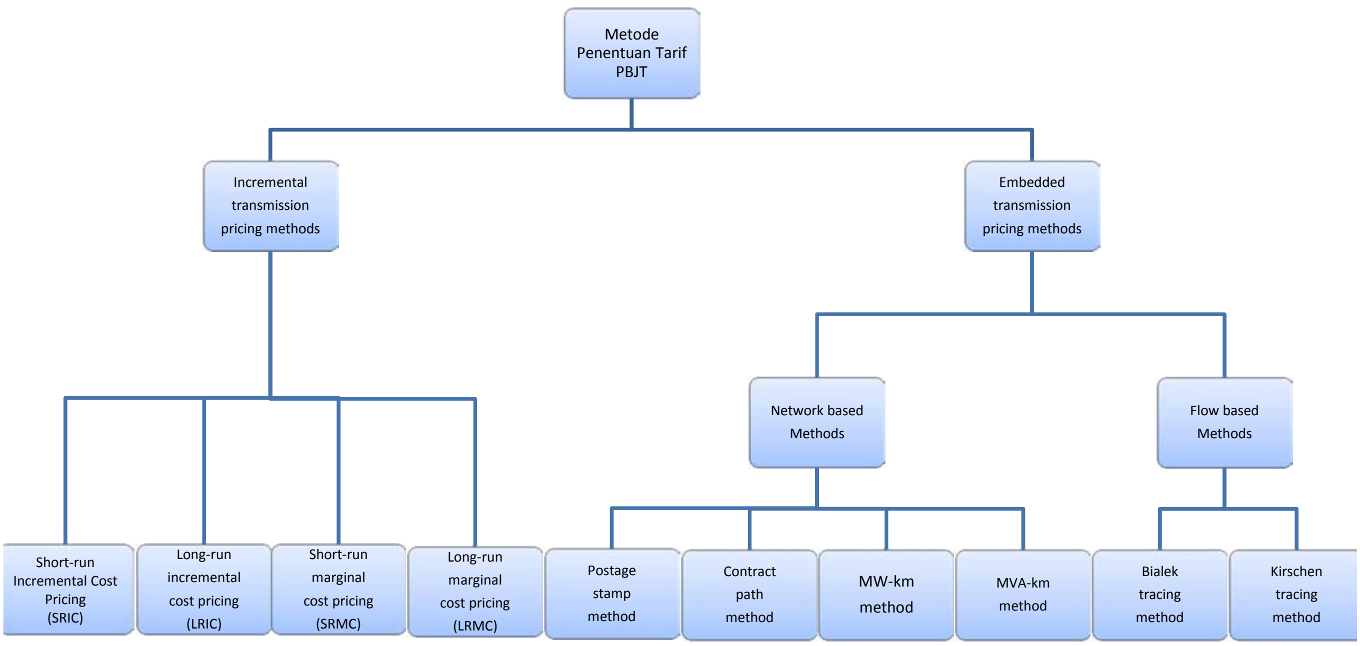
- Kesesuaian biaya pembangkitan dan beban
- Memungkinkan adanya insentif yang sesuai
- Mendorong kompetisi

Transparan, Adil, dan Jelas

- Mendorong adanya pemain baru dalam bidang kelistrikan
- Adil dan terbuka
- Harga yang stabil
- Jelas dan mudah penerapannya

2

Prinsip PBJT



3

Metode-metode PBJT

Incremental Transmission Pricing

Metode penentuan harga ini mengalokasikan biaya tambahan (yaitu, biaya variabel) dari transaksi transmisi.

Short-run Incremental Cost Pricing (SRIC)

Metode ini memerlukan evaluasi dan perhitungan biaya operasional yang terkait aktivitas PBJT. Biaya PBJT dapat ditentukan dengan menggunakan operasi optimal power flow (*OPF*) yang memperhitungkan semua constaints termasuk constaints sistem transmisi dan constaints pembangkitan.

Long-run Incremental Cost Pricing (LRIC)

Metode penentuan harga ini memerlukan evaluasi semua biaya jangka panjang (biaya operasional dan pengembangan) yang diperlukan untuk mengakomodasi PBJT dan menetapkan biaya PBJT. Komponen biaya pengembangan pada transaksi PBJT dapat dievaluasi berdasarkan besar perubahan perencanaan pengembangan jaringan transmisi (jangka panjang) karena adanya transaksi PBJT

Short-run Marginal Cost Pricing (SRMC)

Short-run marginal cost pricing adalah biaya karena adanya daya tambahan pembangkitan sebesar 1 MW dalam suatu transaksi PBJT. SRMC adalah perbedaan biaya marjinal bus pembangkit dan bus beban. Biaya marjinal bus pembangkit dan bus beban dapat ditentukan melalui operasi *optimal power flow*. Biaya PBJT dapat ditentukan dengan mengalikan besar daya PBJT dengan besar nilai SRMC. Metode SRMC memperhitungkan biaya operasi, namun tidak memperhitungkan biaya pengembangan.

Long-run Marginal Cost Pricing (LRMC)

LRMC menentukan *present value* dari investasi masa depan yang dibutuhkan untuk mendukung peningkatan marginal beban di lokasi yang berbeda dalam sistem, berdasarkan scenario beban puncak dan pertumbuhan pembangkit masa depan. Dalam metode PBJT ini biaya operasi dan pengembangan marjinal dari sistem kelistrikan digunakan untuk menentukan tarif PBJT.

Metode	Cost Recovery	Transparansi	Mendorong Efisiensi	Stabilitas Harga	Non-Diskriminatif	Mengakomodasi daya VAR	Kemudahan Implementasi	Ketersediaan Data		Total Score
								Teknis	Non-Teknis	
Postage Stamp	v	v	x	v	x	x	v	v	v	6
Contract Path	v	x	x	v	x	x	v	v	v	5
MW-Mile/km (Load Flow Based)	v	v	v	-	v	x	-	v	v	6
MVA-Mile/km (Load Flow Based)	v	v	v	-	v	v	-	v	v	7
MVA- Mile/km (Optimal Power Flow)	v	v	v	-	v	v	x	v	v	6
Bialek	-	-	-	-	-	-	-	v	-	1
Kirschen	-	-	-	-	-	-	-	v	-	1
LMP	-	x	v	x	v	v	x	v	v	5
SRIC	-	-	v	x	v	-	-	v	-	2
LRIC	-	v	v	v	v	-	-	v	-	4

* v = ya, x = tidak ; - = tidak dapat didefisinikan

Penerapan PBJT di Negara Lain

No.	Negara	Metode	Keterangan
1	*Nord Pool System* : Denmark, Finland, Sweden, Norway, Estonia and Lithuania	*Postage Stamp*	Harga sewa jaringan berbeda dari satu titik (bus) ke titik yang lain.
2	Irlandia	*Postage stamp*	25 % biaya transmisi ditanggung pembangkit dan 75 ditanggung beban
3	Afrika bagian selatan *power pool* : Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, Tanzania, Zaire, Zimbabwe and South Africa	Pada awalnya *postage stamp*. Mulai 2003, metode menjadi MW-km	
4	Jamaika	MW-km	
5	Ingris Raya	Nodal *pricing*	27 % biaya transmisi ditanggung pembangkit dan 73 ditanggung beban
6	US : PJM System	Nodal *pricing*	100 % biaya transmisi ditanggung pembangkit

Penerapan PBJT di Negara Lain

No.	Negara	Metode	Keterangan
7	Brazil	Nodal *Pricing*	50 % biaya transmisi ditanggung pembangkit dan 50 % ditanggung beban
8	Malaysia	Metode MW-Mile	• Power sistem di Peninsular Malaysia • Owner dan maintenance Tenaga Nasional Berhad (TNB) • Sistem transmisi 132KV, 275KV dan 500 KV • Nasional Grid terkoneksi dengan sistem transmisi Thailand (di sisi utara) • (di selatan) terkoneksi dengan sistem transmisi Singapura di Senoko

Penerapan PBJT di Negara Lain

Penerapan PBJT perlu mempertimbangkan: topologi jaringan, metode, pembagian pembebanan biaya transmisi.

Berdasarkan perbandingan metode PBJT sebelumnya, metode yang mungkin diterapkan di Indonesia adalah

	MVA KM	POSTAGE STAMP	LMP
Kelebihan	• Merepresentasikan perubahan aliran daya sistem transmisi yang sebenarnya • Penentuan biaya power wheeling terperinci dan jelas tiap salurannya • Bisa digunakan pada sistem yang simpel dan kompleks • Dapat memotivasi pengguna untuk memperbaiki sistem (MVA-km Reverse Unused)	• Perhitungan simpel dan mudah	• Harga sewa transmisi ideal dari segi ekonomi • Aliran daya menjadi optimal dan dinamis.
Kelemahan	• Memerlukan data input yang realtime • Penambahan beban oleh pelanggan PLN menyebabkan naiknya biaya power wheeling (MVA-KM Unused)	• Tidak dapat memotivasi pengguna untuk memperbaiki sistem • Harga tiap saluran dianggap sama sehingga kurang detail perhitungannya • Kurang merepresentasikan penggunaan pada sistem yang sebenarnya	• Sulit dalam penerapannya karena dibutuhkan OPF dalam periode yang singkat • Membutuhkan informasi yang real time tentang beban, pembangkitan, dan kondisi sistem. • Potensi Ketidakstabilan dan kompleksitas dalam pelaksanaan metodologi

5

Pemilihan Metode PBJT

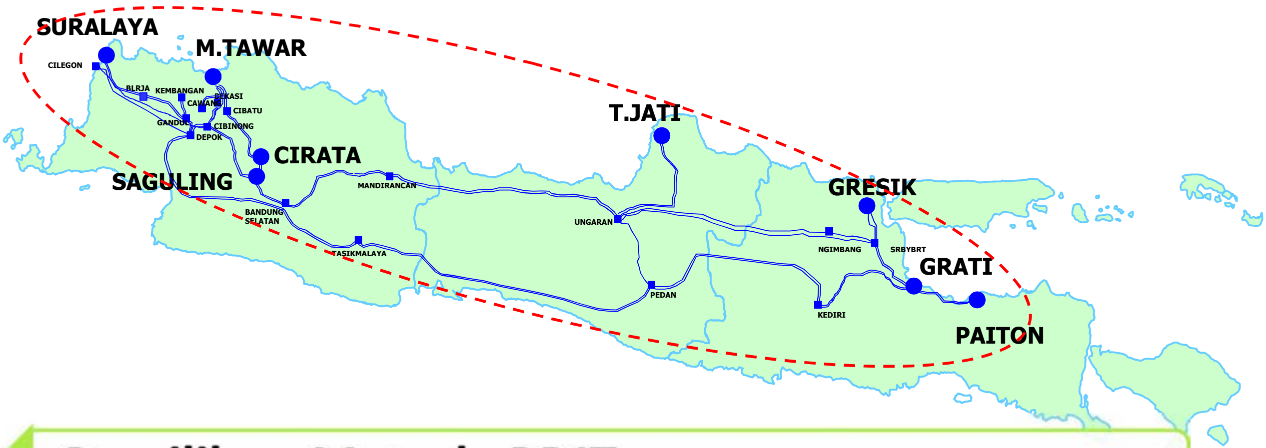
Metode PBJT yang layak secara teknis untuk diterapkan di sistem Jamali adalah MVA-KM, *Postage Stamp*, dan LMP (terbatas)

5

Pemilihan Metode PBJT

Postage Stamp

$$\frac{\text{Revenue Requirement}}{\text{Total Energi mengalir pada Sistem}} \times \text{Energi Power Wheeling}$$



5 **Pemilihan Metode PBJT**

MVA-KM

Konsep dasar *pricing power wheeling* metode MVA-km

Daya X **Jarak**

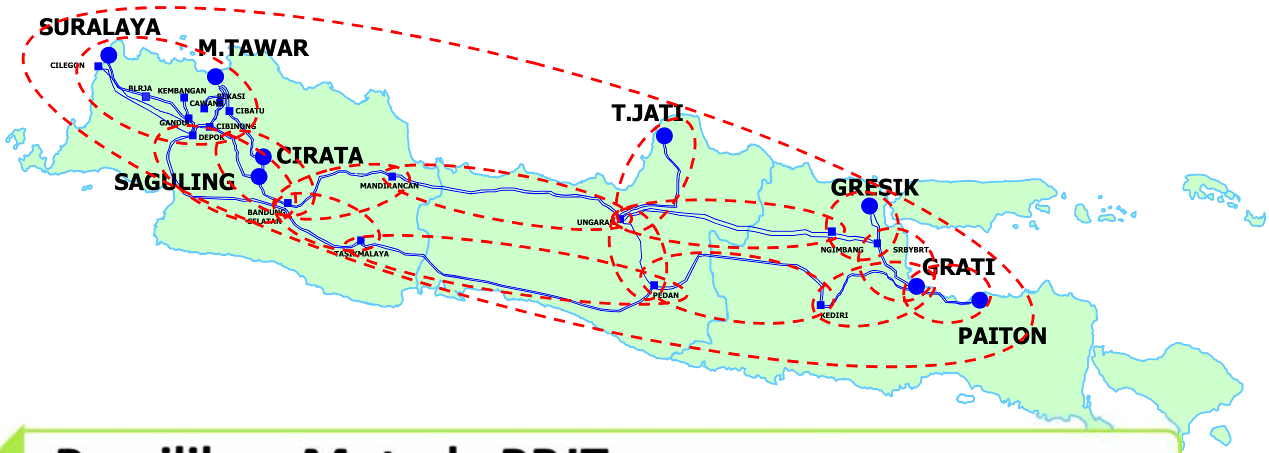
besar daya dikenakan pada saluran (MVA)

Panjang saluran transmisi terdampak (KM)

5 **Pemilihan Metode PBJT**

MVA-KM

$$\frac{(\text{Panjang Saluran})\ \mathbf{X}\ (\Delta\text{Pembenanan Saluran})\ \mathbf{X}\ (\text{Harga Saluran/KM})}{(\text{Kapasitas tak terpakai Saluran})}$$



5 Pemilihan Metode PBJT

MVA-KM	Unused	Reverse
		Absolute
		Dominant
	Capacity	Reverse
		Absolute
		Dominant
	Used	Reverse
		Absolute
		Dominant

5 Pemilihan Metode PBJT

Rumus MVA-km

$$C_k = \sum_{i=1}^{N} \frac{L_i \cdot F_i \cdot P_i^k}{\overline{P_i}}$$

- C_k = Biaya transmisi total yang ditanggung oleh pengguna “k”
- L_i = Panjang saluran “i”
- F_i = Biaya per unit yang telah ditetapkan, merefleksikan biaya saluran per km pada saluran “i”
- P_i^k = Besar perubahan aliran daya pada saluran “i” yang diakibatkan oleh pengguna “k”
- $\overline{P_i}$ = Rating kapasitas saluran “i”
- N = Jumlah pengguna sistem transmisi
- i = Indeks Saluran

Pendekatan MVA-km

$$C_k = \sum_{i=1}^{N} \frac{L_i \cdot F_i \cdot P_i^k}{\overline{P_i}}$$

P_i^k = Besar perubahan aliran daya pada saluran “i” yang diakibatkan oleh pengguna “k”

Absolute $P_i^k = |P_i^k|$

Dominant $P_i^k = |P_i^k|$ Pada saat aliran daya saluran bertambah

$P_i^k = 0$ Pada saat aliran daya saluran berkurang

Reverse $P_i^k =$ Bernilai (+) pada saat aliran daya saluran bertambah

$P_i^k =$ Bernilai (-) pada saat aliran daya saluran berkurang

Pendekatan Variabel Pembagi

$$C_k = \sum_{i=1}^{N} \frac{L_i \cdot F_i \cdot P_i^k}{\overline{P_i}}$$

$\overline{P_i}$: Rating kapasitas saluran "i"

Used = **daya yang mengalir pada saluran i sebelum dilakukan wheeling**

Unused = **kapasitas saluran dikurangi dengan daya yang mengalir pada saluran i sebelum dilakukan wheeling**

Capacity = **kapasitas saluran transmisi i sesuai dengan rating**

Nilai Variabel Fi

$$C_k = \sum_{i=1}^{N} \frac{L_i \cdot F_i \cdot P_i^k}{\overline{P_i}}$$

Fi = Biaya per unit, merefleksikan biaya saluran per km pada saluran "i"

Nilai **Fi** didapat dari *revenue requirement* dibagi dengan total panjang saluran

Fi = RR / TD

- RR = Revenue Requirement
- TD = Total Distance

Satuan nilai Fi adalah Rupiah / Km

Simulasi berbasis kondisi eksisting

Power Flow

***Loading factor* saluran sistem Jamali 500 kV dan 150 kV**

No Saluran	Bus Dari	Bus Ke	Bus Dari	Bus Ke	S Saluran (MVA)	Loading Factor (%)
806	333	331	BNRAN	MNRJO	157.817	82.1
751	363	360	KRSAN	PBLGO	126.481	81.1
752	363	360	KRSAN	PBLGO	126.481	81.1
568	266	267	BRBES	CRBEP	119.216	79.1
569	266	267	BRBES	CRBEP	119.216	79.1
784	374	373	KAPAL	BTRTI	155.848	76.9
802	330	331	SYZAG	MNRJO	147.345	76.6
262	87	88	MKLMA	BDKMY	171.625	71.8
263	87	88	MKLMA	BDKMY	171.625	71.8

6

Hasil dan Analisa simulasi PBJT

Simulasi berbasis kondisi eksisting

Optimal Power Flow

Aliran daya *optimal power flow* saluran 500 kV pada sistem Jamali 500 kV dan 150 kV

No	Saluran	P (MW)	*Loading factor* (%)
1	BKASI-CIBNG	-354.84	22.4
2	BKASI-CWANG	-150.24	11.2
3	CBATU-CRATA	-335.63	21.9
4	CBATU-CRATA	-335.63	21.9
5	CBATU-MTWAR	-172.50	15.9
6	CBATU-MTWAR	-172.50	15.9

No	Saluran	P (MW)	*Loading factor* (%)
27	PEDAN-KDIRI	-555.29	26.9
28	PEDAN-KDIRI	-555.29	26.9
29	PEDAN-TASIK	416.76	21.0
30	PEDAN-TASIK	416.76	21.0
31	PITON-GRATI	989.64	49.1
32	PITON-GRATI	989.64	49.1

6

Hasil dan Analisa simulasi PBJT

Identifikasi lokasi obyek PBJT

Dilihat dari:

- Aliran daya eksisting
- Pemilihan berdasarkan *Locational Marginal Price* (LMP).

6 Hasil dan Analisa simulasi PBJT

Identifikasi lokasi obyek PBJT

Dilihat dari:

- Aliran daya eksisting

Sampel pembebanan pada saluran sistem Jamali 500 kV dan 150 kV

No Saluran	Bus Dari	Bus Ke	Bus Dari	Bus Ke	P Saluran (MW)	Q Saluran (MVAR)	S Saluran (MVA)	Kapasitas Saluran (MVA)	*Loading Factor* (%)	Kapasitas *Unused* (%)
634	284	289	SGMDU	ALTAP	-187.64	-49.24	194.00	384.52	50.5	49.5
635	289	292	ALTAP	SBRAT	-150.61	-42.92	156.61	384.52	40.7	59.3
636	289	292	ALTAP	SBRAT	-150.61	-42.92	156.61	384.52	40.7	59.3
637	285	289	GRLMA	ALTAP	-68.86	-20.84	71.94	384.52	18.7	81.3
638	292	293	SBRAT	BBDAN	35.38	12.69	37.59	192.26	19.5	80.5
639	295	293	DRYJO	BBDAN	-2.32	-0.44	2.36	192.26	1.2	98.8
640	292	294	SBRAT	KLANG	150.87	52.81	159.85	384.52	41.6	58.4

6 Hasil dan Analisa simulasi PBJT

Identifikasi lokasi obyek PBJT

Dilihat dari:

- Pemilihan berdasarkan *Locational Marginal Price* (LMP).

