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GEOTHERMAL ENERGY DEVELOPMENT IN INDONESIA, COUNTRY UPDATE 2005 – 2008

Tafif Azimudin

Pertamina Geothermal Energy
Skyline Building 15th floor
Jl. MH. Thamrin 9 – Jakarta 10340
INDONESIA
tafifaz@pgeindonesia.com

ABSTRACT

Following the establishment of the Policy on Geothermal, Law No. 27/2003, Government Regulation No. 59/2007 and Ministry of Energy & Mineral Resources Regulation No. 14/2008, that control the regulations over geothermal resource development and provide a regulatory basis for working in areas where there are geothermal undertakings and the pricing of geothermal energy, the Government of Indonesia is planning to have geothermal power plants installed with a total capacity of 6,000 MW by the year 2020. The plan also includes a new bidding process

Currently, the total installed generating capacity from geothermal power plants is 1,032 MWe, accounting for about 4.6% of the total energy use in Indonesia in which fossil fuel plants are still dominant (>80%). Energy development to date has been mostly associated with the conversion of geothermal energy to electricity.

1. INTRODUCTION

The Government of Indonesia, through the Presidential Decree No. 76/2000, withdrew the previous Presidential Decree and applied the Law No. 27/2003 on geothermal policy. This implied that PERTAMINA was no longer given the full authority on such business, and is to be treated similarly with other geothermal companies. Following the establishment of the Law No. 22/2001 in the oil and gas sector, PERTAMINA was transformed into PT Pertamina (Persero) and through the Government Regulation No. 31/2003, geothermal activity was transferred to a subsidiary company. For this reason, PT Pertamina Geothermal Energy (PGE) was established.

PT Pertamina (Persero) through PGE continues to administer the operations of 15 geothermal concessions (Figure 1). They have in total a potential of 8,480 MWe equalling 4,392 MMBOE, consisting of the resource of 1,990 MWe and the reserve of 6,490 MWe. The utilization in such activities comprises of PGE's own operations and partnerships through Joint Operating Contracts (JOC).

The PGE's own operations cover 9 fields, Kamojang, Lahendong and Sibayak fields combined have the installed capacity of 252 MWe, equal to 131 MMBOE. Karaha, Ulubelu and Lumutbalai fields are in the drilling stage, while in Hululais, Kotamobagu and Sungai Penuh fields drilling of exploration wells is planned in 2009. The partnership operation covers the following fields: Salak, Darajat, Wayang Windu, Sarulla, Bedugul, Dieng and Patuha by joint operation with partnerships. The total

