

Indonesia's Geothermal Development: Where is it Going?

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ABSTRACT

Indonesia's geothermal resources are among the largest in the world, with around 40 percent of the total geothermal resources worldwide. In order to utilize this enormous energy potential, the Government of Indonesia (the "GOI") has intensified its efforts to encourage geothermal power development. As Indonesia's Deputy Minister for Energy and Mineral Resources said recently that the Government is still hopeful to reach the goal of 7,100 MW in geothermal power generation capacity in Indonesia by 2025. With installed capacity of currently 1,450 MW, this seems to be a rather ambitious goal and would need adding 1,000 MW per year from today until 2025.

This paper will discuss the geothermal resources development in Indonesia that have not come online as quickly as planned, despite huge geothermal resources and a raft of regulatory incentives to move away from a fossil-fuel-based economy and the commitment to deliver electricity to the people of Indonesia. The discussion includes review of geological, technical and non-technical hurdles of geothermal energy development as well as evolution of laws and regulations designed to overcome the hurdles. However, recently issued geothermal pricing policy has impounded interest for new investment on geothermal energy development.

1. BACKGROUND

Indonesia's geothermal resources are among the largest in the world, with around 40 percent of the total geothermal resources worldwide, with speculative and hypothetical reserves of 30,000 MW. To-date the Government of Indonesia (GOI) has identified 325 geothermal prospects, of which more than 90 prospects have been surveyed and/or defined as geothermal working areas which have been put on production, in exploratory status, tendered out or are ready to be tendered.

As of 31 December 2017, the geothermal power plant installed capacity reached 1,808.5 MW. This was after 33 years since the first geothermal plant in Indonesia was put in operation. Indonesia's 2014 National Energy Policy has targeted 23% of Renewable Energy in the Energy Mix by 2025, of which geothermal generating plant capacity is targeted to reach 7,100 MW. This seems to be a rather ambitious goal for adding 750 MW per year from to-day to 2025, if we compare with 54 MW per year accomplished during the past 33 years.

GOI has reformed the basis of regulations and laws for geothermal energy development in attempt to provide certainty of law, create incentive package to attract private investment, and overcome the hurdles, which in turn will accelerate geothermal energy development projects for electricity generation. It appears, however, that geothermal energy development hurdles are compound that they have to be addressed comprehensively rather than piece-meal.

Among the hurdles of geothermal energy development are: uncertainty of laws and regulations, high exploration risk, lack of resource and reservoir data for exploration, market risk, political risk, inconsistency electricity or steam pricing policy, costly land indemnification, prolong permit and license processes, and resentment of local community due to perceived negative environmental impact. All of these have been addressed in the new geothermal law, Law No. 21, Year 2014, and relevant implementing regulations.

However, recent Minister of Energy and Mineral Resources (MEMR) Regulations on geothermal pricing policy and guidelines for power purchase agreement have impounded interest for new investment in geothermal energy development. Since the issuance of the new MEMR Regulations in January 2017, which were revised in July 2017, no private investors are interested in participating in the tendering process of new geothermal projects and investing in renewable energy power projects.

2. UNCERTAINTY OF LAWS AND REGULATIONS

The development of Indonesia's geothermal power projects can be divided into six generations based on governing laws and regulations.

The 1st Generation covers Geothermal Power Plant projects developed prior to 1990. They are based on Presidential Decree No. 22/1984 which stipulates, among others, that PERTAMINA, the state oil and gas enterprise, is the sole authority to developed geothermal fields and PLN, the state electricity enterprise, is the sole authority to generate and distribute electricity supply. Private participation was enabled through a joint operating contract (JOC) with PERTAMINA, which then sell the steam to PLN to generate electricity under an energy sales contract.

The obstacle with the 1st Generation of geothermal power plant projects was difficulty of PLN to raise fund for building the power plant and related transmission lines to the take-off point.

The 2nd Generation covers geothermal power plant projects procured after the issuance of Presidential Decrees No. 41/1991 and No. 45/1991, which stipulates that geothermal power plant projects are integrated projects of upstream and downstream undertakings. The projects obtain special tax treatment: the revenue split after deduction of production bonus of 4 to 6% for PERTAMINA, is 64% for investor and 36% for GOI, inclusive all form of taxes. The projects receive incentives in the form of free import duty and free value added tax for imported components and loss carry forward. The price of electricity was based on negotiation between PLN and JOC, giving the project ROR 16-17% for equity financing, and approximately 24% for project financing.

The 2nd Generation had been successful until 1997/1998 when economic and monetary crisis hit Indonesia, where the rupiah to US dollar exchange rate jumped from 2,400 to 16,000 rupiah per US dollars. Projects that had been ongoing were either continued or postponed, which resulted in renegotiation of the price of electricity, conflict resolution in international arbitration tribunal, or indefinite postponement.