Contoh ΔF/ΔP rendah (Rp/MWh)

Subsistem	No Bus	tegangan	GI	ΔF/ΔP
KRIAN	323	150	CERME	366,486.07
	324	150	BLBND	368,953.15
	325	150	KJTIM	365,254.46
	326	150	MNYAR	366,849.50
KEDIRI	338	150	MJAGN	375,155.16
	339	150	SKTIH	372,536.44
	340	150	NGORO	375,461.67

Contoh ΔF/ΔP tinggi (Rp/MWh)

Subsistem	No Bus	Tegangan (kV)	Nama GI	ΔF/ΔP (Rp/MWh)
SURALAYA	39	150	SLIRA	401,993.85
	40	150	SRLYA150	401,843.18
	41	150	PENDO	401,983.86
	42	150	PENI	402,476.27
	43	150	MTSBS	402,475.36
	44	150	MTSUI	402,018.57

6 **Hasil dan Analisa simulasi PBJT**

Identifikasi lokasi obyek PBJT

Potensi Lokasi PBJT dapat diketahui melalui loading factor yang rendah dan nilai perubahan biaya pembangkitan (ΔF/ΔP rupiah).

6 **Hasil dan Analisa simulasi PBJT**

Simulasi metode perhitungan Postage Stamp

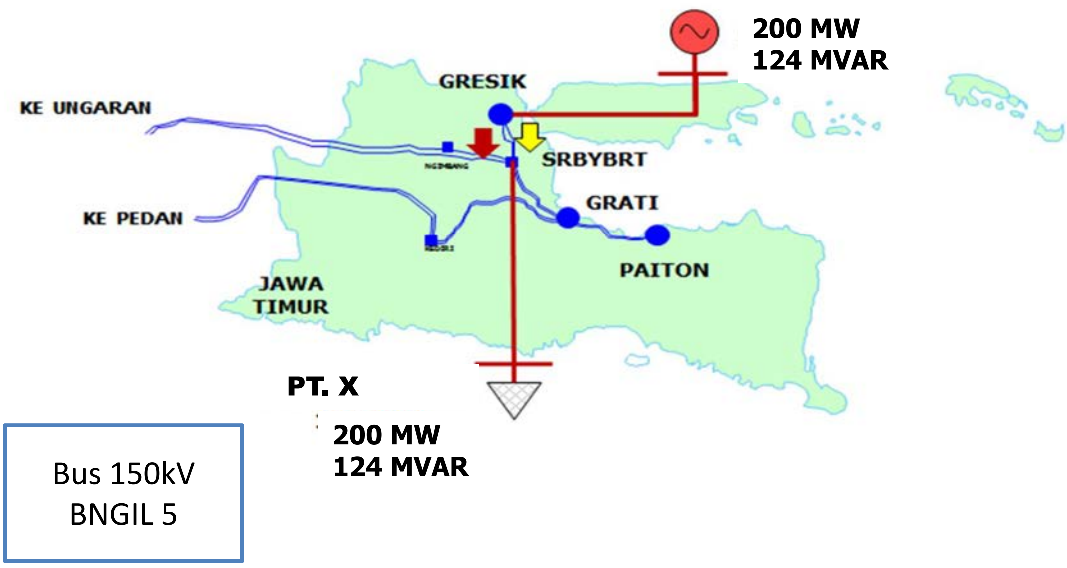
No	Jenis	Nilai	Keterangan
1	Material Pemeliharaan	456.352	Juta Rupiah
2	Jasa Borongan	927.283	Juta Rupiah
3	Pegawai	3.063.757	Juta Rupiah
4	Administrasi	776.897	Juta Rupiah
5	Penyusutan	2.999.910	Juta Rupiah
6	Bunga Pinjaman	2.684.974	Juta Rupiah
	Total	10.909.173	Juta Rupiah

- Biaya penyaluran adalah Rp 10.909.173 Juta untuk seluruh produksi energy yang disalurkan melalui jaringan tegangan tinggi dan tegangan ekstra tinggi sebesar 163.966 GWh, sehingga biaya yang timbul untuk PBJT adalah 66,53 Rp/kWh. Penerapan metode ini sangat sederhana.
- Tidak mendorong efisiensi dan non-diskriminatif

6 Hasil dan Analisa simulasi PBJT

Simulasi metode perhitungan MVA-KM

Bus 150kV
PT. X



6 Hasil dan Analisa simulasi PBJT

Simulasi metode perhitungan MVA-KM
Perubahan pembebanan saluran

NO Saluran	nama saluran	PF		OPF	
		Perubahan (MVA)	Perubahan (%)	Perubahan (MVA)	Perubahan (%)
717	GRATI-GRATI150	112,24	7,62%	120,83	8,21%
623	SBBRT-SBRAT	-80,44	-4,64%	-92,70	-5,35%
743	GRATI150-GDTAN	56,05	11,47%	60,38	12,36%
744	GRATI150-GDTAN	56,05	11,47%	60,38	12,36%
36	SBBRT-GRATI	-53,32	-2,57%	-143,27	-6,89%
37	SBBRT-GRATI	-53,32	-2,57%	-143,27	-6,89%
728	PIER-BNGIL	51,80	12,31%	34,88	8,29%
729	PIER-BNGIL	51,80	12,31%	34,88	8,29%
648	WARU-BDRAN	40,26	20,94%	54,10	28,14%
649	WARU-BDRAN	40,26	20,94%	54,10	28,14%
661	BDRAN-BNGIL	-16,68	-10,70%	-45,53	-29,21%
662	BDRAN-BNGIL	-16,68	-10,70%	-45,53	-29,21%

6 **Hasil dan Analisa simulasi PBJT**

Simulasi metode perhitungan MVA-KM
Biaya sewa total pengguna

		MVA- KM (PF)		MVA-KM(OPF)	
		Biaya Total Pertahun	Harga Per MVAh	Biaya Total Pertahun	Harga Per MVAh
Reverse	Unused	Rp14.332.597.282	Rp6.954	-Rp120.330.262.857	-Rp58.379
	Capacity	Rp3.932.712.785	Rp1.908	-Rp94.392.320.077	-Rp45.795
	Used	-Rp24.673.425.694	-Rp11.971	-Rp496.647.182.094	-Rp240.953
Dominant	Unused	Rp38.667.011.185	Rp18.760	Rp138.994.192.530	Rp67.434
	Capacity	Rp20.751.801.746	Rp10.068	Rp47.114.083.638	Rp22.858
	Used	Rp85.702.055.285	Rp41.579	Rp187.792.203.508	Rp91.109
Absolute	Unused	Rp63.001.425.087	Rp30.566	Rp398.318.647.918	Rp193.248
	Capacity	Rp37.570.890.708	Rp18.228	Rp188.620.487.353	Rp91.511
	Used	Rp196.077.536.263	Rp95.129	Rp872.231.589.112	Rp42.3172

total perubahan pembebanan saluran	389,388 MVA	-2454,203MVA

6 **Hasil dan Analisa simulasi PBJT**

Simulasi metode perhitungan MVA-KM

- **MVA-km dominant unused adalah metode yang paling layak dimplementasikan berbasis power flow.**
- **MVA-km reverse unused adalah metode yang paling baik berbasis optimal power flow, meskipun sulit penerapannya karena dibutuhkan informasi real time sistem Jawa-Bali**

6 **Hasil dan Analisa simulasi PBJT**

Mekanisme implementasi PBJT

Implementasi PBJT harus memperhatikan beberapa aspek:

- Teknis
  - Loading factor
  - Nilai total perubahan biaya pembangkitan dan penyaluran
  - Konjesti
  - Karakteristik pembangkit dan beban yang menjamin grid code tetap terpenuhi
- Non-Teknis
  - Kepastian jangka waktu PBJT

6 **Hasil dan Analisa simulasi PBJT**

Mekanisme implementasi PBJT

Prosedur PBJT:

- Penerapan jangka panjang
  - Permohonan disampaikan ke P3B
  - Aplikasi mengandung informasi terkait: kapasitas yang dibutuhkan, titik injeksinya, titik beban, durasi PBJT, beban puncak, beban rata-rata, dan informasi tambahan lain yang dibutuhkan P3B
  - P3B melakukan studi terkait kelayakan permintaan PBJT tersebut (*base case*)
  - Jika perlu penguatan sistem, pelaku PBJT bisa meminta P3B untuk melakukan studi investigasi guna menghitung estimasi biaya dan jadwal penyelesaian penguatan sistem
  - P3B harus melakukan studi segera berdasar permintaan tersebut dan mengirim hasilnya kepada pelaku PBJT
  - Pemohon wajib membayar pengeluaran yang dibutuhkan untuk melakukan studi penguatan sistem
- asd

6 Hasil dan Analisa simulasi PBJT

Kesimpulan

- Penerapan PBJT perlu mempertimbangkan: topologi jaringan, metode, pembagian pembebanan biaya transmisi.
- Metode PBJT yang layak secara teknis untuk diterapkan di sistem Jamali adalah MVA-KM, *Postage Stamp*, dan LMP (terbatas)
- Berdasarkan tingkat pembebanan IBT dan pembebanan penghantar, PBJT layak diterapkan di sistem Jawa-Bali.
- PBJT dapat dilakukan untuk lima tahun kedepan

Kesimpulan

- Tersedia data finansial yang audited untuk mendukung implementasi PBJT.
- Potensi Lokasi PBJT dapat diketahui melalui loading factor yang rendah dan nilai perubahan biaya pembangkitan (ΔF/ΔP rupiah).
- MVA-km dominant unused adalah metode yang paling layak dimplementasikan berbasis power flow. MVA-km reverse unused adalah metode yang paling baik berbasis optimal power flow, meskipun sulit penerapannya karena dibutuhkan informasi real time sistem Jawa-Bali

Rekomendasi

Direkomendasikan penggunaaan **load flow based MVA-KM** pada sistem Jawa-Bali yang memiliki keunggulan diantaranya : memungkinkan cost sharing, transparan, *cost recovery,* dan mendorong efisiensi penggunaan jaringan.

Appendix5
Power Wheeling Provision Model

I. General Provisions

1. Applicability

These Wheeling Service Provisions (hereinafter, “Provisions”) shall apply to the charges and other supply conditions for Wheeling Service provided by PLN.

2. Definitions

(1) Wheeling Service

Service pursuant to which PLN receives electricity from a Subscriber and simultaneously supplies such Subscriber with electricity to be used for the Subscriber’s electricity sales business via the supply facilities maintained and operated by PLN at a point within PLN’s service area other than where PLN has received electricity.

(2) Wheeling Service Contract

The contract entered into or to be entered into between PLN and the Subscriber in accordance with the Provisions

(3) Subscriber

Operator of an electricity sales business who has entered into Wheeling Service Contract with PLN pursuant to the Provisions.

(4) Power Producer

Person other than PLN who generates and supplies electricity pertaining to Wheeling Service to be used for an electricity sales business.

(5) Consumer

Person to whom a Subscriber supplies electricity as an operator of an electricity sales business.

(6) MEMR Regulation No. 1/2015

Minister of Energy and Mineral Resources Regulation No. 1 of 2015 on Cooperation on Supply of Power and Joint Utilisation of Power Network

(7) Receiving Point

Point at which PLN receives electricity pertaining to Wheeling Service from a Subscriber.

(8) Place of Generation

Place in which Power Producer generates electricity pertaining to Wheeling Service.

(9) Service Point

Point at which PLN supplies electricity pertaining to Wheeling Service to a Subscriber.

(10) Place of Demand

Place in which Consumer uses electricity supplied by Subscriber pertaining to Wheeling Service.

(11) PLN

PT. PLN (PERSERO), a state owned company established and organized under the laws of the Republic of Indonesia, with its principal address at Jl. Trunojoyo Blok M I/135, Jakarta Selatan, Indonesia, who will provide Wheeling Service to the Subscriber under the terms of the Provisions and the Wheeling Service Contract.

(12) Evaluation of Receiving-Side Connection

Evaluation by PLN on Subscriber’s request for installation or alternation of new or existing supply facilities prior to receiving electricity from the Subscriber to be used for its electricity sales business.

(13) Preliminary Evaluation of Supply-Side Connection

Evaluation by PLN on the necessity and the type of installation work requested by Subscriber prior to supplying electricity to the Subscriber to be used for its electricity sales business.

(14) Received Electric power

Electric power pertaining to Wheeling Service received by PLN from Subscriber at Receiving Point.

(15) Received Electric Energy

Electric energy pertaining to Wheeling Service received by PLN from Subscriber at Receiving Point.

(16) Supplied Electric Power

Electric power pertaining to Wheeling Service supplied by PLN to Subscriber at Service Point.

(17) Supplied Electric Energy

Electric energy pertaining to Wheeling Service supplied by PLN to Subscriber at Service Point.

(18) Adjusted Supplied Electric Power

Supplied Electric Power adjusted by Loss Factor.

(19) Adjusted Supplied Electric Energy

Supplied Electric Energy adjusted by Loss Factor

(20) Loss Factor

Rate of loss of electricity between Receiving Point and Service Point in Wheeling Service.

(21) Contract Demand

The maximum electric power (kilowatt) that Subscriber can use under Wheeling Service Contract.

(22) Contracted Electric Power

The maximum Received Electric Power (kilowatt) at Receiving Point determined in advance by consultation between Subscriber and PLN.

(23) Maximum Demand

The maximum Electric power consumed over each 30-minute period measured by a recording electric meter.

(24) Load-Dispatch Instruction

Instruction issued by PLN with respect to the operation of power generating units of Power Producer or an interconnection point between companies, or with respect to the use of electricity by Consumer.

(25) Load-Following Operation Mode

Time during which electricity supplemented by Load-Dispatch Instruction, etc. is not being used.

(26) Wheeling Service Charge

Has the meaning set out in Article 17(2).

3. Appointment of Representative Subscriber

In case there is more than one Subscriber under a Wheeling Service Contract, a Representative Subscriber shall be appointed in advance.

4. Handing of Information

PLN shall not use any information, which PLN has obtained in connection with the application for and performance of Wheeling Service, for any purpose other than for performing Wheeling Service.

5. Unit of Measurement and Rounding of Numbers

Electric power and electric energy shall be expressed in kilowatt (kW) and kilowatt-hour (kWh), respectively, and any fraction of 1kW and 1kWh shall be rounded off to the nearest whole number. Total amount based on rates and other calculations shall be expressed in Rupiah (IDR) terms truncated to the nearest whole number.

6. Detailed Matters

Detailed matters necessary for the performance of the Provisions shall be discussed and agreed upon between Subscriber and PLN as occasion demands.

II. Application for Wheeling Service

7. Requirements

To subscribe to Wheeling Service, Subscriber must satisfy the following requirements:

(1) Subscriber must be able to supply electricity according to demand fluctuations of Consumer.
(2) Power Producer and Consumer must be interconnected in a technically appropriate manner in compliance with an applicable grid code.
(3) Subscriber, Power Producer, and Consumer must follow PLN's Load-Dispatch Instructions.
(4) Subscriber, Power Producer, and Consumer must comply with the Provisions.

8. Application for Evaluation and Subscription

(1) Application for evaluation of receiving-side connection

Subscriber shall apply for Evaluation of Receiving-Side Connection by using a prescribed form disclosing the information listed below. PLN shall charge each Subscriber *** IDR as a survey fee for each evaluation at each Receiving Point at the time of accepting the application for Evaluation of Receiving-Side Connection. As a general rule, PLN shall conduct the evaluation and inform the result thereof within **** days after accepting the application.

a Name of Subscriber
b Name of Representative Subscriber (only when there is more than one Subscriber)
c Name of Power Producer, locations of Place of Generation and Receiving Point
d Power generation method, output, and other specifications of power generation equipment necessary for stable operation of the electric system.
e Maximum and minimum Received Electric Power
f Receiving voltage at Receiving Point
g Load equipment and receiving equipment of Place of Generation
h Preferred date for commencing Wheeling Service
i Permission of power supply business

(2) Application for Preliminary Evaluation of Supply-Side Connection

Subscriber shall apply for Preliminary Evaluation of Supply-Side Connection by using the prescribed form disclosing the information listed below. In principle, PLN shall conduct the evaluation and inform the result thereof within **** days after accepting the application.

a Name of Subscriber, Locations of Place of Demand and Service Point
b Contract Demand
c Supply voltage at the Service Point
d Preferred date for commencing Wheeling Service

(3) Application for Wheeling Service

Subscriber shall apply for Wheeling Service by using the prescribed form disclosing the information listed below along with a copy of letters of consent of Power Producer and Consumer to the Subscriber.

a Name of Consumer, Locations of Place of Demand and Service Point
b Supply voltage at the Service Point
c Load equipment, receiving equipment, and power generating equipment at the Place of Demand
d Contract Demand
e Contracted Electric Power
f Preferred rate plan for Wheeling Service
g Planned values of Received Electric Power and Supplied Electric Power
h Contact system

9. Effective Date and Term

(1) The term of Wheeling Service Contract shall be one (1) year from the date of execution thereof and after the date on which the wheeling charge becomes applicable.
(2) Wheeling Service Contract shall be renewed on the same terms and conditions contained therein for successive one (1) year terms thereafter unless it is terminated or amended prior to the expiration thereof.

10. Commencement of Wheeling Service

PLN shall, upon accepting the application for Wheeling Service, immediately begin providing Wheeling Service on the commencement date agreed upon in consultation with the Subscriber.

11. Cooperation for Preparation and Other Necessary Procedures

Subscriber, Power Producer, and Consumer shall cooperate with PLN in securing land, etc. necessary for installing and maintaining supply facilities to be installed or owned by PLN for providing Wheeling Service.

12. Electrical Mode, Voltage, and Frequency

(Contents in this section should be determined in accordance with PLN's technical rule.)

13. Place of Generation and Place of Demand

(Contents in this section should be in line with the styles of indicating the geometrical locations in Indonesia.)

14. Limitation of Consent

PLN may decline the whole or part of an application for Wheeling Service due to legal restrictions, supply-demand situation of electricity, site conditions, payment status of charges, or other unavoidable reasons, in which case, PLN will inform the applicant the reason thereof.

15. Preparation of Contract

As a general rule, PLN will prepare the Wheeling Service Contract with Subscriber, which provides for necessary matters concerning Wheeling Service prior to commencement of Wheeling Service.

III. Charges

16. Charges

Applicable charge shall be the sum of the Wheeling Service charge and the charge for load fluctuation-linked power.

17. Wheeling Service

(1) Applicability

Charges shall be applied to electricity supplied by PLN to the Subscriber at the Service Point via Wheeling Service.

(2) Wheeling Service Charge

Monthly charge for Wheeling Service is calculated for each Service Point based on the electric energy supplied by Wheeling Service during that month.

a **** IDR per 1kWh when Supplied Electric Energy during that month is greater than**** kWh.
b A flat rate of **** IDR when Electric Energy during that month is less than**** kWh.

(Omitted)

(3) Other

When Subscriber is going to use electricity to compensate for a shortfall caused by inspection, repair, or accident (including suspension due to power outage) of Consumer's power generating equipment at the Service Point where the Contract Demand in Wheeling Service is established; the Subscriber shall notify PLN of the times at which the Subscriber plans to begin and end to use electricity for such purpose in advance, except in case of accident or under other unavoidable circumstances, in which case, the Subscriber shall notify PLN thereof immediately after starting to use such electricity. PLN will request the Subscriber to submit the record of the operation of Consumer's power generating equipment as necessary.

18. Load Fluctuation-Linked Power

(1) Applicability

Charge for load fluctuation-linked power shall be applied to electricity used for supplementing a shortfall when the Received Electric Power for a 30-minute period is less than the Adjusted Supplied Electric Power for the same period in Load-Following Operation Mode.

(2) Charge for load fluctuation-linked power

Charge for load fluctuation-linked power shall be the sum of the rate within the fluctuation range and the rate beyond the fluctuation range.

a Rate within the fluctuation range

This rate shall be applied to electricity for supplementing a shortfall below the standard electric energy within the fluctuation range when the Received Electric Energy for a 30-minute period is below the Adjusted Supplied Electric Energy for the same period.

b Standard electric energy within the fluctuation range

Standard electric energy within the fluctuation range shall be the value, which is derived by dividing by two the equivalent to 3% of the value obtained by the following formula for each 30-minute period.

Contract Demand under Wheeling Service Contract x 1 – Loss Factor (as defined in Section 26)

c Rate for electric energy with the fluctuation range

Rate for electric energy within the fluctuation range shall be calculated based on the monthly total of electric energy, to which (1) is applicable, and which is equal to or less than the standard electric energy within the fluctuation range.