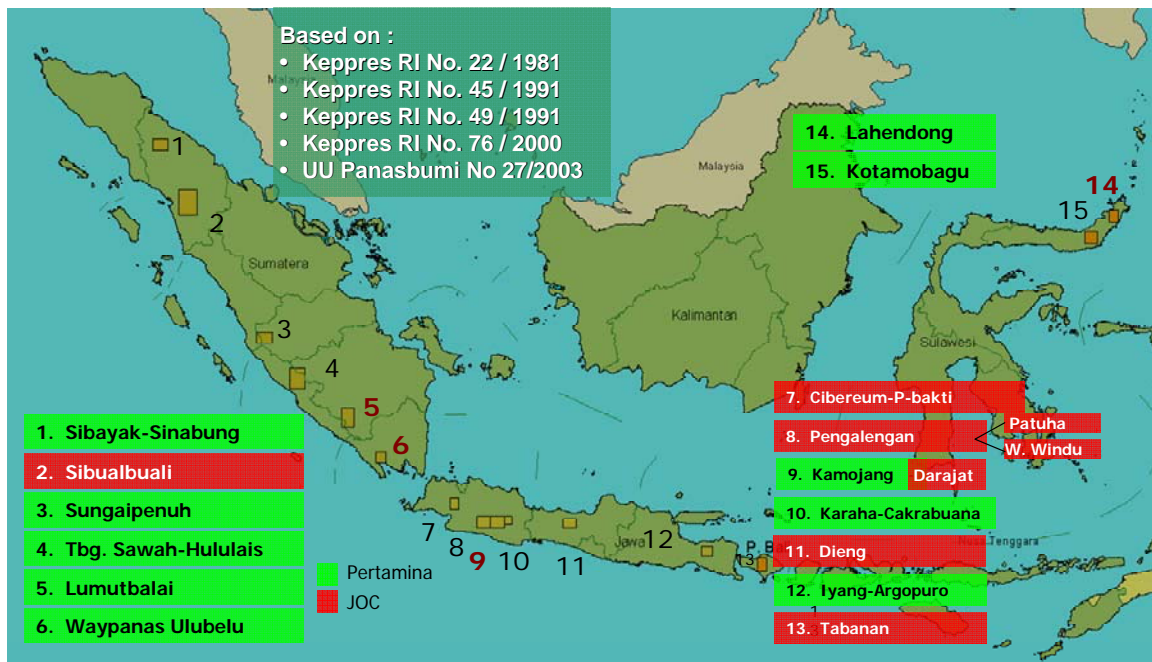


FIGURE 1: Pertamina Geothermal Energy concessions map

installed capacity is 780 MWe, equal to 404 MMBOE. The total capacity of the power plants consisting of PGE's own operations and partnerships is 1,032 MWe equal to 535 MMBOE.

The utilization activities of PGE's own operations and partnerships are either currently producing, or likely to be developed in the next decade. They are discussed below which is essentially an update of the country paper presented by Sudarman et al. (2000) and Ibrahim et al. (2005) in the World Geothermal Congresses in Japan and Turkey, respectively.

2. GEOTHERMAL POTENTIAL

More than 200 volcanoes are located along the islands of Sumatra, Java, Bali and the other islands of eastern Indonesia, and known as 'The Ring of Fire'. This gives a large concentration of high-temperature geothermal systems. The total geothermal potential is believed to reach the amount of about ~27,000 MWe from ~250 locations. It comprises speculative resources (9460 MWe), hypothetical resources (4555 MWe), possible reserves (9960 MWe), probable reserves (725 MWe) and proven reserves (2300 MWe). These potential data were obtained from the Directorate of Mineral Resources Inventory (Table 1).

The resource potential increase through time is due to the availability of additional detailed data coverage in the prospect areas. Since 2005, 220 MWe has been added to the total installed capacity and a total of seven exploitation wells and four exploration wells with total of 22 km have been drilled.

3. ELECTRICITY USAGE

The energy mix used to produce electricity in Indonesia includes fossil fuel (oil, gas and coal) and renewable (hydro and geothermal). The total installed generating capacity from geothermal power plants is about 1,032 MWe and is about 4.6% of the country's total capacity of 22,393 MWe (Figure 2). The largest geothermal installation is located in the Salak field, West Java with an aggregate capacity of 330 MWe or 36% of the total installed geothermal capacity.

TABLE 1: Geothermal potential of Indonesia in 2003

No	Province	Number of Locations	Energy Potential (Mwe)					Total (Mwe)
			Resources		Reserves			
			Speculative	Hypothetical	Possible	Probable	Proven	
1	Aceh	17	630	390	280			1300
2	North Sumatera	16	1500	170	1620		330	3620
3	West Sumatera	16	925	70	700			1695
4	Bengkulu	5	450	220	600			1270
5	South Sumatera	5	725	390	790			1905
6	Lampung	13	925	830	1050		20	2825
7	Bangka Belitung	3	75					75
8	Riau	1	25					25
9	Jambi	8	375	250	355	15	40	1035
10	Banten	7	450	100	285			835
11	West Java	38	1500	770	1290	485	1550	5595
12	Central Java	14	275	340	610	115	280	1620
13	Yogyakarta	1			10			10
14	East Java	11	130	360	650			1140
15	Bali	5	75		220			295
16	East Nusa Tenggara	18	100	350	575		15	1040
17	West Nusa Tenggara	2		70	70			140
18	North Sulawesi	5	25	125	540	110	65	865
19	Gorontalo	2	25		15			40
20	Central Sulawesi	14	300		65			365
21	South Sulawesi	16	325		45			370
22	Southeast Sulawesi	13	250		50			300
23	North Maluku	9	150	120	40			310
24	Maluku	6	125		100			225
25	Papua	2	50					50
26	West Kalimantan	3	50					50
Total		250	9460	4555	9960	725	2300	27000