With the experience of losing in the international arbitration tribunal, GOI issued Presidential Decree No. 76/2000, which relieve PERTAMINA from the authority to develop geothermal resources. In the 3rd Generation, all new geothermal development business activities are procured by and under license with the Government and taxes follow general tax regulations. This resulted in a revenue split of approximately 53% for investor and 47% for the Government. No new geothermal energy developers were interested to participate in the 3rd Generation.

In order to provide certainty of law to attract investment in geothermal energy development, GOI announced Law No. 27/2003 on geothermal energy to replace all previous regulations, followed by Government Regulation (GR) No. 59/2004, which was amended by GR No. 70/2010. Under the new law and implementing regulations, Central or National Government conducts preliminary survey to define geothermal working areas to be tendered, and local or regional governments conduct the tendering process. Private entities may conduct preliminary survey at its own cost and risk and they are granted the first right to match the winning bidder. The winning bidder is selected based on its technical and financial qualifications and the lowest bid of electricity price.

Several technical and non-technical barriers for geothermal project development surfaced after the 5th Generation. Table-1 shows those significant barriers and ways to resolve them.

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In September 2014, a new Law No. 21/2014 on Geothermal was announced to replace Law No. 27/2003, followed by issuance of implementing Government Regulation No. 7/2017. The law addresses concerns that hinder geothermal development projects as shown in Table-1. The new law constitutes the 6th Generation of Indonesia Geothermal Development.

The concern on economic value of geothermal electricity price to attract investment was addressed by Minister EMR Regulation No. 17/2014 by giving a ceiling price of geothermal electricity depending on the region (Table-2). A draft of geothermal pricing policy was submitted to the Minister of Energy and Mineral Resources in 2015 which is based on Feed-In Tariff concept that recognizes capacity and enthalpy differentiation as shown in Table-4, Exhibit 2.

However, the newly appointed Minister EMR issued Minister EMR Regulation No. 10/2017 and No. 12/2017 in January 2017, which were replaced by Minister EMR Regulations No. 48 and No. 50/2017. The new regulations replaced the ceiling prices and FIT concepts with much lower ceiling prices, which should be less than 85% of the regional BPP or national BPP, if the regional BPP is less than national BPP. The BPP is the basic power generation cost in the region or at national average of previous year before the PPA/ESC negotiation (Exhibit-1, Table-3).

In addition, Minister EMR Regulations No. 48 and 50/2017 also stipulates new financial terms and business scheme in order to further reduce the electricity price, which in turn distract investment:

- All power projects should follow Build, Own, Operate and Transfer (BOOT) scheme after the term expires instead of previously Build, Own and Operate (BOO) and can be extended after expiry date
- Depreciation is after 20 years instead of previously accelerated depreciation of 8 years.
- Take-or-pay should cease after the investment pays off.
- Change of directors and commissioners should be approved by Minister EMR.

Such major changes in business terms stated in minister regulations raises concern among private investment community on the uncertainty of law. Note that the hierarchy of laws in Indonesia follows the following merit order: Constitution, Law and Government Regulation in place of Law, Government Regulation, Presidential Regulation and Regional Regulation. Minister Regulation is implementing regulation of Government Regulation, it could be changed in a matter of one month and thus it is considered not providing certainty of law needed by investors.