***** IDR per 1kWh

d Electric energy beyond the fluctuation range

The rate for electric energy beyond the fluctuation range shall be applicable to electric energy used for supplementing the portion of a shortfall, which exceeds the standard electric energy within the fluctuation range, caused by imbalance between the Received Electric Energy for each 30-minute period and the Adjusted Supplied Electric Energy for the corresponding period.

e Rate for electric energy beyond the fluctuation range

The rate for electric energy beyond the fluctuation range shall be calculated for the electric energy, to which (1) is applicable, and which exceeds the standard electric energy within the fluctuation range, based on the monthly total for each time slot of the day.

***** IDR per 1kWh

IV. Calculation of Charges and Payment

19. First Day of Billing

Charges shall become applicable on the commencement date of service set forth in the Wheeling Service Contract, or another date agreed upon between the Subscriber and PLN if a request is made to defer the commencement date or when Wheeling Service cannot be commenced on the originally set date due to reasons not attributable to the Subscriber, Power Producer, or Consumer.

20. Billing Period

The billing period shall run from the first day to the last day of each calendar month. However, in case Wheeling Service starts or terminates in the middle of a calendar month, the billing period shall run from the commencement date of Wheeling Service to the end of the calendar month, to which the commencement date belongs; or from the first day of the month, to which the termination date belongs, to the day before the termination date; respectively.

21. Metering

PLN shall measure Received Electric Energy using a recording electric meter installed at each Receiving Point at the voltage equivalent to the receiving voltage, as well as Supplied Electric Energy using a recording electric meter installed at each Service Point at the voltage equivalent to the supply voltage, every 30 minutes. Meter readings shall be notified to the Subscriber every month without delay.

22. Calculation of Electric Power and Electric Energy

(1) Received Electric Energy

Received Electric Energy means the electric energy measured every 30 minutes at each Receiving Point. However, if the measurement of a particular 30-minute period exceeds the Adjusted Supplied Electric Energy for the same period, the Received Energy for the 30-minute period shall be the Adjusted Supplied Electric Energy for the same period.

(2) Supplied Electric Energy

Supplied Electric Energy shall be the electric energy measured every 30 minutes at each Service Point.

(3) Adjusted Supplied Electric Energy

Adjusted Supplied Electric Energy for each 30-minute period shall be calculated using the formula below:

Supplied Electric Energy = 1/(1 – Loss Factor)

(4) Load Fluctuation-Linked Electric Energy

Load fluctuation-linked electric energy shall be calculated for each 30-minute period using the formula below when the Received Electric Energy for a 30-minute period is less than the Adjusted Supplied Electric Energy for the same period in Load-Following Operation Mode.

Load fluctuation-linked electric energy = Adjusted Supplied Electric Energy – Received Electric Energy

(5) Other

Matters necessary for calculating the amount of electric energy shall be discussed and agreed upon in advance between the Subscriber and PLN. When electric energy or maximum demand cannot be measured accurately due to a faulty electric meter, etc., the electric energy in question shall be determined by consultation between the Subscriber and PLN, in which case, the agreed-upon electric energy shall be deemed as the electric energy measured at the Receiving Point or the Service Point.

23. Loss Factor

The Loss Factor applied under the Provisions shall be **** % .

24. Calculation of Charges

(1) The billing period shall be one (1) calendar month except in the following instances:

a When Wheeling Service has been commenced, resumed, or suspended, or the Wheeling Service Contract has been terminated, in the middle of a month.

b When the applicable rate has been changed due to change in Contract Demand under the Wheeling Service Contract.

25. Payment Obligation and Due Date

(Omitted)

26. Payment of Charges, etc.

(Omitted)

V. Supply

27. Provision of Wheeling Service

(1) Subscriber shall make adjustments to match the electric energy supplied to PLN and the Adjusted Supplied Electric Energy for each 30-minute period.

(2) Subscriber shall notify PLN in writing of its power generation plan and supply-demand plan prior to the commencement of Wheeling Service.

(3) Subscriber shall, when requested by PLN to submit a plan as necessity arises for the operation of its electrical system, immediately notify PLN of such plan, in which case, PLN shall prepare a separate memorandum of understanding, which stipulates necessary matters based on prior discussions with the Subscriber and Power Producer.

(4) PLN may, depending on the supply-demand situation and the conditions of its supply facilities, etc., adjust the plan notified by the Subscriber.

(5) PLN may issue a Load-Dispatch Instruction to the Subscriber, Power Producer, or Consumer due to restrictions in operating its electrical system or other reasons, in which case, the Subscriber, Power Producer, and Consumer shall follow PLN's Load-Dispatch Instruction.
With respect to matters concerning cooperation of Power Producer and Consumer for Load-Dispatch Instruction, security, etc. and other matters necessary for the operation of the electrical system, PLN shall prepare a separate memorandum of understanding with the Power Producer and Consumer.

28. Issuance of Load-Dispatch Instruction, etc.

(1) PLN may ask the Power Producer to change the timing of periodic inspection or periodic servicing when necessary due to restrictions in the operation of its electrical system or other reasons.

(2) In the events listed below, PLN may restrict or suspend the generation of electricity by Power Producer or the use of electricity by Consumer by issuing a Load-Dispatch Instruction to the Subscriber, Power Producer, or Consumer, or without issuing a Load Dispatch Instruction in case of emergency or under unavoidable circumstances:

a When a failure occurs, or there is a risk of failure, in the supply facilities maintained or operated by PLN.

b When there is an unavoidable reason due to inspection, repair, modification, or other works, which must be performed on the supply facilities maintained and operated by PLN.

c When the demand of the entire electrical system drops significantly, which necessitates the reduction of hydroelectric output despite the efforts of PLN.

d When there are other necessities due to supply-demand situation or for security reasons.

(3) When PLN limits or suspends electricity generation by Power Producer by issuing a Load-Dispatch Instruction, etc. on the scheduled day of Wheeling Service, PLN shall supply electricity to be used for electricity sales business to compensate for the shortfall caused by such limitation or suspension until such limitation or suspension is lifted so long as there is no restriction on the supply of electricity at the Service Point due to reasons attributable to the operation of its electrical system. In this case, the charges for the supply of electricity and other conditions shall be as per the separately provided Guidelines for Supplementing Electric Power at the Time of Load-Dispatch Instruction.

(4) In case PLN limits or suspends the use of electricity by Consumer pursuant to Paragraph (2) above, PLN shall calculate the charge by providing the following discount, which, however, shall not apply to limitation or suspension of use due to causes, for which the Subscriber, Power Producer, or Consumer is responsible.

(Discount method is omitted)

29. Maintenance of Appropriate Rate Plan, etc.

When the Subscriber's rate plan under the Wheeling Service Contract is deemed inappropriate for its actual use, PLN will ask the Subscriber to immediately switch to a more appropriate rate plan.

30. Performance of Duties by Entering the Place of Generation and Place of Demand

PLN may enter the land or building of the Power Producer or Consumer upon obtaining their consent in order to perform the following duties, in which case, neither the Power Producer nor Consumer can refuse to give consent to PLN personnel's entry to perform such duties without a justifiable reason. If requested by the Power Producer or Consumer, PLN personnel shall present designated ID cards.

31. Cooperation Associated with Wheeling Service

If Power Producer or Consumer has interrupted the use of electricity of another person, or there is a risk thereof, due to the reasons listed below, Subscriber shall install a necessary regulating device or protection devise at the Place of Generation or Place of Demand, and, if there is a particular necessity, have PLN modify its supply facilities or install dedicated supply facilities, in either case at the expense of the Subscriber.

(1) When there is a significant load imbalance between phases due to load properties, etc.
(2) When there is a significant fluctuation in voltage or frequency due to load properties, etc.
(3) When there is a significant distortion in waveform due to load properties, etc.
(4) When extremely high frequencies or harmonic waves are generated.

32. Suspension of Wheeling Service

(1) PLN may suspend Wheeling Service when any of the following conditions applies to the Subscriber, Power Producer, or Consumer:

a An immediate action is required due to security risk, for which the Subscriber, Power Producer, or Consumer is responsible.

b Subscriber, Power Producer, or Consumer has caused serious damage or loss to PLN as a result of intentionally damaging or losing PLN's electric facilities within the Place of Generation or Place of Demand.

c Subscriber, Power Producer, or Consumer has connected their electric equipment to that of PLN by violating the Provisions.

(2) PLN may suspend Wheeling Service when any of the following conditions applies to the Subscriber, in which case, PLN shall notify the Subscriber thereof at least five (5) days prior to suspension of Wheeling Service.

a Subscriber fails to pay billed charges by the due date.
b Subscriber fails to pay off other debt obligations under the Provisions.
(3) PLN may suspend Wheeling Service when any one of the following conditions applies to the Subscriber, Power Producer, or Consumer and is not remedied despite a warning from PLN.
a There is a security risk due to reasons, for which Subscriber, Power Producer, or Consumer is responsible.
b Subscriber, Power Producer, or Consumer has used PLN's electric grid or electricity illegally by altering the electric facilities, etc.
c Subscriber, Power Producer, or Consumer fails to meet the requirements under the Wheeling Service Contract.
d Subscriber, Power Producer, or Consumer refuses the entry of PLN personnel into the Place of Generation or Place of Demand to perform duties without a justifiable reason.
e Subscriber, Power Producer, or Consumer fails to provide necessary cooperation associated with Wheeling Service.
(4) PLN may suspend Wheeling Service when the Subscriber's load fluctuation-linked electric energy for each 30-minute period frequently exceeds the standard electric energy within the fluctuation ranged, and the Subscriber refuses to respond to PLN's request to switch to a more appropriate rate plan or adjust the use of electric energy to fit within the current plan.
(5) PLN may suspend Wheeling Service when Subscriber, Power Producer, or Consumer is found to be in violation of the Provisions.
(6) When suspending Wheeling Service pursuant to Paragraphs (1) through (5) above, PLN shall perform appropriate work on PLN's supply facilities or the electric facilities of the Power Producer or Consumer for suspending Wheeling Service.

33. Release of Suspension of Wheeling Service

(Omitted)

34. Charges during Suspension of Wheeling Service

Charges for the period, during which Wheeling Service was suspended, shall be calculated on a pro-rata basis, based on the monthly charge for zero consumption.

35. Penalties

(Contents of this section should be determined in accordance with Indonesia rules or customs)

36. Indemnity from Liability

(Contents of this section should be determined in accordance with Indonesia rules or customs)

37. Compensation for Equipment Damage

(Contents of this section should be determined in accordance with Indonesia rules or customs)

VI. Amendment and Termination of Contract

38. Amendment

In case there is any change in the matters agreed upon under the Wheeling Service Contract, the Subscriber shall immediately apply for amendment of the Wheeling Service Contract to PLN by following the same procedure as that for newly applying for Wheeling Service.

39. Termination

(In this section, the termination of the due, the mutual rights and the procedure of termination should be determined.)

40. Settlement of Charge and Installation Fee Associated with Cancellation or Amendment

of Contract

In the following events, the Subscriber shall pay the charge and installation fee due on the date of cancellation or amendment of Intra-Area Wheeling Service Contract or Cross-Area Wheeling Service Contract:

("The following events" are omitted.)

41. Cancellation

PLN may terminate Wheeling Service Contract if the Wheeling Service is suspended due to reasons attributable to the Subscriber, Power Produce, or Consumer, which are not remedied by the due date set by PLN, in which case, PLN shall notify thereof to the Subscriber in writing.

42. Debts and Credits after Termination of Contract

Any charges or other debts or credits applicable during the term of the Wheeling Service Contract will remain applicable after the termination of the said Contract.

XI. Receiving / Supply Methods and Installation Work

43. Receiving Point, Service Point, and Facilities

(1) Receiving Point

Receiving Point of electricity shall be the connecting point of PLN's supply facilities and the Power Producer's electric facilities.

(2) Service Point

Service Point shall be he connecting point of PLN's supply facilities and the Consumer's electric facilities.

(3) Supply facilities up to the Receiving Point, as well as those up to the Service Point, shall be owned and installed by PLN for a fee payable as installation fee.

When PLN is installing supply facilities only to be used by the Power Producer or Consumer within the land or building of the Power Producer or Consumer, the Power Producer or Consumer shall provide such land or building free of charge.

44. Overhead Service Line

(1) As a general rule, PLN's supply facilities and the electric facilities of Power Producer or Consumer shall be connected with overhead service lines, which shall be installed by PLN up to the building of the Power Producer or Consumer, or up to the point at which the service line is attached to a supporting pole.

(2) PLN and Subscriber shall discuss and agree on the position of the attaching point of the service line, which shall, as a general rule, be at the nearest point from the most appropriate support structure of PLN's supply facilities, and where the service line can be attached securely.

(3) Subscriber shall install the supporting pole for attaching the service line to be installed within the Place of Generation or the Place of Demand at the expense of the Subscriber and allow PLN to use it free of charge.

45. Underground Service Line

(1) When PLN's supply facilities and the electric facilities of the Power Producer or Consumer are to be connected by an underground service line, PLN shall install such underground service line up to the point (a) or (b) below, whichever is closer to PLN's supply facilities.

a Connection point with the circuit breaker, disconnector, or connecting device installed by the Power Producer within the Place of Generation, or the contact point with the circuit breaker, disconnector, or connecting device installed by the Consumer within the Place of Demand.

b Connection point with the electric meter (including auxiliary devices) installed by PLN.

PLN may install connecting devices, etc. within the land or building of the Power Producer or Consumer.

(2) When installing electric facilities to be connected with PLN's supply facilities pursuant to Paragraph (1) above, Subscriber and PLN shall discuss and agree on the place of installation, which shall be at the nearest point from the most appropriate supporting structure of PLN's supply facilities or branch point.
In cases other than the above, underground service lines within the Place of Generation or the Place of Demand shall be installed by the Subscriber at the expense of the Subscriber.
(3) Facilities incidental to the installation of underground service lines shall, as a general rule, be installed by the Subscriber at the expense of the Subscriber, in which case, PLN can use such incidental facilities free of charge.
Incidental facilities in this case shall refer to the followings:
a Steel pipes, culverts, and other structures for housing service wires within the land or building walls, etc. of the Power Producer or Consumer.
b Foundation blocks (for anchoring connecting devices) and handholes installed within the land or building of the Power Producer or Consumer.
c Other facilities of similar functions to those of a or b above.
(4) When the Subscriber desires to install underground service lines in places where overhead service lines can be installed, such underground service lines shall, as a general rule, be installed by and at the expense of the Subscriber, except when PLN determines that installation of such underground service lines is appropriate for security or maintenance reasons, in which case, connection work shall be performed pursuant to Paragraph (1), and the cost for installing the service lines up to the Receiving Point or Service Point shall be charged as an installation fee to the Subscriber.

46. Connection of Service Lines

PLN's supply facilities and the electric facilities of Power Producer or Consumer shall be connected by PLN.

47. Installation of Electric Meter

(1) As a general rule, electric meters necessary for measuring electric energy supplied via Wheeling Service, as well as their auxiliary devices and sorting devices, shall be owned and installed by PLN, except for secondary wiring of a transformer or other expensive connections, which shall be done by and at the expense of the Subscriber in some cases.
(2) As a general rule, electric meters, auxiliary devices, and sorting devices necessary for measuring Received Electric Energy and the electric energy supplied by Cross-Area Wheeling Service shall be owned and installed by PLN, in which case, the Subscriber shall pay PLN the fee for installing such devices as set forth under Section 60 hereof.
(3) Subscriber and PLN shall discuss and agree on the locations for installing the electric meters, auxiliary devices, and sorting devices, where accurate measurements can be taken and where inspection, installation, and removal of such devices can be easily performed.
(4) Power Producer or Consumer shall provide the sites for installing the electric meters, auxiliary devices, and sorting devices free of charge and allow PLN to use the devices installed by the Subscriber pursuant to Paragraph (1) above free of charge.
(5) If PLN relocates the electric meters, auxiliary devices, or sorting devices at the request of the Subscriber or performs equivalent work, the Subscriber shall pay PLN the actual expense incurred for such relocation or equivalent work.
(6) If PLN replaces the electric meters, auxiliary devices, or sorting devices in accordance with applicable law, the Subscriber shall pay PLN the actual expense incurred for such replacement.

48. Installation of Telecommunication Equipment, etc.

(1) PLN shall own and install telecommunication and other equipment necessary for issuing Load-Dispatch Instructions at the expense of PLN, excluding the amount to be borne by the Subscriber as installation fee. Power Producer or Consumer shall provide the sites for installing the

telecommunication and other equipment free of charge.

49. Dedicated Supply facilities

(1) PLN shall install supply facilities dedicated to the Subscriber, the cost of which shall be paid by the Subscriber as installation fee, in the following cases:

a Installation of such facilities is particularly desired by the Subscriber and is deemed not to interfere with the supply of electricity to general consumers or the reception of electricity from another Power Producer.

b Installation of such facilities is part of cooperation associated with Wheeling Service.

c Installation of such facilities dedicated to a specific Subscriber is deemed appropriate due to security reasons of the Power Producer or Costumer, or because it is highly unlikely that such facilities will be used by other persons at any point in future, etc.

X. Payment of Installation Fee

50. Installation Fee of Supply Facilities to the Receiving Point

(1) Installation Fee of Receiving-Side Connecting Facilities

When a Subscriber requires installation of new receiving-side connecting facilities (excluding dedicated and reserve supply facilities) for newly commencing Wheeling Service or upgrading the Contracted Electric Power, PLN will charge the Subscriber the cost for installing the standard design facilities defined in the table below (hereinafter, "Standard Design") as installation fee for such facilities (hereinafter, "Standard Installation Fee").

(Standard Design Table is omitted.)

(2) Installation Fee for Upgrading Supply Facilities to the Receiving Point

a When PLN's supply facilities to the Receiving Point are to be upgraded at the request of the Subscriber without increasing the Subscriber's Contracted Receiving Power or Contract Demand in reserve transmission service, PLN shall charge the Subscriber the entire cost incurred for such upgrading work as installation fee, except when PLN charges the Subscriber the actual expenses incurred for connecting service lines and installing electric meter, telecommunication and other devices.

b When supply facilities to the Receiving Point are to be newly installed or upgraded as part of cooperation associated with Wheeling Service, PLN will charge the Subscriber the entire cost incurred for such installation or upgrade as installation fee.

c Supply facilities of which the mainly purpose is the use of receiving, and except receiving-side connecting facilities(only supply facilities of High Voltage and Extra High Voltage, also excluding dedicated supply facilities) are to be installed.

(3) Calculation of Installation Fee

Installation fee shall be equal to the applicable Standard Installation Fee, except when the Subscriber desires installation work, the cost of which exceeds the Standard Installation Fee. Installation fees in the cases of Paragraphs (1), (2) and (3) shall be calculated as follows.

(Calculation is omitted.)

51. Installation Fee of Supply Facilities to the Service Point

(1) Installation Fee of Supply-Side Connecting Facilities

When a Subscriber requires installation of new supply-side connecting facilities (excluding dedicated and reserve supply facilities) for newly commencing Wheeling Service or upgrading the Contract Demand, PLN will charge the Subscriber an installation fee based on the rates shown in Subparagraph "a" below, in which case, the installation fee shall be calculated for each Service Point.

a Installation Fee

(a) For Supply-Side Overhead Connection:

When supplying at standard voltage of 150kV: **** IDR (per 100-meter line length)

(b) For Supply-Side Underground Connection:

When supplying at standard voltage of 150kV: **** IDR (per 100-meter line length)

However, in cases when the Subscriber newly commences Wheeling Service or increases its Contract Demand and when PLN supplies electricity using supply-side connecting facilities that have been installed less than three years ago, only the newly used portion shall be deemed as the newly installed supply-side connecting facilities.

(2) Installation Fee for Upgrading Supply Facilities to the Service Point

a When PLN's supply facilities to the Service Point are to be upgraded at the request of the Subscriber without increasing the Subscriber's Contract Demand, PLN shall charge the Subscriber the entire cost incurred for such upgrading work as installation fee, except when PLN charges the Subscriber the actual expenses incurred for connecting service lines and installing electric meter, telecommunication and other devices

b When supply facilities to the Service Point are to be newly installed or upgraded as part of cooperation associated with Wheeling Service, PLN will charge the Subscriber the entire cost incurred for such installation or upgrade as installation fee.

(4) Calculation of Installation Fee

Except when Subscriber desires to install facilities, the cost of which exceeds that of Standard Design, the installation fee in the cases of Paragraphs (2) and (3) above shall be the Standard Installation Fee, which is the sum of the material and labor costs and miscellaneous expenses (including the costs for supervising surveying work, compensation, and construction-related work) necessary for PLN to install the supply facilities.