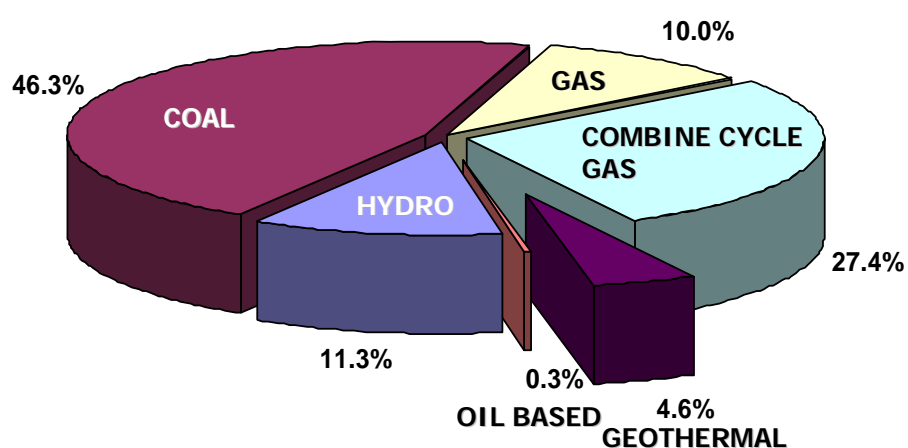


FIGURE 2: The total energy mix in Indonesia (June 2008)

Direct use of geothermal energy is limited to agricultural processing. Indonesia began developing geothermal direct utilization (non-electricity usage) when the Research and Technology Agency (BPPT) investigated methods to apply geothermal energy in the agricultural processing to sterilize the growing medium used in mushroom cultivation. The pilot project was done in 2002 in the Kamojang field, but has no proven commercial application yet. In the middle of 2007, in cooperation with the local non profit entity (“Yayasan Masarang”) in the Lahendong field, the direct utilization for processing palm water to become brown sugar was accomplished as part of the company’s social responsibility.

4. GEOTHERMAL OPERATORS

Currently, the utilization of geothermal energy comprises of PGE’s own operations and partnerships which operate on the scheme of JOC between Pertamina and the operator (Table 2).

TABLE 2: Utilization of geothermal energy for electric power generation

Field	Operator	1983	1988	1994	1997	2000	2001	2002	2006	2007	2008	Total MWe
Own Operation												252
Kamojang	PGE	30	110								60	
Lahendong	PGE						20			20		
Sibayak	PGE						2				10	
Lumutbalai	PGE											
Ulubelu	PGE											
Hululais	PGE											
Sungaipenuh	PGE											
Kotamobagu	PGE											
Karaha	PGE											
JOC												780
Salak	CGS			180	195							
Drajat	CGI			55		70				110		
Wayang Windu	MNL					110						
Sarulla	M+O+I+K											
Bedugul	BEL											
Dieng	GDE							60				
Patuha	GDE											
Total MWe												1032

4.1 PGE’s own operations

The **Kamojang** field is located about 80 km south of Bandung, the capital city of West Java Province. The activities cover the steam production to maintain the supply for power plant Units 1, 2 and 3 (140 MWe). In 2007, Unit 4 (60 MWe) was added to increase the total installed capacity to 200 MWe. Also, a delineation drilling for the steam supply for additional power plant Unit 5 has been completed. Since 1983 up to 2007, the Kamojang geothermal field has generated a total of 22,782 GWh of electricity (Table 3).

The **Lahendong** field is located about 30 km south of Manado, the capital city of North Sulawesi Province. The activity included the steam production to secure the first power plant 20 MWe. Since 2005, 7 production drillings have been completed for the additional steam for Units 2 and 3, each rated at 20 MWe. Unit 2 went online on June 2007 and the Unit 3 is expected to be online at the end of 2008. Since 2001 up to 2007, Lahendong geothermal field has generated a total of 941 GWh of electricity.