BARRIERS TO GEOTHERMAL DEVELOPMENT	WAYS TO RESOLVE THE BARRIERS
<ul style="list-style-type: none"> Many geothermal prospects are located in conservation forest areas. Indonesian forest law prohibits mining operations in conservation forests. Geothermal was defined as a mining activity. 	<ul style="list-style-type: none"> New Geothermal Law No. 21/2014 defines geothermal as an energy process instead of a mining activity. New Ministry of Forestry regulation enables development of geothermal projects in conservation forest with other in exchange for other areas
<ul style="list-style-type: none"> Lack of data provided by GOI for conducting geothermal exploration National geothermal developers face difficulties in raising funds for high risk exploration undertaking 	<ul style="list-style-type: none"> GOI has set state Budget of Rp.3 trillion (USD 280 million) to help mitigate exploration risk Study has been conducted to establish insurance mechanism for geothermal exploration risk
<ul style="list-style-type: none"> Lack of competency among the local government staffs to manage the tendering process 	<ul style="list-style-type: none"> New Geothermal Law No. 21/2014 declares geothermal tendering process by Central Government
<ul style="list-style-type: none"> Resentment of local community for geothermal development in their area related to development of roads and locations and their benefit of the project for them 	<ul style="list-style-type: none"> New Geothermal Law No. 21/2014 stipulates that the region will receive geothermal production bonus
<ul style="list-style-type: none"> Impact of Indonesian economic and monetary crisis: drastic increase of Rupiah exchange rate, from 2,400 to 16,000 rupiah to US dollar. PLN purchase electricity from IPP in US dollar and sell to consumer in Rupiah. 	<ul style="list-style-type: none"> Renegotiate ESC/PPA contract for lower electricity price Postpone projects and renegotiate contract Resolve through international arbitration court
<ul style="list-style-type: none"> In appropriate geothermal pricing policy, not meeting the economic value to attract investment High price of geothermal electricity price does not meet the criteria of just and fair value Perceived high price of geothermal electricity as compared to electricity from coal fired power plants. 	<ul style="list-style-type: none"> MERM Regulation No. 17/2014 introduces ceiling prices of geothermal electricity, depending on capacity and location of geothermal power plant to attract investment Minister Regulations No. 49 and 50/2017 withdraw regulation ceiling price and replaces with 85% of regional BPP or National BPP and stipulate other financial terms and business scheme to reduce electricity price.
<ul style="list-style-type: none"> Rising cost of land indemnification for roads and locations 	<ul style="list-style-type: none"> Need local government to create breakthrough
<ul style="list-style-type: none"> Long process for permits and license 	<ul style="list-style-type: none"> GOI has issued regulations on one-door policy to issue permits and licenses. The number of permits and licenses has been reduced from 96 to 34 permits and is further reduced

Table 1: Barriers of Geothermal Development and Ways to Resolve

3. GEOTHERMAL PRICING POLICY

Geothermal pricing policy has been a major issue in Indonesia geothermal energy development. Law No. 30/2007 on Energy stipulates that energy prices shall be determined on the basis of a fair economic value. The energy price should therefore be determined to attract private sector investment, as GOI has no fund to finance infrastructure projects, but it should also be affordable to the community.

Earlier, upon signing of Law No. 27/2003, the price of electricity followed Minister EMR regulation which stipulates that the price of electricity should not be more than 85% or 80% of PLN basic regional generating cost (BPP), depending on interconnecting voltage. This price of electricity ranges from below US 6 cent/kWh in Java – Bali to as high as USD 12 cent/kWh in Flores Island and US 17 cent/kWh in the Maluku. Twelve new geothermal contracts, the 4th Generation of Geothermal Power Projects, were signed but geothermal development in Java-Bali did not move forward due to prices of electricity bid are much lower than the economic hurdle.

Minister EMR then revised the regulation stipulating that the price of electricity should be based on business to business negotiation between PLN and developers. This did not work either, because negotiation between PLN and developers was very time consuming.

In 2009, Minister EMR announced a new pricing policy for geothermal electricity, which stipulate that electricity price for all geothermal power project should be less than US 9.7 cent/kWh. This value was based on calculation of economic value of geothermal power projects with unit capacity of 110 MW. This calculation is based on assumption that developers take all risks, including exploration, political and commercial risks, and that the project will get 16-17% IRR. For lower geothermal capacity, however, it takes US 11.6 cent/kWh for 60 MW, and more than US 15 cent/kwh for 20 MW capacity to meet the economic hurdles of IRR 16-17%.

Year Commercial Operation Date (COD)	Highest Price Reference (US cent/kWh)		
	Region I	Region II	Region III
2015	11.8	17.0	25.4
2016	12.2	17.6	25.8
2017	12.6	18.2	26.2
2018	13.0	18.8	26.6
2019	13.8	19.4	27.0
2020	13.8	20.0	27.4
2021	14.2	20.6	27.8
2022	14.6	21.3	28.3
2023	15.0	21.9	28.7
2024	15.5	22.6	29.2
2025	15.9	23.3	29.6

Source: Minister EMR Reg. No. 17/2014

Table 2: Reference Ceiling Prices for Purchase of Geothermal Electricity by PLN

More than 30 geothermal projects were awarded under this 5th Generation. Only five projects continued through exploration stage. The remaining ones failed to raise exploration fund as their proposals were not bankable.

Projects which had been on going based on previous regulations, such as the 4th Generation, can be continued. PLN agreed to continue only after the developers had conducted exploration activities. National investors which won the bid for offering low geothermal price failed to raise funds for geothermal exploration.

Minister EMR issued Minister EMR Regulation No. 17/2014 to set ceiling prices of geothermal electricity for different regions as shown on Table-2 and a set of geothermal electricity prices based on Feed-In Tariff was submitted to the former Minister EMR before he was replaced (Refer Exhibit-2). The new Minister EMR and PLN considered the prices are too high and do not meet the fair and affordable criteria as meant in the Energy Law. The new Minister EMR withdrew Minister Regulation No. 17/2014 and dropped the Feed- In Tariff proposal and issued Minister EMR Regulations no. 10 and No. 12 in January 2017, and replaced them within just six months by Minister EMR Regulations No. 48 and No. 50/2017, promulgated in July 2017 (Refer Table-3, Exhibit-1).