52. Billing and Settlement of Installation Fee

(Omitted)

53. Preparation of Agreement Pertaining to Installation Fee, etc.

When desired by Subscriber or required by PLN, PLN shall prepare an agreement to set forth necessary matters pertaining to installation fee, etc. prior to the commencement of the installation work in principle.

(Omitted)

IX. Security

54. Responsibility for Security

PLN shall assume the responsibility for ensuring the security of its supply facilities up to the Receiving Point and Service Point, as well as electric meters and other electric facilities of PLN within the Place of Generation and Place of Demand.

55. Cooperation of Power Producer and Consumer for Security, etc.

(1) Power Producer or Consumer shall immediately notify PLN in the following cases, to which PLN shall immediately respond by implementing appropriate countermeasures:

a Power Producer or Consumer finds abnormality or failure, or a risk thereof, in any of the service lines, electric meters, and other electric facilities of PLN within the Place of Generation or Place of Demand.

b Power Producer or Consumer finds abnormality or failure, or a risk thereof, in electric facilities of the Power Producer or the Consumer, which could affect PLN's supply facilities.

(2) In cases when Power Producer or Consumer installs, alters, or repairs a property, which could

directly affect PLN's supply facilities, and when PLN's supply facilities have been directly affected as a result of installation, alteration, or repair of a property by Power Producer or Consumer; the Power Producer or Consumer shall inform the detail thereof to PLN. When deemed necessary for security reasons, PLN may ask the Power Producer or Consumer to make adjustments to such installation, alteration, or repair.

(3) Prior to the commencement of Wheeling Service, PLN shall consult with Power Producer and Consumer as necessary as to how to operate a circuit breaker to shut down wheeled electric power, etc.

X. Other

56. Governing Law and Jurisdiction

(1) The validity, interpretation and enforcement of these Provisions will be governed by the laws of the Republic of Indonesia.

(2) Both PLN and the Subscriber agree that any legal action or proceeding arising out of, or in connection with, this General Provisions may be brought in the District Court of [Central Jakarta]. Both PLN and the Subscriber hereby irrevocably and unconditionally submits to the non-exclusive jurisdiction of such court. Notwithstanding the foregoing, each of PLN and the Subscriber will have the right to proceed against each other in any other competent court in any other jurisdiction.

(3) Both PLN and the Subscriber irrevocably waives any immunity to which it or its assets may at any time be or become entitled, whether characterized as sovereign immunity or otherwise, from any set-off or legal action in the Republic of Indonesia or elsewhere, including immunity from service of process, immunity from jurisdiction of any court or tribunal, and immunity of any of its property from attachment prior to judgment or from execution of a judgment.

57. Language

This Provisions has been made in both Bahasa Indonesia and English. The two versions of this Provisions shall not be construed as separate documents and, when taken together, shall constitute one and the same instrument. In the event of any conflict or inconsistency between the English language version and the Bahasa Indonesia language version of this Provisions, the English language version shall prevail save to the extent that the Bahasa Indonesia language is required to prevail in accordance with applicable Laws from time to time.

Appendix6
Workshop Materials

JICA Data Collection Survey on New Power Supply Scheme by Using Power Wheeling in Indonesia

Workshop

Jakarta

May 27th, 2016

TEPCO Holding with TEPCO Power Grid

TEPSCO

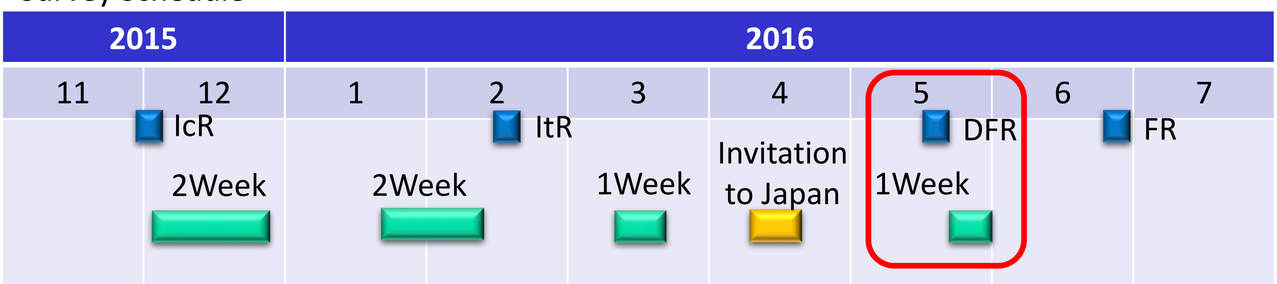
Survey Schedule & Purpose

The purpose of this survey is to propose;

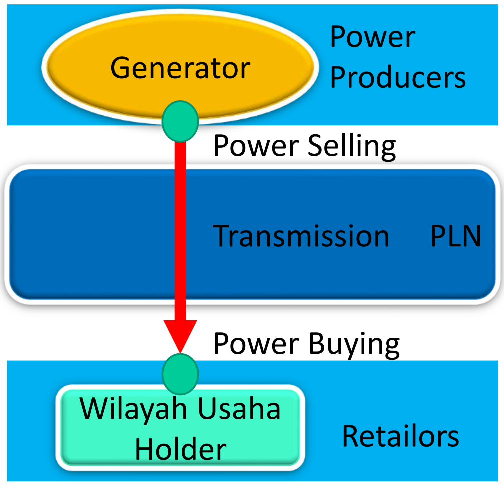
- A calculation scheme of "Power Wheeling Tariff"
- To propose draft "Power Wheeling Provision".

  (=General Conditions of Power Wheeling Contract)
- A Standard Operational Procedure for power wheeling scheme.
- To formulate "Draft Road Map"
- Necessary ODA cooperation on the actual operation and management of the wheeling system

Survey Schedule



Power Wheeling Scheme (Definition)



- Power Producers sells electricity to Retailors.
- PLN does Power Wheeling.

Power Producer: IUPTL holder

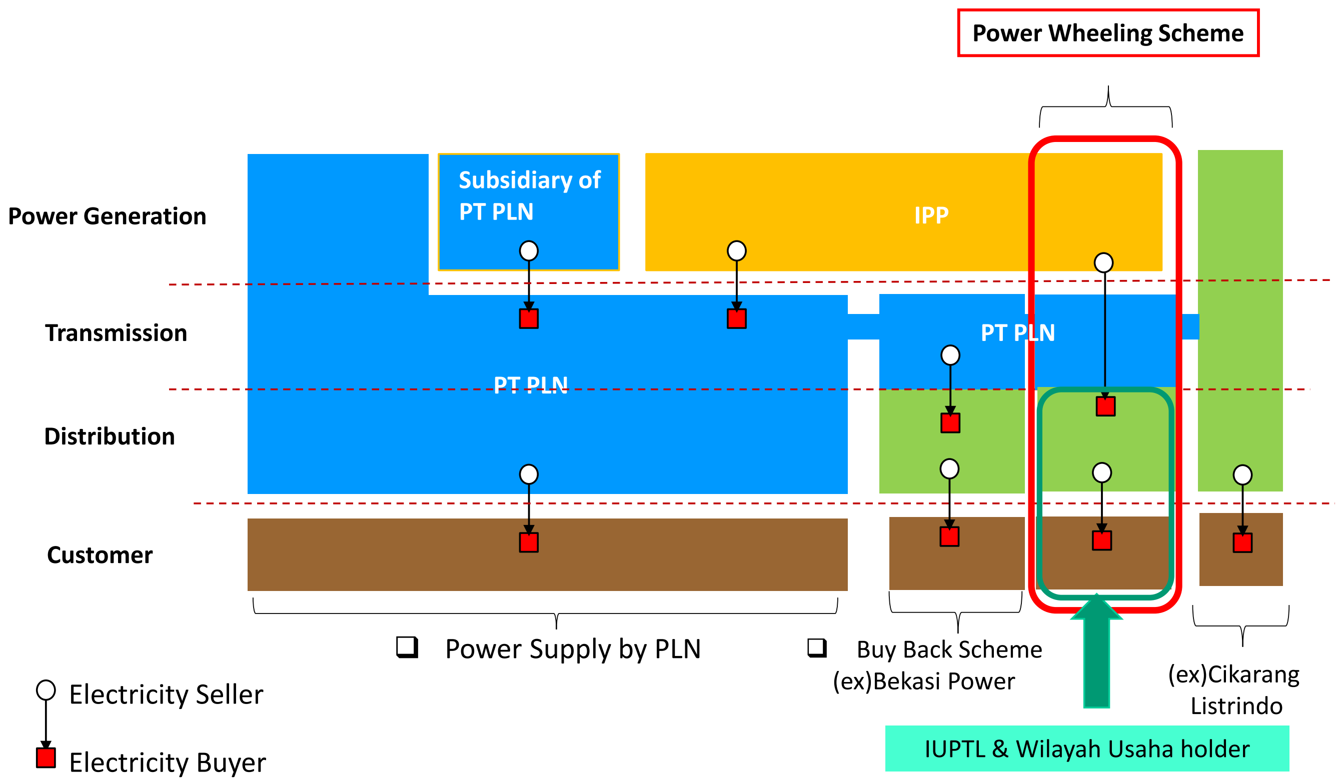
Transmission: Owned by PLN

Retailor: UPTL＋ *Wilayah Usaha holder*

Case A: Own-use
Power Producer and Retailors are the same Company. Generators are located in other place.

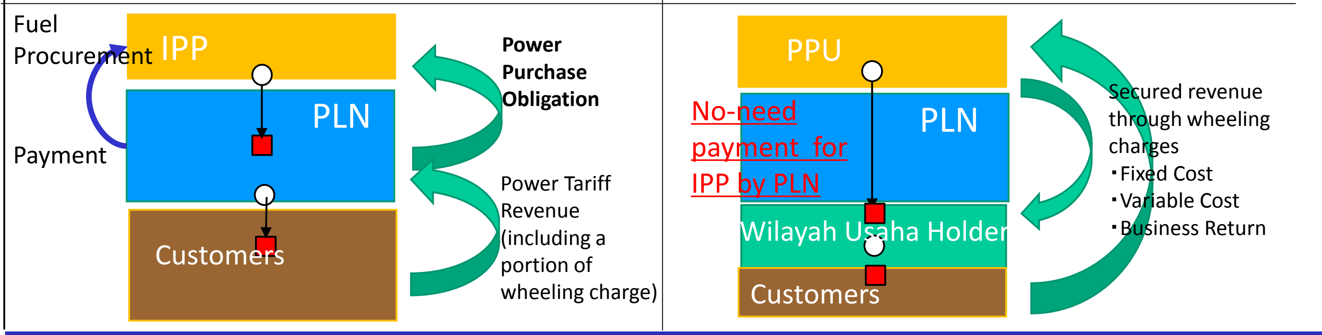
Case B: Different Companies
Power Producer and Retailors are the different companies.

Power Wheeling Scheme (Current Indonesia Power Sector)



Power Wheeling Scheme (Advantages)

A: PLN's Power Purchase from IPP Scheme	B: Power Wheeling Scheme



Advantage	
Power Consumers	• Increasing alternatives of power producers
Power Producer	• No need PLN-IPP bidding (business to business) • Increasing alternatives for investment
PLN	• Reducing the burden of power purchase obligation • Securing revenues through wheeling charge collection
Indonesia	• Increasing power supply to Industrial zones • Encouragement of local power production for local consumption

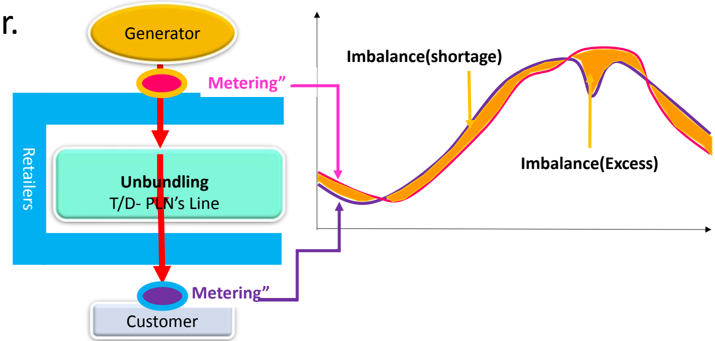
Power Wheeling Scheme (Securing Power System Reliability)

- **System Planning**
  - "**Power Wheeling Provisions**" states PLN can check the power system reliability in advance for grid connection before making a contract.
  - "**Power Wheeling Tariff System**"; installation fees of grid connection/reinforcement are paid by power wheeling users.

  (This installation should fulfill "N-1 criteria" and it should be reflected to RUPTL .)
- **System Operating**
  - "**Power Wheeling Provisions**" states POWER wheeling users should obey the instructions by power dispatching center.
  - There is a possibility of operational constraints for power wheeling users in emergency cases.
- **Requirements of subscribers -Power Wheeling Provisions**
  - To supply power in accordance with the change in power demand.
  - To connect to the power grid by the technically appropriate methods (e.g. N-1 criteria, capacity) with complying with the grid code.
  - To obey the designation of the power dispatchers of PLN.

Power Wheeling Provisions states;

- **Wheeling tariff consists of the following two categories.**
  - Wheeling service charge
    - The charge collected for the wheeling service
  - Charge for load fluctuation-linked power
    - The charge applied for the imbalance between the received and the supplied electric power.



- **Installation fee of supply facilities required for grid connections/reinforcement should be paid by users.**

Power Wheeling Tariff in Future

- **The wheeling tariff system is currently proposed as Postage-Stamp for the initial one because it is simple, easily calculated, transparent and predicable for the current power sector in Indonesia.**
- **However, the wheeling tariff system must be continuously reviewed in future. (e.g. modifying postage-stamp, regional pricing or elaboration of the adequate business return for a transmission company)**

Power Wheeling Tariff (3)

Transmission Pricing Methodology in Other Countries

	Transmission Pricing Methodology	
	Postage Stamp	Locational Charge
Norway		✓
Germany	✓	
UK※1		✓
Australia※2	✓(50%)	✓(50%)
United States※3		✓
Morocco	✓	
Japan	✓	

※1 England and Wales, Scotland

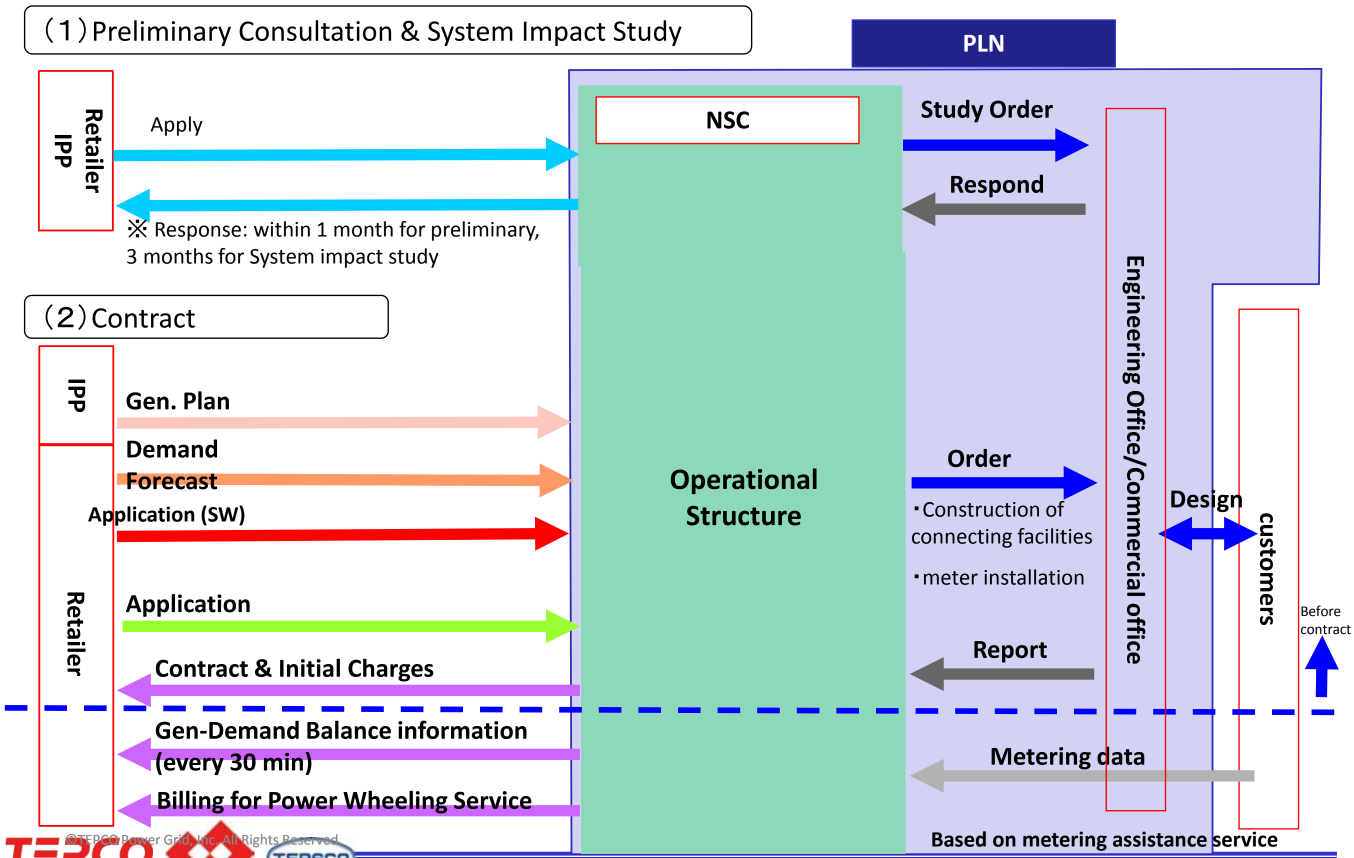
※2 NEM

※3 PJM

Network Service Center (1)
- Proposing New Organization in PLN

- **Three Obligation for Power Wheeling**
  1. Prohibition of Utilization of information other than for Intended Purposes
  2. Prohibition of Discriminatory Treatment of Power Wheeling applicants
  3. Separate Accounting
- **In order to deal fairly with power wheeling users, power wheeling should be carried out in the organizations independent of PLN's generation and retailer departments.**
- **Network Service Center is proposed to be established in PLN**
  – Independent organization of other organizations
  – Preliminary Consultation, System Impact Study & Contract
  – Support for technical balancing measurement

Network Service Center (2)



Draft Road Map for End of up to 2017

- **MEMR approves Wheeling Provisions.**
- **MEMR enacts Wheeling Tariff.**
- **PLN conduct "Three Obligation" for power wheeling.**
- **Network Service Center is established in PLN.**
- **PLN determines the specifications of the energy measurement power balance measurement.**

Draft Road Map Starting from 2018

Starting 2018

- Several contracts are made between private companies. Power wheeling started.
- Conditions for accepting "Wilayah Usaha" are modified for its clear acquisitions
- Feasibility study is done about using PLN's power wheeling scheme for power import and export as cross boundary trade.

From 2019 to 2030?

- Large power retailers such as new industrial zones or commercial areas become to able to select freely their power suppliers.
- Works for PLN's obligation of electric power balancing is increased. Ancillary service market for power adjustment is established.
- The Project using PLN's power wheeling scheme is realized for power import and export.

Possibility of ODA Cooperation

- **Support for implementation of power wheeling system**
  - Establishment of **Network Service Center** in PLN
  - Technology transfer regarding Network Service Center
  - The methodologies of balancing measurement of energy
  - The methodology of procurement of ancillary service for power frequency control.
- **Feasibility study of the projects of power import and export with using power wheeling scheme and new development of industrial zones**
  - The promotion of power import and export with neighboring countries with direct power selling to neighboring countries by power generation companies in Indonesia.

Thank you!

Power Wheeling Tariff

Attachment : Detailed wheeling tariff calculation sheet of TEPCO

JICA Data Collection Survey
on New Power Supply Scheme by using Power Wheeling in Indonesia

Work shop

On May 27, 2016
Jakarta, INDONESIA

Power Wheeling Tariff

1 Introduction

2 How to calculate Wheeling Tariff
3 Trial calculation result examples of Wheeling Tariff in Indonesia
4 The reason why we propose the postage stamp method
(Comparison to MW-mile method)
5 The reason why we propose the sharing facility construction cost rule
(Case study)

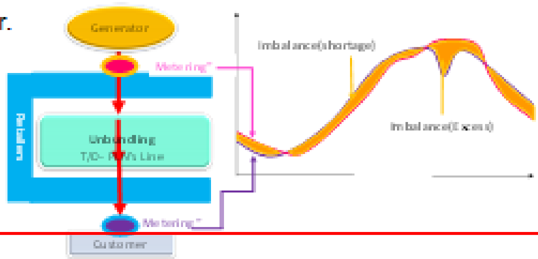
- **This part of the Workshop presents:**
  - Basic concept of how to calculate wheeling tariff
  - Proposal to start with **the postage stamp method** as wheeling tariff calculation method, and to introduce **the sharing facility construction cost rule** in Indonesia.