TABLE 3: Geothermal energy gross generation in MWh

PGE's Own Operation

Tahun	KAMOJANG		LAHENDONG		SIBAYAK		CUMMULATIVE	
	Steam (Ton)	Electricity (MWh)	Steam (Ton)	Electricity (MWh)	Steam (Ton)	Electricity (MWh)	Steam (Ton)	Electricity (MWh)
1984	1,840,700	217,590			9,420	670	1,850,120	218,260
1985	1,903,770	224,500			43,320	3,940	1,947,090	228,440
1986	1,952,880	232,350			85,850	7,800	2,038,730	240,150
1987	5,392,200	719,470			31,450	2,860	5,423,650	722,330
1988	7,750,470	1,012,010			69,760	6,340	7,820,230	1,018,350
1989	7,737,330	1,006,870			81,000	7,360	7,818,330	1,014,230
1990	8,651,750	1,125,420			60,880	5,530	8,712,630	1,130,950
1991	8,066,660	1,049,460			11,290	2,050	8,077,950	1,051,510
1992	8,331,030	1,083,740			0	0	8,331,030	1,083,740
1993	8,364,000	1,088,080			68,200	340	8,432,200	1,088,420
1994	8,133,690	1,058,440			89,960	350	8,223,650	1,058,790
1995	7,924,500	1,031,010			0	0	7,924,500	1,031,010
1996	8,496,780	1,107,550			46,390	1,910	8,543,170	1,109,460
1997	8,875,320	1,153,650			37,220	930	8,912,540	1,154,580
1998	8,798,760	1,144,900			0	0	8,798,760	1,144,900
1999	6,928,790	900,990			0	0	6,928,790	900,990
2000	6,506,040	846,650			66,270	2,830	6,572,310	849,480
2001	8,623,300	1,116,289	457,450	61,430	241,890	11,170	9,322,640	1,188,889
2002	9,291,920	1,202,394	953,750	93,050	212,030	9,570	10,457,700	1,305,014
2003	9,273,500	1,201,600	1,131,100	155,100	41,200	1,300	10,445,800	1,358,000
2004	9,276,804	1,200,489	1,173,341	158,208	126,124	4,075	10,576,269	1,362,772
2005	7,462,169	962,526	1,012,069	134,407	81,153	2,643	8,555,391	1,099,575
2006	8,122,130	1,046,638	1,238,793	165,995	164,688	6,137	9,525,611	1,218,770
2007	8,120,333	1,049,429	1,284,204	173,218	76,855	2,437	9,481,392	1,225,084
Total	175,824,826	22,782,045	7,250,707	941,409	1,644,950	80,241	184,720,484	23,803,695

PGE's Joint Operation Contract

Tahun	SALAK		DARAJAT		WAYANGWINDU		GEODIPA	
	Steam (Ton)	Electricity (MWh)	Steam (Ton)	Electricity (MWh)	Steam (Ton)	Electricity (MWh)	Steam (Ton)	Electricity (MWh)
1994	4,694,080	657,280	1,033,550	160,430				
1995	5,087,740	706,950	2,315,510	364,600				
1996	5,588,520	775,560	2,424,450	390,630				
1997	10,614,210	1,472,600	2,351,790	378,460				
1998	17,069,680	2,371,260	2,296,780	370,440				
1999	19,061,370	2,358,880	2,925,620	416,350				
2000	14,729,210	1,807,610	4,144,250	637,480	3,717,360	506,850		
2001	22,043,830	2,726,350	7,241,550	1,106,880	6,668,640	887,690		
2002	21,741,620	2,667,690	7,453,420	1,169,130	6,929,030	910,490	407,369	50,319
2003	20,360,700	2,612,300	7,384,400	1,167,200	6,434,500	861,400	1,603,700	234,300
2004	22,595,107	2,737,109	8,011,193	1,250,855	6,862,732	920,513	2,304,898	287,930
2005	24,167,347	2,930,445	7,551,158	1,217,250	6,841,127	936,361	2,518,210	323,499
2005	24,167,347	2,930,445	7,551,158	1,217,250	6,841,127	936,361	2,518,210	323,499
2006	23,925,937	2,919,938	7,633,442	1,175,629	6,624,966	924,435	2,544,427	319,017
2007	24,345,980	2,963,107	10,321,836	1,595,436	6,523,859	938,006	1,209,049	162,921
Total	260,192,678	32,637,523	80,640,106	12,618,018	57,443,342	7,822,107	13,105,864	1,701,485

The **Sibayak** field is located about 60 km south of Medan, the capital city of North Sumatra Province. Current activity includes the steam production to supply a 2 MW small scale power plant. In early 2008, the addition of 10 MWe went online to increase the total installed capacity to 12 MWe. Since 2001 up to 2007, Sibayak geothermal field has generated a total of 37 GWh of electricity.