(One of the slides presented in the previous part)

Power Wheeling Tariff (1)

Power Wheeling Provisions states;

- **Wheeling tariff consists of the following two categories.**
  - Wheeling service charge
    - The charge collected for the wheeling service
  - Charge for load fluctuation-linked power
    - The charge applied for the imbalance between the received and the supplied electric power.



Not include in this part

- **Installation fee of supply facilities required for grid connections/reinforcement should be paid by users.**

Power Wheeling Tariff

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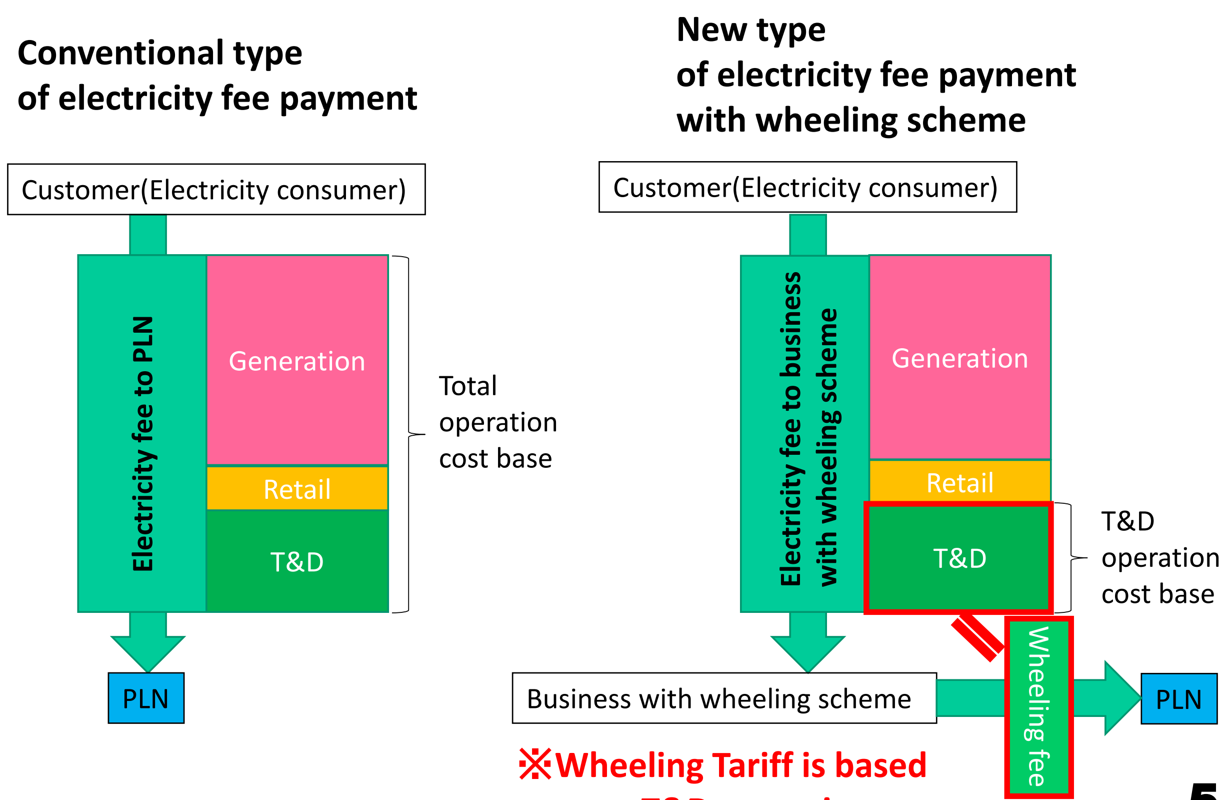
(Case study)

Difference in electricity fee payment



※Wheeling Tariff is based on T&D operation cost

Distinguish Operation Expense (1)

Total PLN	Operation Cost
Electricity Purchase and Diesel Rented	11,359,026
Fuel and Lubricant Oil	170,487,926
Maintenance	20,206,661
Personnel	15,749,478
Depreciation	23,618,262
Others	5,488,617

Functional Unbundling

Generation	Operation Cost
Electricity Purchase and Diesel Rented	11,359,026
Fuel and Lubricant Oil	170,487,926
Maintenance	9,605,244
Personnel	1,570,407
Depreciation	16,153,530
Others	391,882

T&D	Operation Cost
Maintenance	OOO
Personnel	OOO
Depreciation	OOO
Others	OOO

Retail	Operation Cost
Maintenance	OOO
Personnel	OOO
Depreciation	OOO
Others	OOO

To be continued for the next slide

Distinguish Operation Expense (2)

T&D	Operation Cost
Maintenance	OOO
Personnel	OOO
Depreciation	OOO
Others	OOO

Regional Unbundling

Java	Operation Cost
Maintenance	OOO
Personnel	OOO
Depreciation	OOO
Others	OOO

Sumatra	Operation Cost
Maintenance	OOO
Personnel	OOO
Depreciation	OOO
Others	OOO

....

OOO	Operation Cost
Maintenance	OOO
Personnel	OOO
Depreciation	OOO
Others	OOO

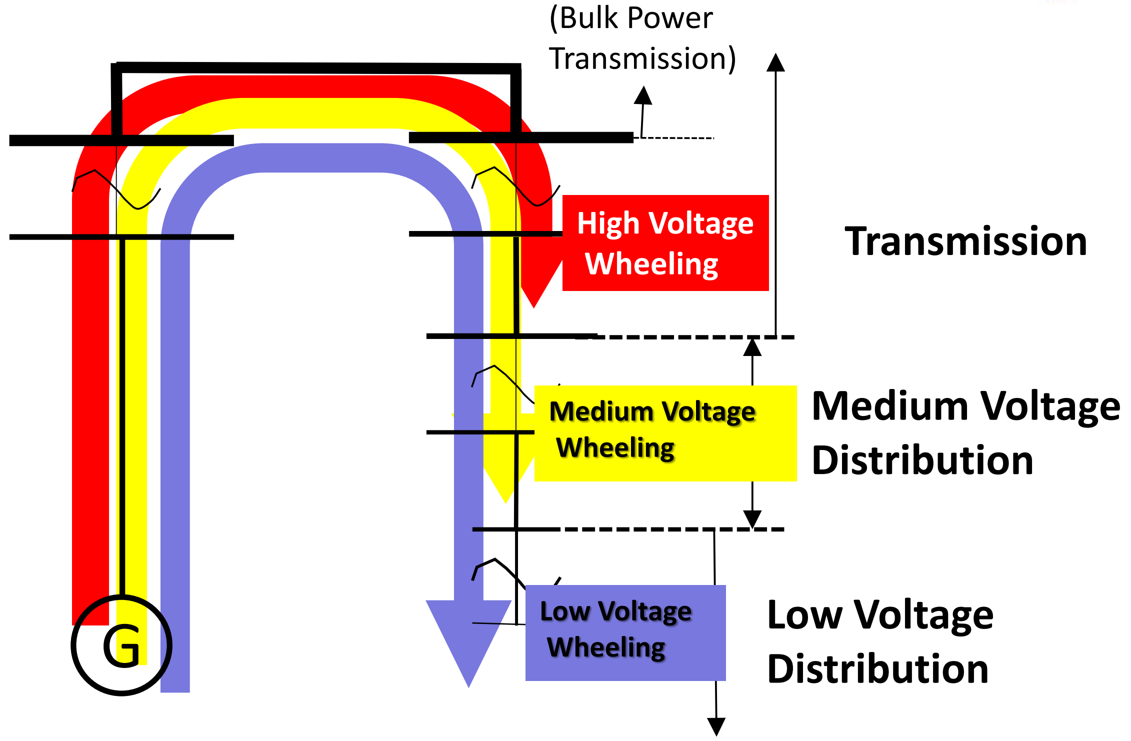
Voltage Level Unbundling

HV	Operation Cost
Maintenance	OOO
Personnel	OOO
Depreciation	OOO
Others	OOO

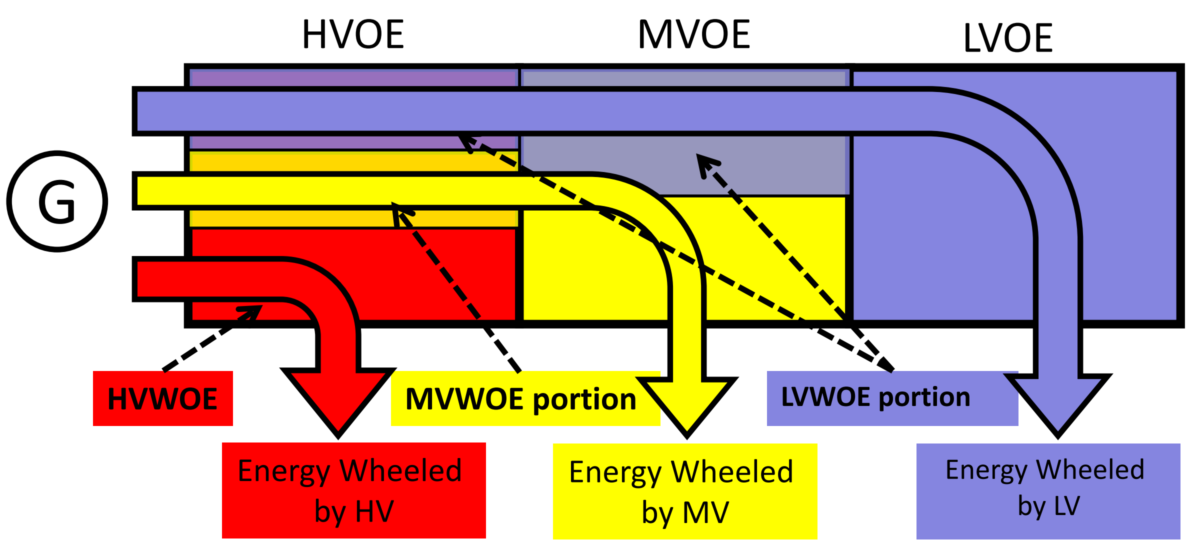
MV	Operation Cost
Maintenance	OOO
Personnel	OOO
Depreciation	OOO
Others	OOO

LV	Operation Cost
Maintenance	OOO
Personnel	OOO
Depreciation	OOO
Others	OOO

Typical Indonesian Power System and Wheeling



Wheeling Cost according to voltages



Wheeling Operation Expense (WOE)
= High Voltage Operation Expense (HVOE)
+ Medium Voltage Operation Expense (MVOE)
+ Low Voltage Operation Expense (LVOE)

Procedure of Wheeling Tariff Calculation

Distinguish Transmission & Distribution (T&D) Operation Expense from Whole Expense

Transmission Operation Expense	Medium Voltage (MV) Distribution Operation Expense	Low Voltage (LV) Distribution Operation Expense

← **Ancillary Service (AS) Expense**

← **Adequate Business Return (ABR)**

Calculation of Wheeling Cost

Determination of Fixed and Variable Portion

High Voltage (HV) Wheeling Tariff	Medium Voltage (MV) Wheeling Tariff	Low Voltage (LV) Wheeling Tariff

Power Wheeling Tariff

1 Introduction

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3 Trial calculation result examples of Wheeling Tariff in Indonesia

4 The reason why we propose the postage stamp method (Comparison to MW-mile method)

5 The reason why we propose the sharing facility construction cost rule (Case study)

Procedure of Wheeling Tariff Calculation

Distinguish Transmission & Distribution (T&D) Operation Expense from Whole Expense

Transmission Operation Expense	Medium Voltage (MV) Distribution Operation Expense	Low Voltage (LV) Distribution Operation Expense

↓ ← **Ancillary Service (AS) Expense**
← **Adequate Business Return (ABR)**

Calculation of Wheeling Cost and Average Wheeling Tariff

1) Estimation from the financial statements and statistical data of PLN <u>in 2014</u>

- Average wheeling tariff for whole of Indonesia
- Wheeling tariff in Java according to voltage

2) Estimation from T&D operating expenses of PLN in Java, <u>2014</u>

- HV wheeling tariff in whole of Java
- HV wheeling tariff each in four regions of Java

※ Real wheeling tariff should be determined by forecasted future T&D operating expense based on RUPTL.

Power Wheeling Tariff

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(Case study)

- **Studies and discussions on wheeling tariffs in Indonesia**
  - Embedded-Cost-Based Approaches
    - Postage Stamp Method
    - Contract Path Method
    - Distance Based MW-mile Method
    - Power Flow Based MW-mile Method
  - Marginal-Cost-Based Approaches
    - Short-Run Marginal Cost (SRMC) Pricing Method
    - Long-Run Marginal Cost (LRMC) Pricing Method
- **Reference**
  - Dr. Hardv 'Prospek Bisnis Terkait Kebijakan Power Wheeling dalam Rangka Meningkatkan Penyediaan Tenaga Listrik – The Way Forward'
  - Prof. Sasongko Pramono Hadi 'Power Wheeling Pemanfaatan Bersama Jaringan Tenaga Listrik (PBJT)'

Why is The Postage Stamp Method Appropriate?

- **The most important conditions of wheeling tariff**
  1. **To guarantee the income to continue the power transmission and distribution business stably. [Condition (A)]**
  2. **To reduce useless expenses and promote efficiency. [Condition (B)]**

- **The Postage Stamp Method is the most suitable and the easiest to satisfy condition (A).**
- **For satisfaction of condition (B), required wheeling operation expense should be calculated from the future ideal expense, not from past expense. The ideal expense means expense with anything unnecessary removed.**

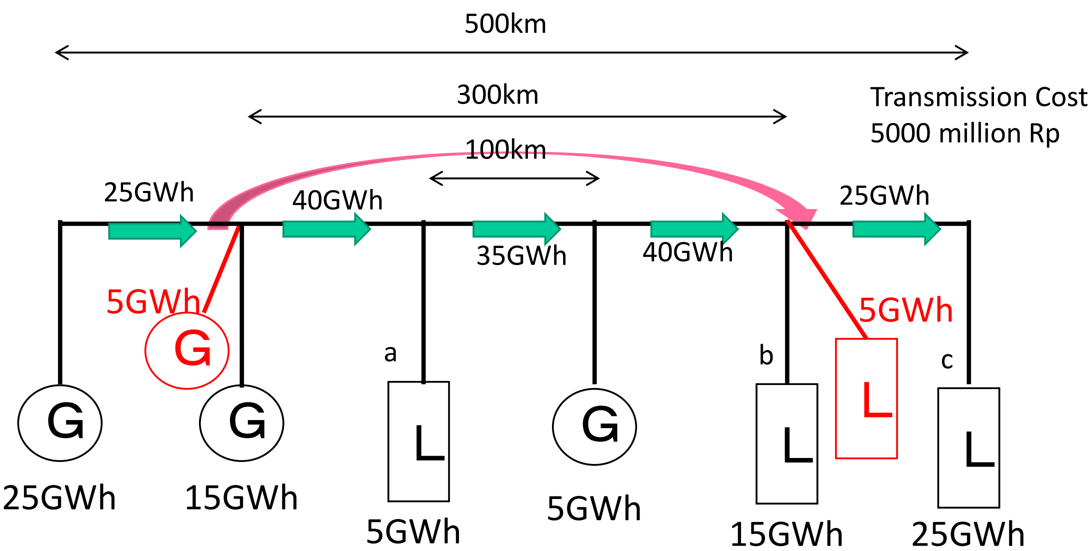
Comparison between Postage Stamp Method and MW-mile Method

	Postage Stamp Method	MW-mile Method
Guarantee of revenue	◎ (Guarantee)	△(Ok,,)
Reduction of redundant expenses and promotion of efficiency	△(Ok,,) →○(Good) : by adding incentive regulation	△(Ok,,)
Control of the power flow distance/direction (Suppression of the new transmission line)	△(Ok,,) →◎(Excellent) : by adding the sharing facility construction cost rule	○(Good)
Conclusion	◎(Excellent)*	○(Good)

Better to start with postage stamp method

- **The simple example :**
  MW-mile method does not guarantee about recovery of T&D cost.

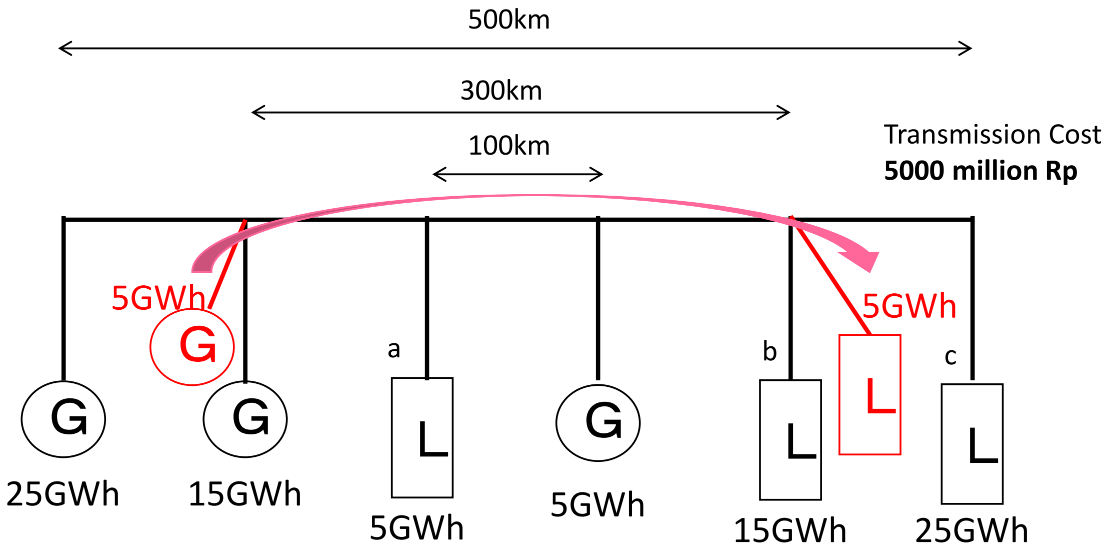
Recover of T&D cost (1)



PLN Customers : 5+15+25=45(GWh)
Wheeling Customer : 5GWh
Total : 50GWh

(Postage Stamp Method)
Wheeling Tariff
5000/50=**100(Rp/kWh)**

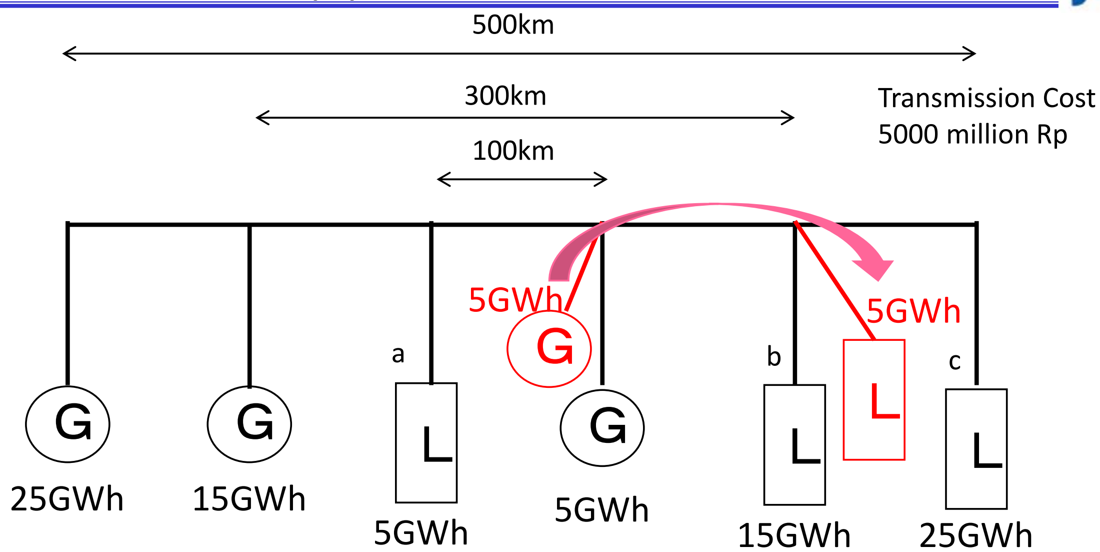
Recover of T&D cost (2)



Income
From PLN Customer : Postage Stamp
100 × 45= 4500 million Rp
From Wheeling Charge :
100 × 5 = 500 million Rp
Total : 5000 million Rp

Postage stamp method guarantees revenue

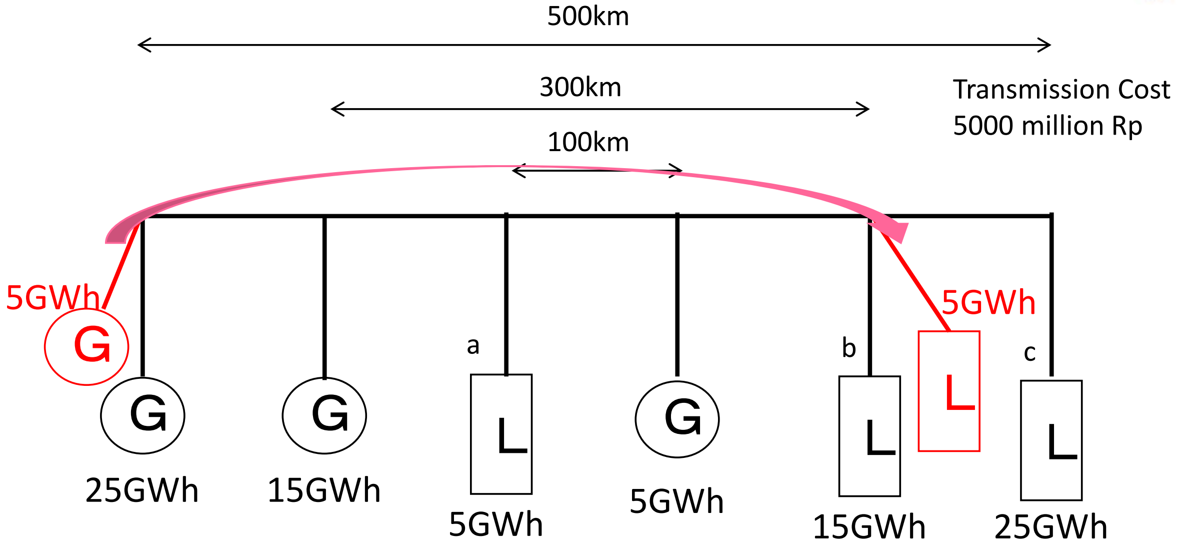
Recover of T&D cost (3)



An Example of The Method other than Postage Stamp Method
~100km : 80 Rp/kWh
~300km : 100 Rp/kWh
~500km : 120 Rp/kWh

Income
From PLN Customer : Postage Stamp
100 × 45= 4500 million Rp
From Wheeling Charge :
80 × 5 = 400 million Rp
Total : 4900 million Rp
▲100 million Rp short!

Recover of T&D cost (4)



An Example of The Method
other than Postage Stamp Method
～100km : 80 Rp/kWh
～300km : 100 Rp/kWh
～500km : 120 Rp/kWh

Income
From PLN Customer :
100 × 45= 4500 million Rp
From Wheeling Charge :
120 × 5 = 600 million Rp
Total : 5100 million Rp
100 million Rp excess!

Highway charges are usually due to the distance.

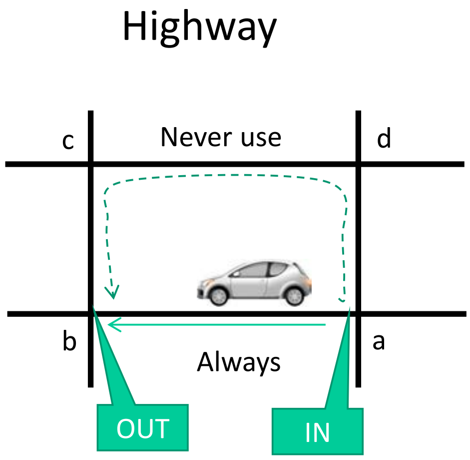
Wheeling tariff is also due to the distance(?)

Postage stamp method is unfair(?)

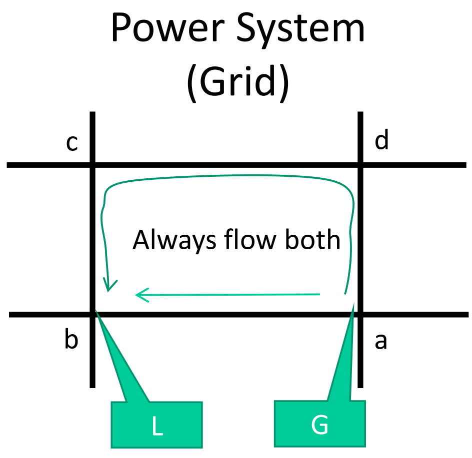
(Wheeling tariff is different to highway charges)

- **Postage stamp method is intended in accordance with the nature of power flows in power syatem.**
- **Postage stamp method is not unfair for power wheeling tariff.**

Difference between Highway Charge(Tall) and Wheeling Charge(1)



Able to be charged according to distance between IN and OUT
Payment should be a-b.
Payment on c-d is unfair.

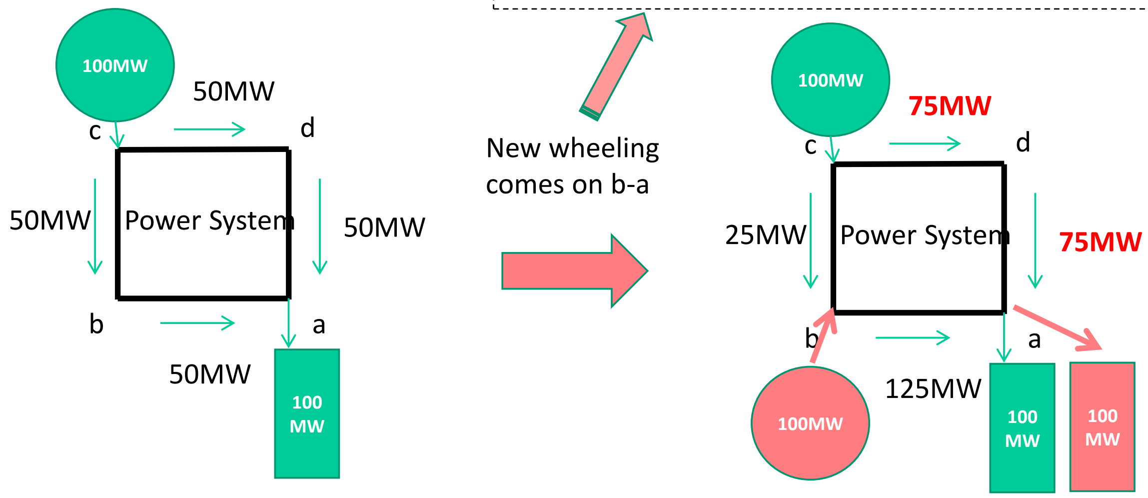


Not able to be charged according to distance between G and L

Payment on c-d is not unfair.

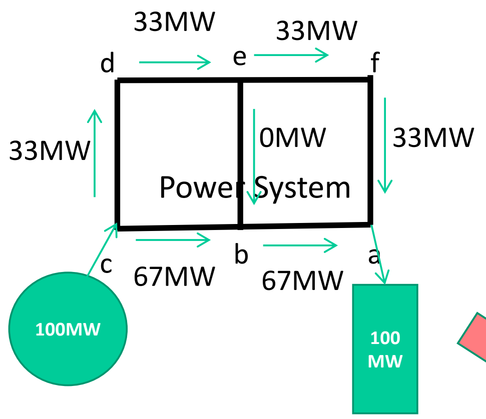
Difference between Highway Charge(Tall) and Wheeling Charge(2)

It will affect power flows of c-d and d-a also!
Average cost sharing, that is the postage stamp method, is **not unfair**.

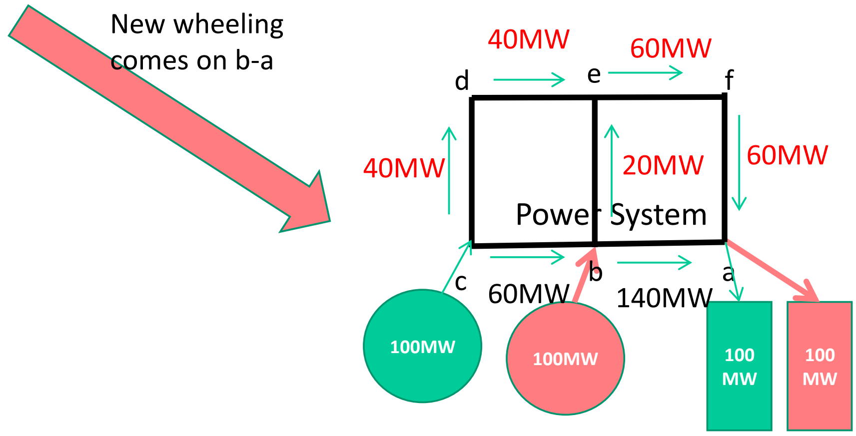


All of a-b, b-c, c-d, d-a are summed transmission lines with the same reactance.

Difference between Highway Charge(Tall) and Wheeling Charge(3)



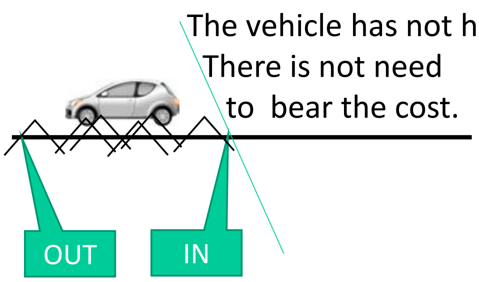
It will affect power flows of c-d, d-e, e-f and f-a!
That new wheeling pays only cost of b-a is not fair.
Average cost sharing, that is the postage stamp method, is **not unfair**.



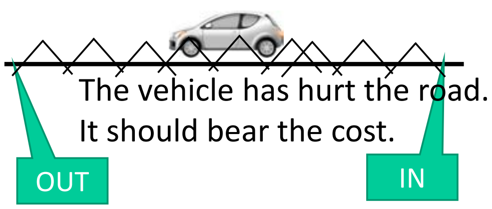
All of a-b, b-c, c-d, d-e, e-f, f-a are summed transmission lines with the same reactance.

Difference between Highway Charge(Tall) and Wheeling Charge(4)

Highway

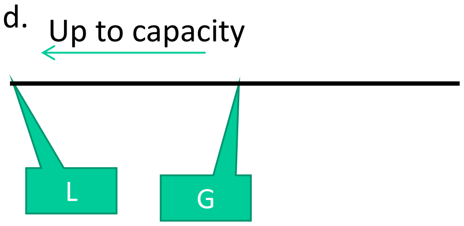


The vehicle has hurt the road.
It should bear the cost.

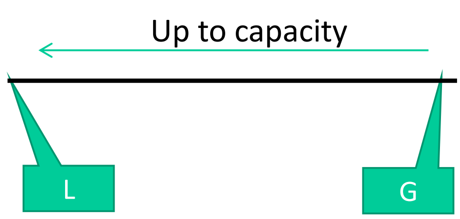


Payment is based on the distance.

Power System

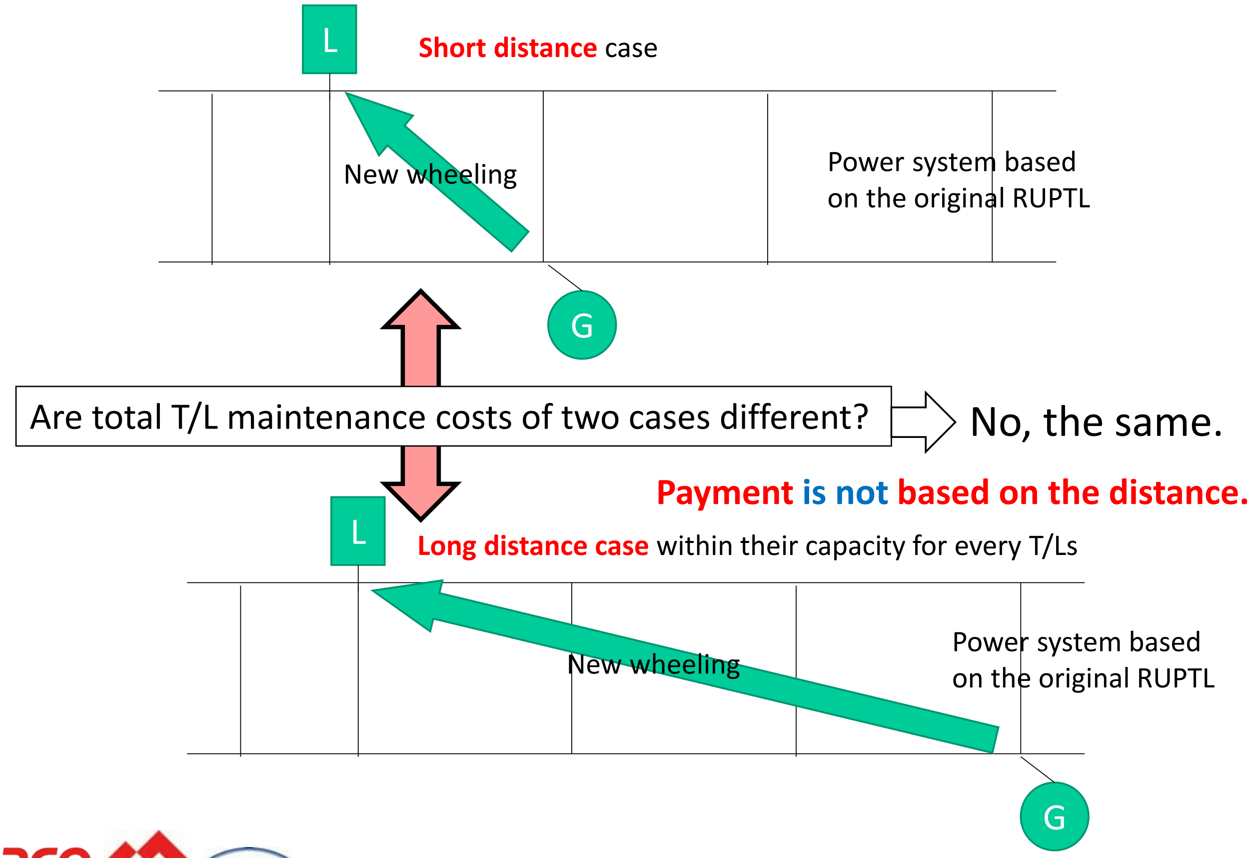


Power flow has not hurt the transmission line.
Not particularly costs generated.

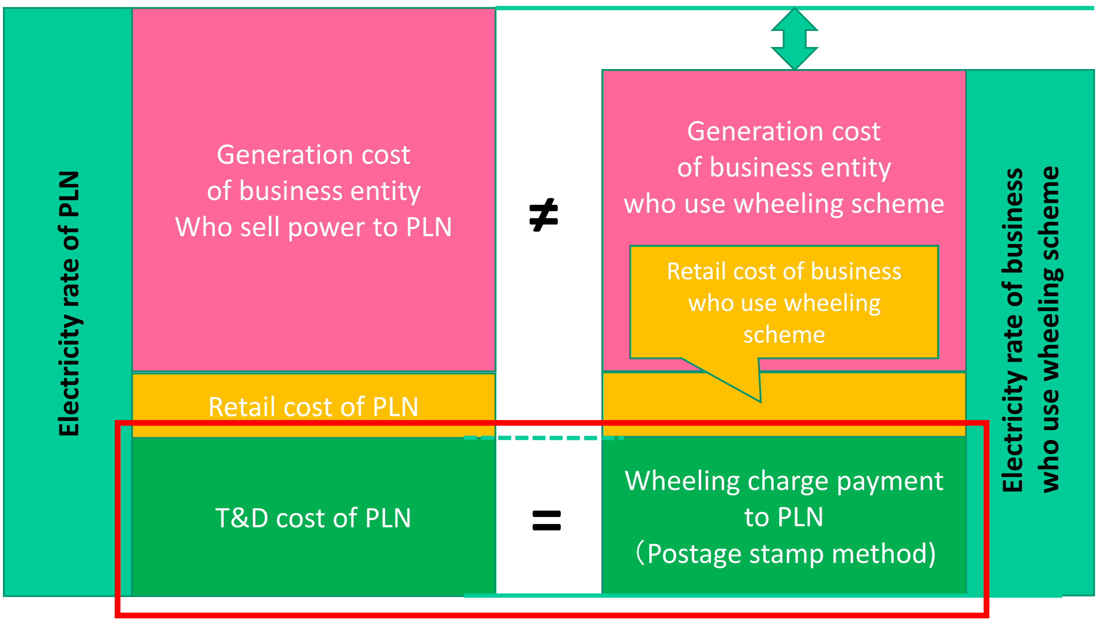


Power flow has not hurt the transmission line.
Not particularly costs generated.

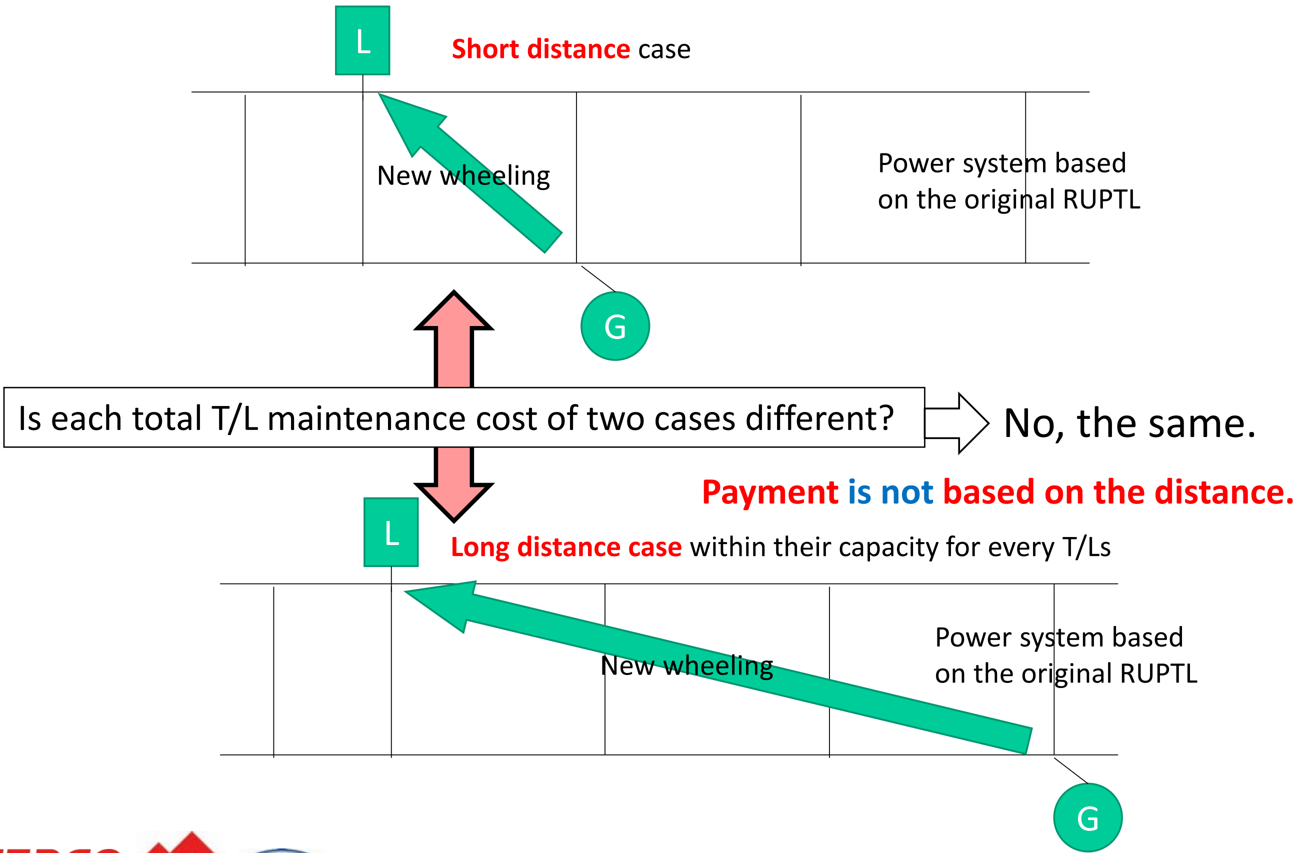
Payment is not based on the distance.