4.2 PGE's joint operation contracts

Chevron Geothermal Salak. In 1982, Unocal Geothermal Indonesia signed the first joint operation contract (JOC) and energy sales contract (ESC) for geothermal exploration and development in Gunung Salak, West Java with a plant total capacity of 475 MWe. The contract was transferred to

Chevron in 2006. Presently, the Salak field has been producing reliable electricity at a rate of 375 MWe. Since 1994 up to 2008, Salak geothermal field has generated a total of 32,638 GWh of electricity.

Chevron Geothermal Indonesia. In December 1984 Amoseas (a wholly owned subsidiary of Chevron) signed a joint operation contract (JOC) and an energy sales contract (ESC) to develop geothermal energy in Darajat, West Java with a total capacity of 330 MWe. Presently, the Darajat field has been producing reliable electricity at a rate of 235 MWe. Since 1994 up to 2008, Darajat geothermal field has generated a total of 12,618 GWh of electricity.

Magma Nusantara Limited – Star Energy. In December 1994, Mandala Magma Nusantara BV signed a total project contract for the development of the Wayang Windhu geothermal field in West Java, with a total capacity of 400 MW. The contract was transferred to Star Energy in 1998. Presently, the Wayang Windu field has been producing electricity at a rate of 110 MWe. Since 2000 up to 2008, Wayang Windu geothermal field has generated a total of 7,822 GWh of electricity.

GeoDipa Energy. In December 1994, Himpurna California Energy Limited (HCE), a joint venture between PT Himpurna Enersindo Abadi (10 percent) and California Energy International of the US (90 percent), signed a contract to undertake the Dieng geothermal project in Central Java with a total capacity of 400 MWe. The contract was transferred to GeoDipa Energy in 1999. Presently, the Dieng field has been producing electricity at a rate of 60 MWe. Since 2002 up to 2008, Dieng geothermal field has generated a total of 1,701 GWh of electricity.

5. OPPORTUNITIES AND CHALLENGES

A new geothermal period was started when the government of Indonesia, through the Presidential Decree No 76/2000, withdrew the previous presidential decree and applied the Law No 27/2003 on geothermal. This implied that Pertamina was no longer given the full authority on such business, and is to be treated similarly to other geothermal companies. To comply with the regulations Pertamina handed in 16 geothermal concessions to the Government from the previous 31 areas.

Following the establishment of the Policy on Geothermal, Law No. 27/2003, Government Regulation No. 59/2007 and Ministry of Energy & Mineral Resources Regulation No. 14/2008, that controls regulation over geothermal resource development and provides a regulatory basis for working in areas where there are geothermal undertakings and the pricing of geothermal energy. The Government of Indonesia is planning to develop 50 new concession areas to have geothermal power plants installed with a total capacity of 6,000 MW by the year 2020 (Figure 3). Figure 4 shows the mechanism of the bidding process that leads to the completion of the process to get the new concession areas based on Law 27/2003 and Government Regulation No. 59/2007 with the offering price of electricity in specific concession areas. To date, five concessions consisting of the Masigit, Malabar, Papandayan, Guntur and Ciremai areas, situated in West Java Province are in the bidding process.