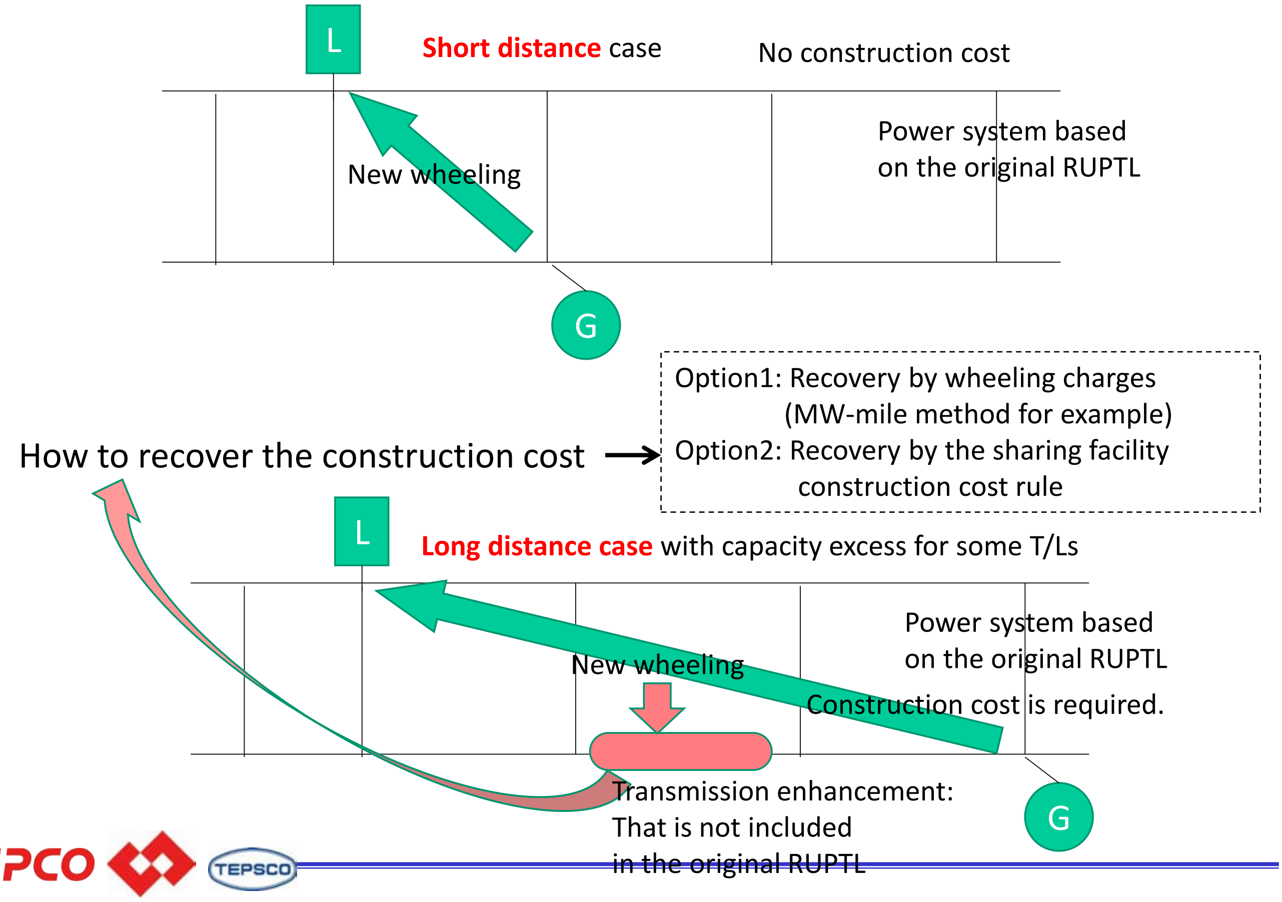


Relation between PLN Electricity Rate and Wheeling Charge



Power Wheeling Tariff





Option 1 ;

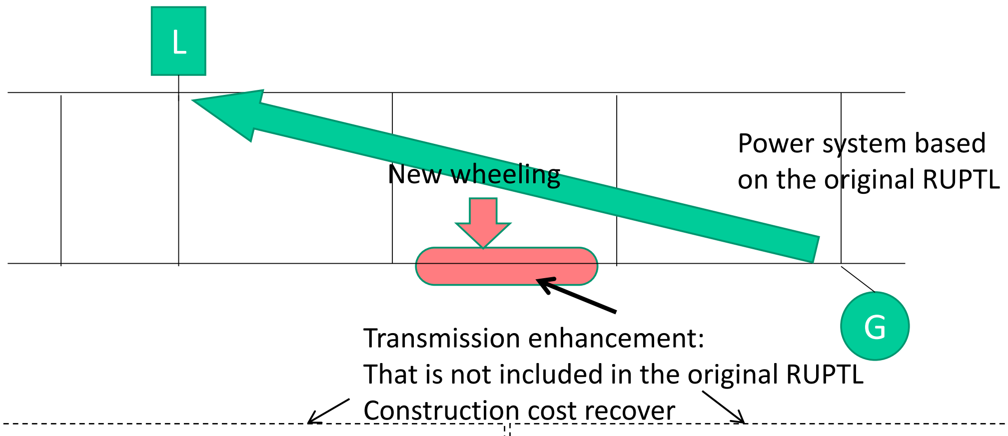
[Recovery by wheeling charges]

1. **PLN constructs transmission reinforcement .**
2. **The wheeling start.**
3. **The wheeling user pays wheeling charge which include facility construction cost. (MW-mile Method)**
4. **Construction cost recovery takes at least around 10 years .**

Option 2 ;

[Recovery by the sharing facility construction cost rule]

1. **The wheeling user pay facility construction cost. (Cost recovery is completed.)**
2. **PLN constructs transmission reinforcement .**
3. **The wheeling start.**
4. **The wheeling user pays same wheeling charge as the other users. (Postage Stamp Method)**



Option 1；

[Recovery by wheeling charges]
(MW-mile Method)

Recovery takes at least around 10 years after starting the wheeling.

Option 2；

[Recovery by the sharing facility construction cost rule]

Recovery has been completed before starting the wheeling.

◎

- **Securing Power System Reliability in Power Wheeling**
  - The sharing facility construction cost rule is superior than the wheeling charge (MW-mile method for example)

✓Effect to avoid the long distance of wheeling is strong.

✓Impact on the financial of the T&D organization (PLN) is small.

Thank you for your attention.

Power Wheeling:

its legal framework & Standard Operational Procedure (SOP)

May 27th, 2016
JICA Study Team
Takashi WAKABAYASHI (TEPCO Power Grid)

Why introduce Power Wheeling to Indonesia ?

We guess:

【MEMR】

- 35GW power generation development necessary by 2019 with public & private funding
- Development of private generation to supply domestic industrial consumers
- Build new industrial zones in rural area & remote islands (rural electrification, industry enhancement)

【PLN】

- Less power purchase obligation including fuel procurement cost risk
- Less debt on the balance sheet as IPP generators
- Less initial investment for distribution facility (if PLN allows private company to do so)
- Build new industrial zones in rural area & remote islands (industry enhancement, rural electrification)
- Reduce the congestion in transmission network by increasing local generation &consumption

Power wheeling scheme can be designed to enable:

- PPU to exercise a new business arrangement
- T&D companies to earn wheeling fee by lending their T&D facility for other entity's power supply.
- (future) customers to select their electricity supplier

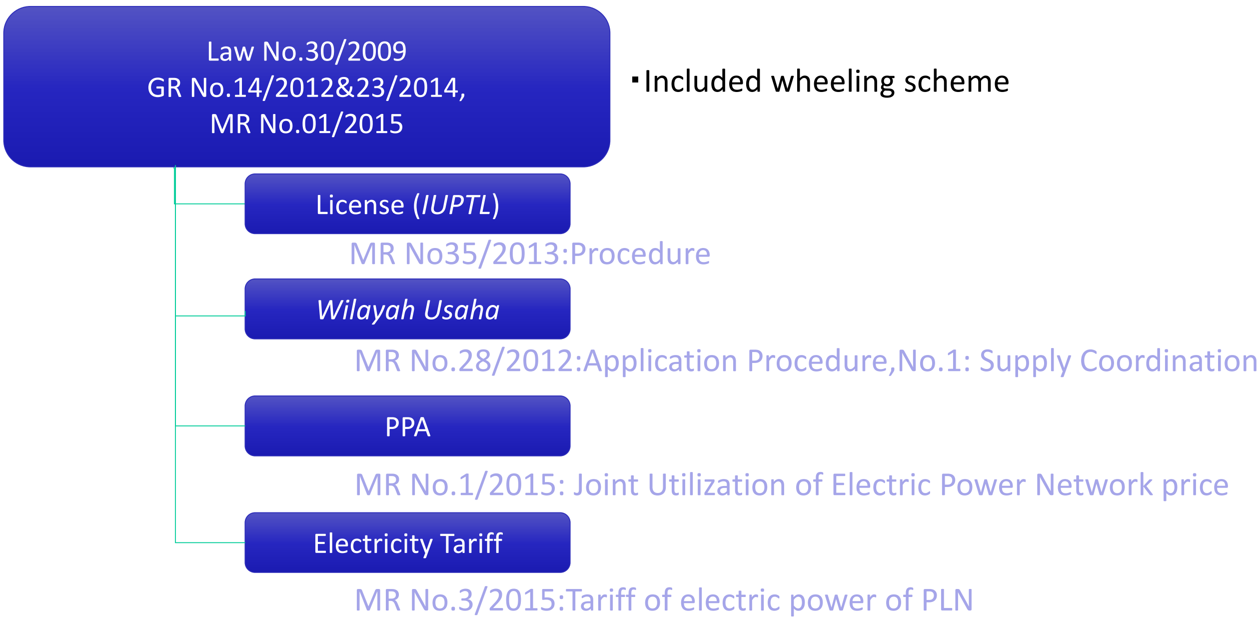
Power Wheeling Road Map (proposed)

Establishing efficient & reliable network to deal with new 35GW generation & electrification

Open & de-regulated electricity market for optimized electricity business

- **Up to 2017 (Policy design)**
  - MEMR enacts **wheeling tariff**
  - MEMR approves **Wheeling Provisions**.
  - PLN develops the specifications of the **energy measurement system** and installs them for power wheeling to monitor the power balance between power generation and its consumption.
  - Network service center is established in PLN
  - PLN Organizational re-configuration for fair treatment
- **Up to 2019 (Preliminary introduction with social study)**
  - Social experiment of initial power wheeling scheme with projects of selected candidate retailers with Wilayah Usaha to select their suppliers.
  - Criteria for "Wilayah Usaha" awarding will be clarified and amended to introduce de-regulation of the electricity market in future
  - Feasibility study is done about using PLN's power wheeling scheme for power import and export as cross boundary trade.
- **From 2019 to 2030(?) (Future De-regulated open market)**
  - Electric Power market for large power consumers
  - Allow large independent power customers (e.g. new industrial zones or commercial buildings) to select their power suppliers freely to boost national economic efficiency.
  - PLN Power Grid outsources ancillary service to market player(s).
  - Cross boundary trade with Power wheeling scheme

Legal Framework: Current



MEMR must control future electricity market to be maintained as:

1. Reliable (=sufficient capacity,35GW) and universal (=everywhere)
2. Efficient (=less cost, along with ADB's effort)
3. Operated in a fair manner (= open-market for prospective business chances in Indonesia)

ADB: Asian Development Bank

Fundamental license & approvals for new electricity business

- All electricity supply business entities must acquire an electricity supply business license, an *IUPTL*, from the local government or MEMR, as MEMR's regulation stipulates.
- If the electricity supply business entity distributes electricity to public customers, the entity must be approved by MEMR to supply electricity to a particular business area, termed a *Wilayah Usaha*.
- Most business areas now belong to PLN with some exceptions
- Based on this business area ownership situation, if a new business entity developing a new industrial zone newly acquires a business zone, the business zone approval can only be obtained in the following circumstances, as MR No.28/2012 stipulates. MEMR can assign a technical team to assess the technical feasibility of the establishment of business zone.(MR No.07/2016)

Revised

a. Such area has not been reached by the existing business area holder
b. The existing holder of the business area is incapable of providing the electric power or an electric power distribution network with of good quality and reliability; or
c. The existing holder of the business area returns, in part or in whole, the business area to the Minister of MEMR.

Proposed Legal Framework for power wheeling

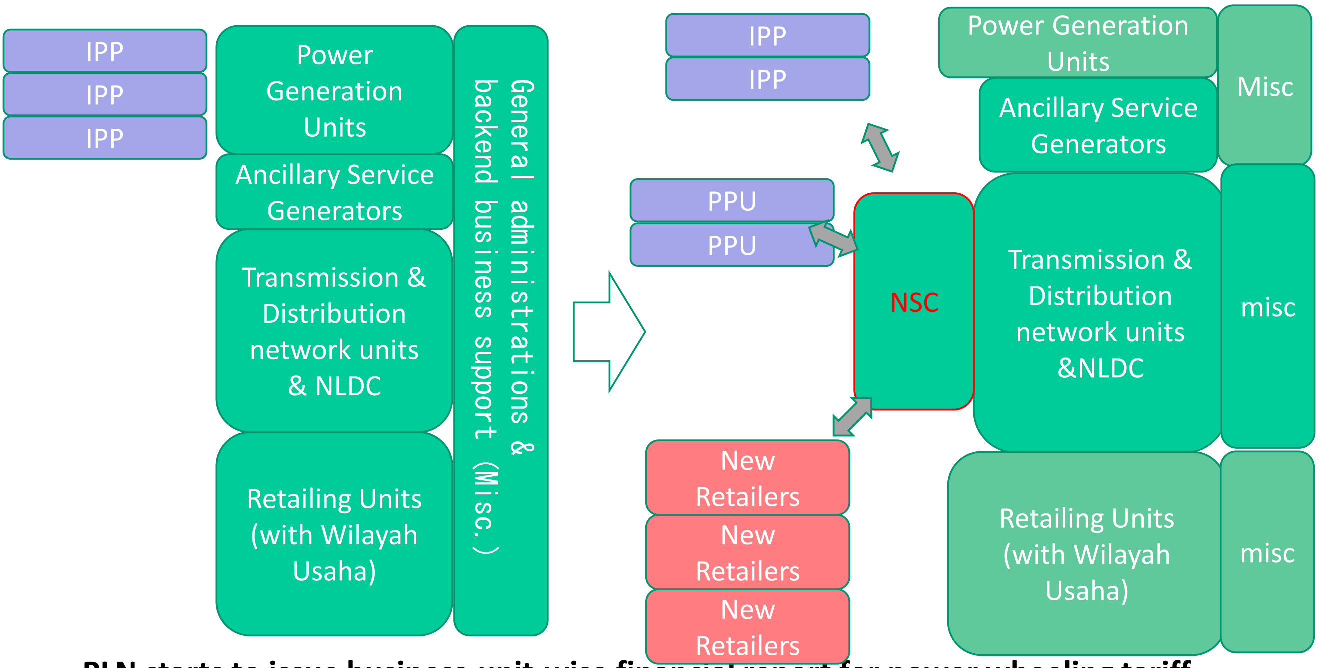
Law No.30/2009
GR No.14/2012&23/2014,
MR No.01/2015

・Included wheeling scheme
amendments: BtoB contract basis to an universal service,no-bidding required for power transaction among IUPTL holders

- Power Wheeling — MR No /20xx :Procedure — NEW → NEW
  - Fairness, Unbundling(NSC)
  - Rights & Obligations for MEMR,PLN, & Retailers
  - Cost allocation policy (ancillary, connection & expansion cost)
- License (*IUPTL*) — MR No35/2013:Procedure — Amendment → One-stop standard procedure for power wheeling scheme
- *Wilayah Usaha* — MR No.28/2012:Application Procedure,No.1: Supply Coordination
- Power Wheeling Charge — MR No.1/2015: Joint Utilization of Electric Power Network price — Amendment → Power Wheeling tariff, & Contract agreement
- Electricity Tariff — MR No.3/2015:Tariff of electric power of PLN

GR: Government's regulation, MR: MEMR's regulation, NSC: network Service Center

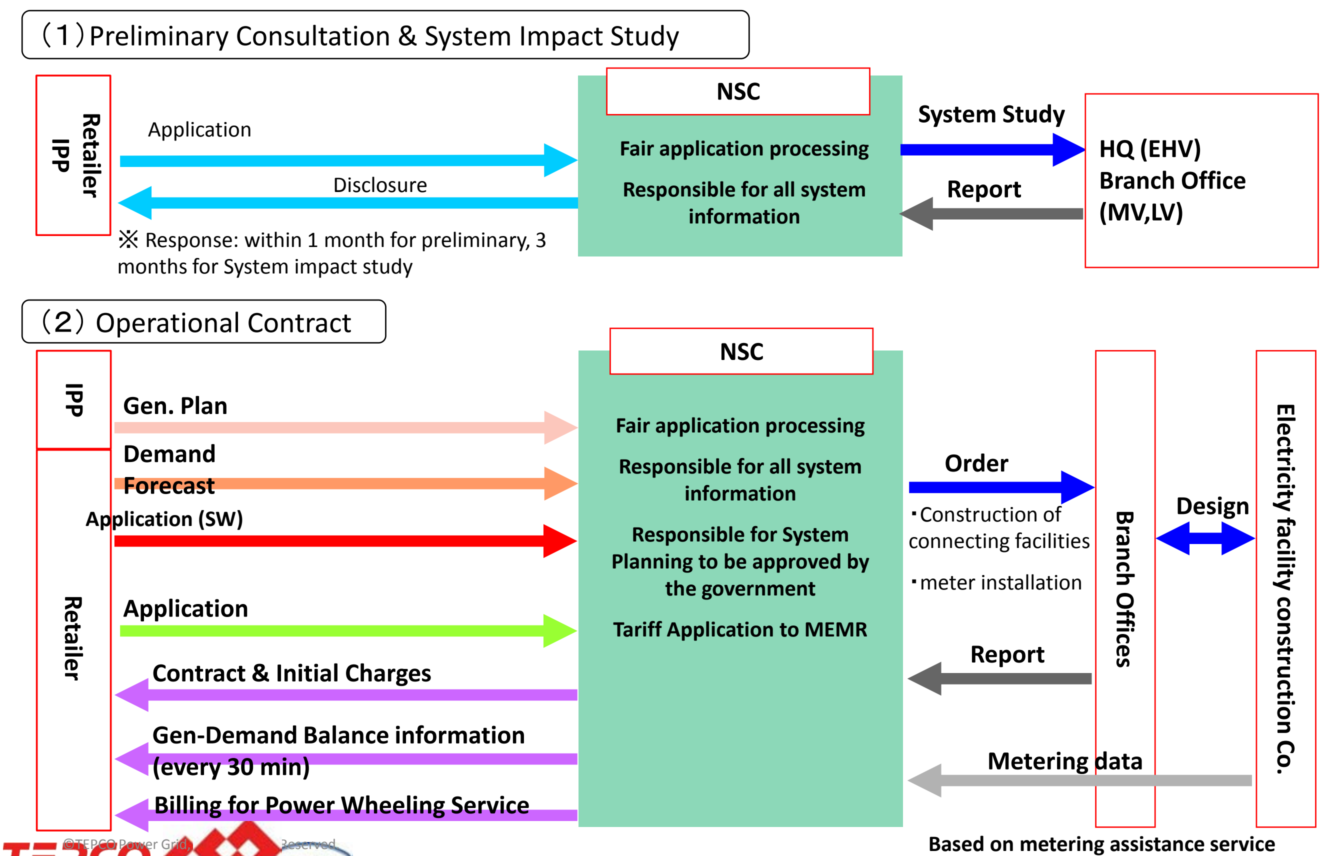
PLN's role models for Power Wheeling



- PLN starts to issue business-unit-wise financial report for power wheeling tariff calculation.
- PLN treat all generation entities and retailers (including PLN departments) in a fair manner by establishing a liaison & representative department: Network Service Center

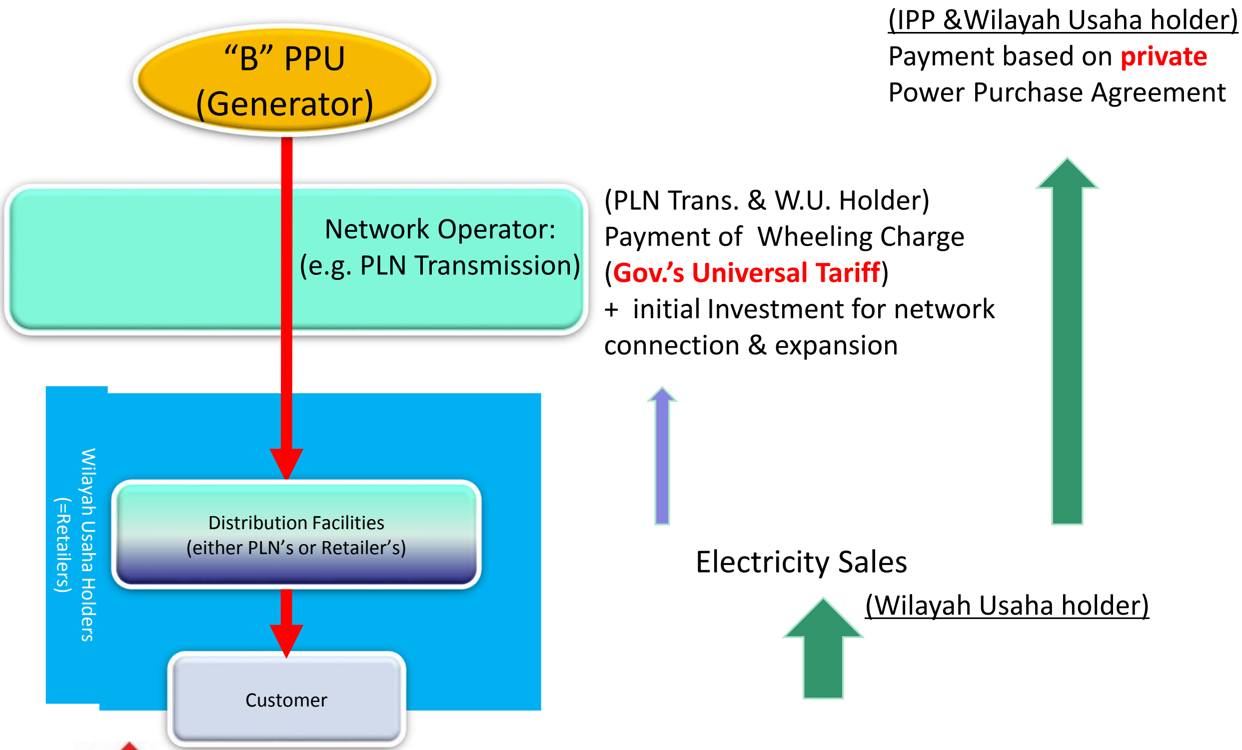
NSC: network service center, NLDC: National Load Dispatching Centre

PLN's fair business transaction: Network Service Center

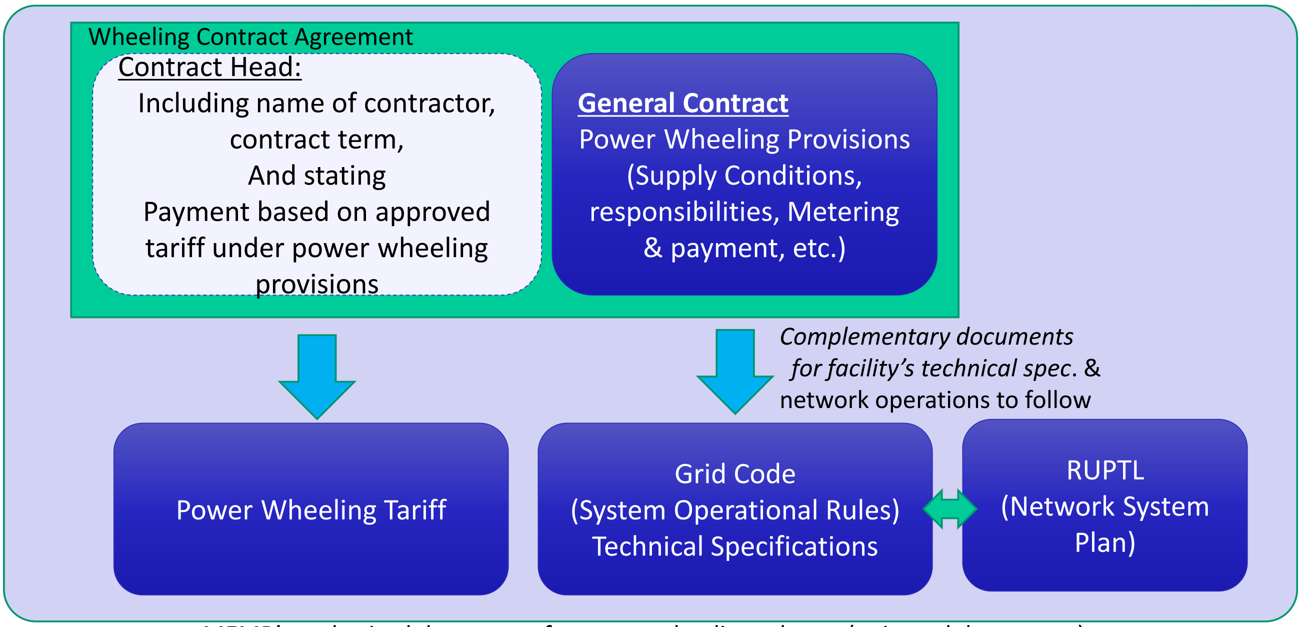


Power Wheeling Scheme and its Contracts Proposed

Assumption: "A" retailer wants to supply an industrial zone by purchasing "B" company's (IPP) electricity and PLN's power wheeling



Structure for Power Wheeling Universal Tariff



MEMR's authorized documents for power wheeling scheme (universal documents)

Power Wheeling must be fair every business entity, thus the contract to be fair, open, and reasonable.

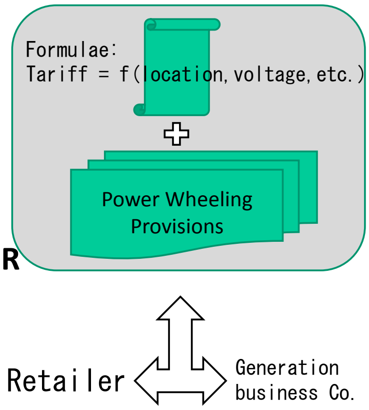
MEMR must approve any changes in the contract terms, tariff system, and Grid Code. RUPTL will incorporate retailers' projects with power wheeling scheme.

Wheeling System Policy

All legal authority for wheeling system belongs to MEMR.

- **Wheeling Tariff (= approval of tariff calculation formula, and the numbers used for the calculation)**
- **Unique set of calculation formulae for wheeling tariff shall be applied to all wheeling scheme users for its fairness**
- **PLN, other IUPTL holders can propose the reform of the applied calculation formulae, MEMR rejects/approves after public hearings and technical, financial, and political investigations.**
- **Power Wheeling Contract Agreement**
- **Power Wheeling Contract agreement shall be approved by MEMR in advance**
- **Power Wheeling Contract agreement shall be closed between retailer and PLN (transmission) based on the standard contract condition.**
- **All power wheeling contract agreement shall be examined by MEMR to secure its fairness**
- **PLN, other IUPTL holders can propose the amendment of the contract provisions, MEMR rejects/approves after public hearings and technical, financial, and political investigations.**

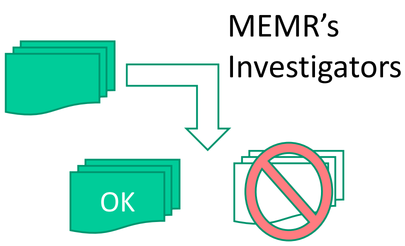
MEMR approves an unique set of contract basis

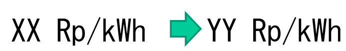


MEMR: Power Wheeling Tariff Approval

(Example Tariff Model)
- Universal tariff in every island
- postage stamp
- cost includes Ancillary Service, Trans. & Dist. costs, reasonable Profits

PLN submits tariff revision proposal to MEMR with:
- Justification, updated Cost breakdown, newest RUPTL, asset breakdown etc.





(Initial setup for tariff model and calculation structure)

a) Tariff approval procedures &

b) Applicable Cost structures and their elements be defined as MR regulatory document after public hearing

c) Criteria for cost evaluation will be developed internally in MEMR

(Request for tariff change)

PLN can propose the tariff revision (usu. increase)
- **with evidences for cost breakdown**
- **At least one year after the last tariff revision**

(Revision of tariff model & tariff calculation structure)

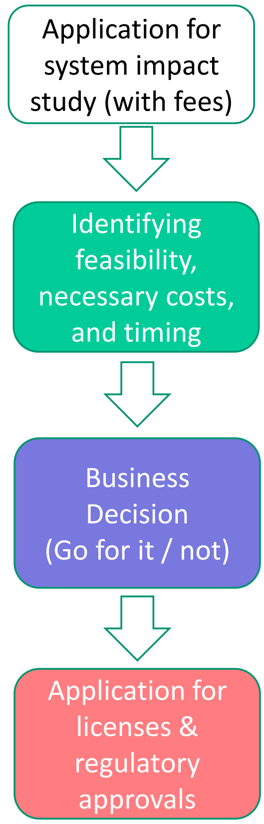
Retailers and PLN can propose the revision

MEMR's investigation on tariff revision proposal along with hearings with PLN and stakeholders, public hearings

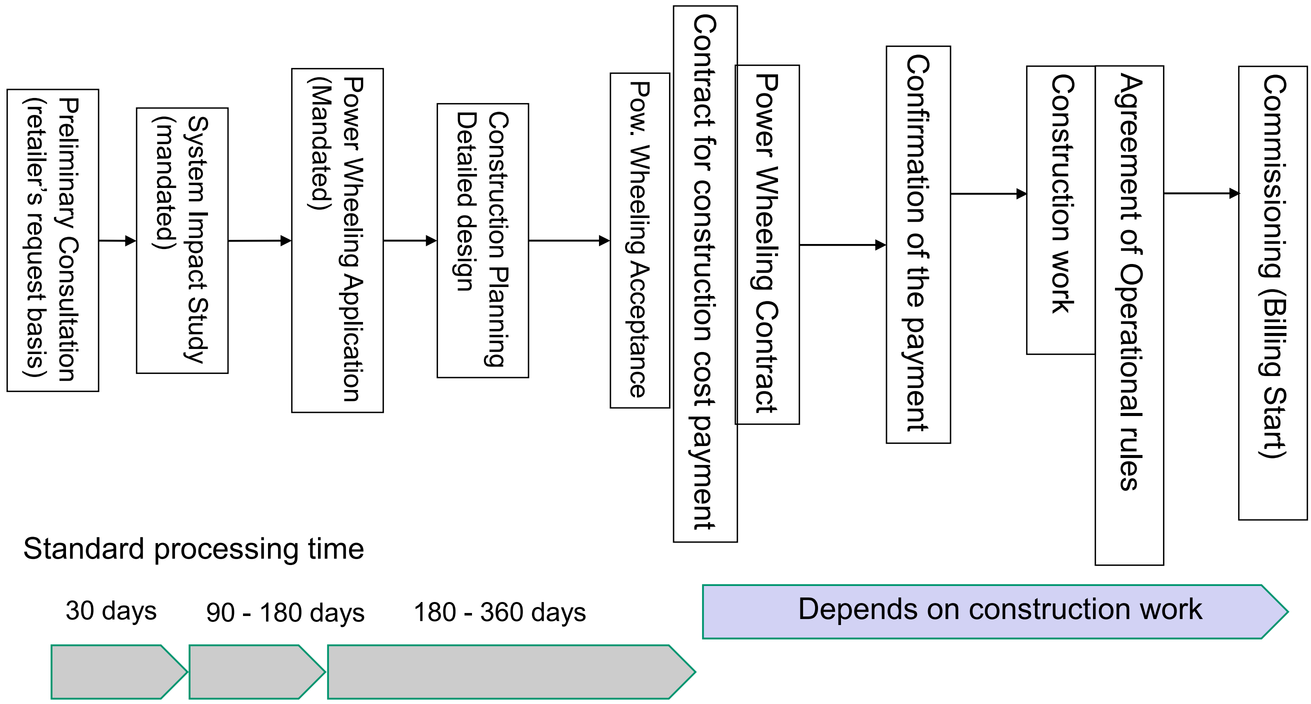
SOP for Retailer: Application Steps

Assumption: The facility installation cost and necessary system expansion cost must be borne by New retailers.

1) System impact study of the new power wheeling tells the applicant estimation cost for grid connection, as their initial cost, and estimated commissioning date
2) Then the applicant must study their business feasibility with these estimated costs and project duration provided by PLN transmission
3) MEMR must monitor PLN's estimated costs for facility connection and expansions, and also project duration for the scheme's fairness and conformance to RUPTL and existing project plans.
4) If the applicant believes the business plan positive, they must go forward to acquire Wilayah Usaha, IUPTL, and relevant government licenses & approvals.



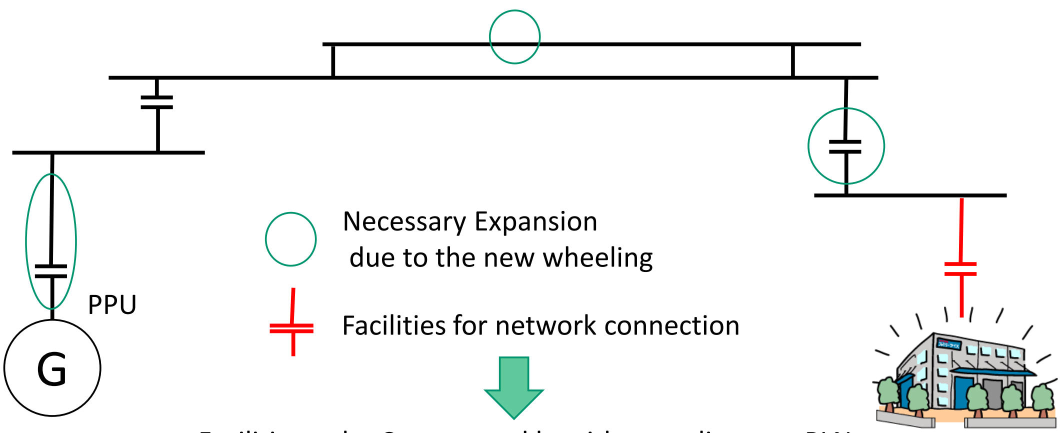
SOP for Retailer: Application Steps



* Depending on projects, degree of impact, availability, and number & capacity of Engineers

System Impact Study & RUPTL

* single line represents 2 cct.



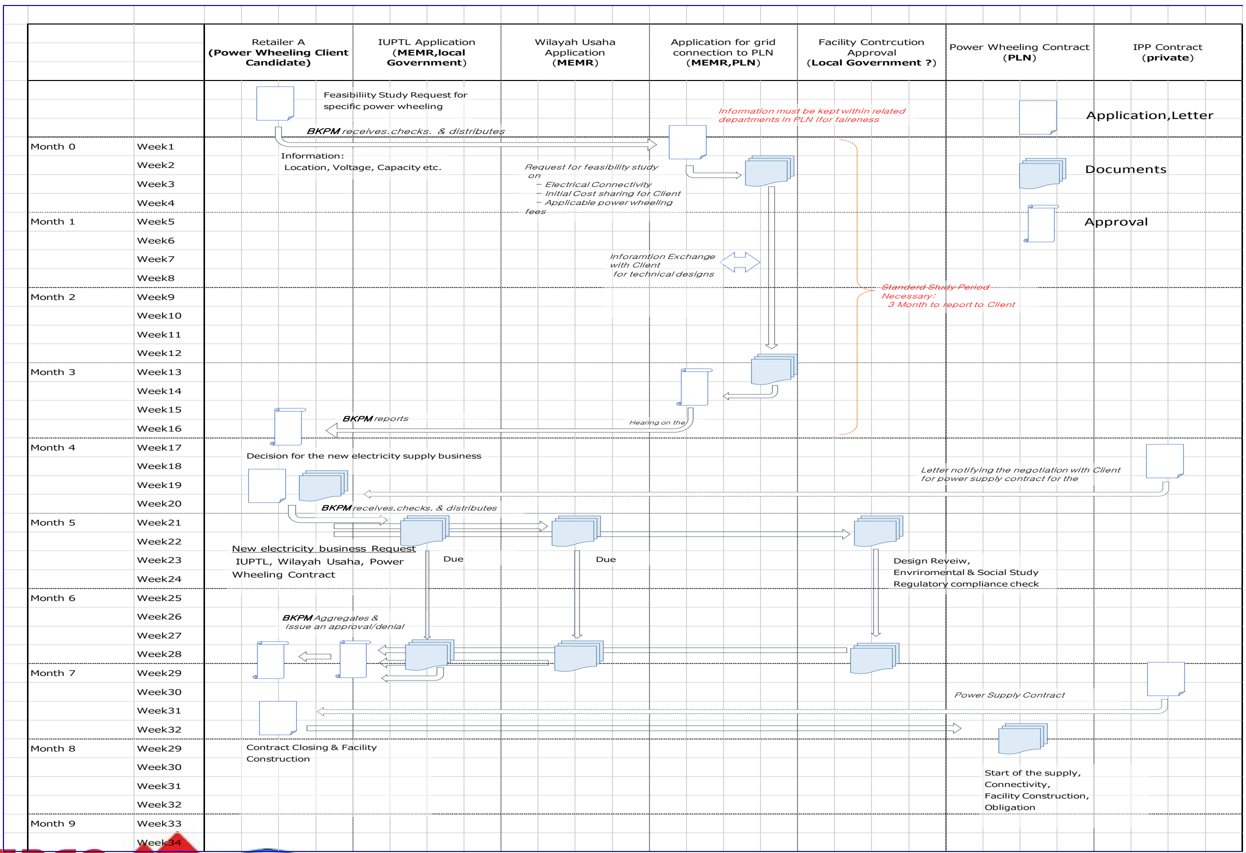
Facilities to be Constructed by either applicant or PLN,
And costs to be borne by Applicant (Retailer)

Once the power wheeling impact study requested, PLN investigates necessary network expansion to maintain whole network security, and evaluate necessary costs.

If the necessary expansion requires MEMR's RUPTL approval, the impact study report can be preliminary one. Instead, PLN informs the applicant company that RUPTL approval is mandated along with evaluated costs and project duration.

PLN (PLN NSC) will revise RUPTL based on not only PLN's network plan but also feasible power wheeling study for the plan's better precision. ⇨ Cost sharing rules are necessary (future study components)

Draft Wheeling SOP(Standard Operating Procedure) in Indonesia



Summary (1)

To introduce Power Wheeling Scheme in Indonesia,

1) **Indonesian power network must be expanded and maintained in a healthy and efficient condition while satisfying increasing demand by fulfilling 35GW plan.**
2) **MEMR must lead every stakeholders in power supply market to prosperous future while carefully maintaining network's capacity, reliability, and efficiency.**
3) **Thus, the proposed power wheeling scheme is designed to let MEMR**
   1) Approve tariff and conditions for Power Wheeling, which is universal
   2) monitor necessary business transactions including Wilayah Usaha approval
   3) develop proper network plan (RUPTL) along with PLN's vast knowledge.

Summary (2)

- **The current Law No.30/2009, and GR No.14/2012&23/2014 already incorporate fundamental framework for Power Wheeling**
- **New framework proposed**
  - System Impact Study to estimate new business' cost for connection facilities and necessary network expansions
  - Re-organization of PLN structure to implement fair treatment of every business entity.
  - Power wheeling tariff formula can be anything, but start with postage stamp system for its simplicity
- **Necessary amendments proposed:**
  - Change in Power Wheeling Scheme : (current) Business to Business scheme with negotiable price to (future) universal tariff for its fairness.
  - IUPTL approval timing due to the introduction of System impact study: Enable companies without IUPTL can apply the system impact study to PLN for possible Power Wheeling Business
  - Changes in IUPTL holder's obligation: retailer can contract PPU without bidding process