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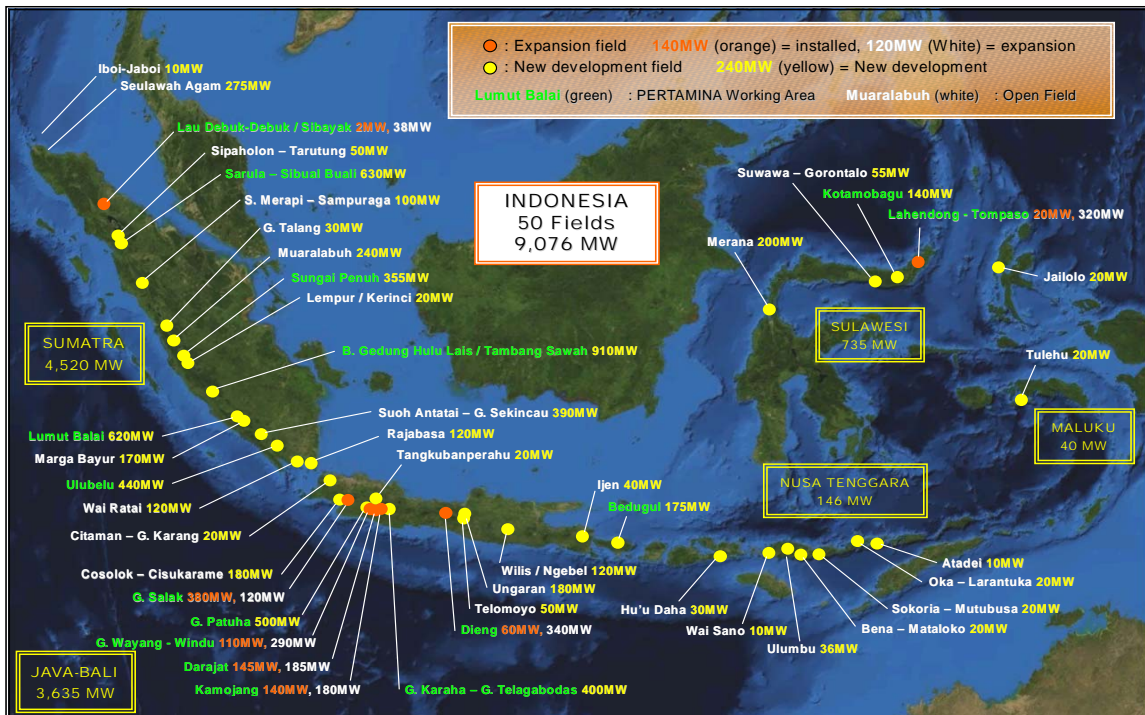


FIGURE 3: Concessions map of new development field

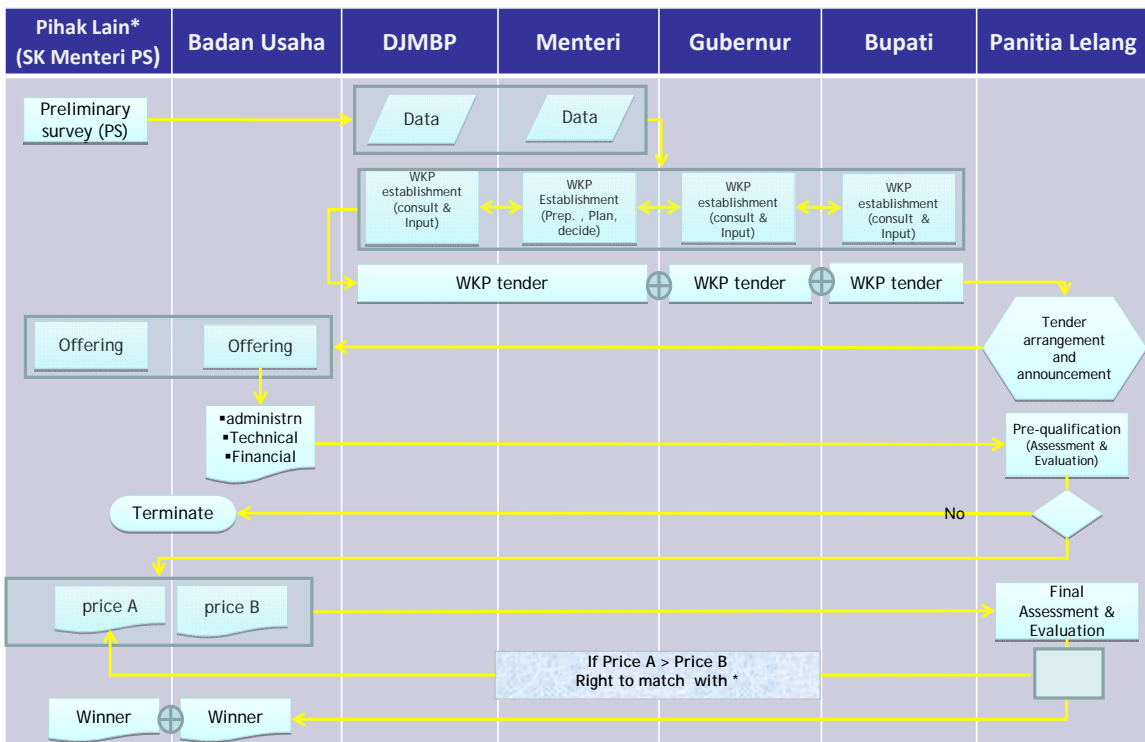


FIGURE 4: Mechanism chart of concessions in bidding process

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