3. WHERE INDONESIA’S GEOTHERMAL DEVELOPMENT IS GOING?>

With uncertainty of laws and regulations and the dilemma of decreasing geothermal electricity price to meet just and fair value for consumers and increasing electricity price to attract private investment and compensate for increasing investment cost and risks, the geothermal development in Indonesia is facing a new stumbling block.

The Indonesian Geothermal Association (API/INAGA) submitted to the Minister EMR in 2015 the calculation of geothermal feed-in tariff to verify economics of various geothermal projects at different capacity and enthalpy Results of API study are comparable with the ceiling prices set by Minister EMR Regulation No. 17/2014 where Region I in the western part of Indonesia usually contains high enthalpy geothermal resources, for 110 MW and above capacity; Region II contains medium enthalpy geothermal resources for 55 MW and 20 MW capacity; and Region III in the eastern part of Indonesia is low enthalpy area with geothermal capacity of 10 MW and below.

Minister EMR Reg. 17/2014	Region I	Region II	Region III	
Ceiling Price, Various Capacity	15.0 cent/kWh	21.9 cent/kWh	28.7 cent/kWh	
API Calculation	110 MW	55 MW	20 MW	10 MW
Feed in Tariff	16.2 cent/kWh	18.8 cent/kWh	23.1 cent/kWh	29.7 cent/kWh
Minister EMR Reg. 50/2017	Java-Bali-Sumatera	Sulawesi-West NT	East NT- Maluku	
100% BPP national or Local	7.59 – 17.52 cent/kWh	7.63 – 17.52 cent/kWh	11.93-17.52 cent/kWh	

Table-5: Comparison of geothermal pricing policies

The comparison in Table-5 shows that geothermal prices which had shown an upward trend since the 1990's through 2016 to attract investment had been significantly brought down in 2017 in order to meet affordable price to consumers, which distracts private investors. Additionally, there are terms and conditions of the PPA as stipulated in the new Minister EMR Regulations No.48 and 50/2017, as shown above, that add barriers to investment in geothermal energy development.

The price of geothermal electricity could have been reduced, and yet still provide attractive economic value to investors, if GOI is willing to give incentives to cut the high front end cost of geothermal energy development by among other things, but not limited to: a). Share exploration risks; b). Give tax holiday for the eight to first ten years instead of loss carry forward; c). Accelerate depreciation to 5 – 8 years instead of 20 years; d). Extend geothermal license validity beyond 30 years instead of transfer after contract expiration in 30 years; e). Develop insurance mechanism to mitigate exploration risk and political risk; f). Introduce policy for local banks to give low interest rate for renewable energy development; and g). GOI or local government participate in reducing cost of land indemnification.

Additionally, new barriers of geothermal energy development introduced in Minister EMR Regulations No. 48 and No. 50/2017 should be removed.

Continuing the geothermal energy development under current regulations will bring Indonesia geothermal energy development to nowhere. The target of generating electricity from geothermal energy to 7,100 MW by 2025 will be hardly achievable. Geothermal energy development should be regulated separately from other Renewable Energy due to its site specific and high exploration risk.

In closing, it is recommended that in order to move forward and accelerate Indonesia geothermal energy development in the right direction, GOI should consider the following pursuits:

- Provide incentives to geothermal development so that the price of geothermal electricity could meet “the economic and just” value to attract private investment and induce competitiveness with other sources of energy. The incentives include, but not limited to: free import duty and value added tax as currently provided; loss carry forward as currently provided or new tax holiday for the first 10 years; continue the Geothermal Fund Facility deployment to mitigate exploration risk; government provide land for lease during project life; government comfort letter; apply BOO instead of BOOT scheme, accelerated depreciation
- Accelerate permit and license process, and effective negotiation process for PPA/ESC. Generate model ESC and negotiate ESC based on heads of agreement.
- Constitute certainty of laws.

REFERENCES

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EXHIBIT-1

**Regional Basic Electricity Production Cost (BPP)
PT. Perusahaan Listrik Negara (Persero) - Year 2016 ***

NO	DISTRIBUTION AREA/SYSTEM/SUB-SYSTEM	BPP/kWh (Rp)	BPP/kWh (US \$) **
I	SUMATERA	1,194	8.98
	A. NORTHERN SUMATERA		
	1. ACEH	1,383	10.39
	a. Weh Island	1,733	13.02
	b. Simeuleu Island	1,817	13.65
	2. NORTH SUMATERA	1,235	9.28
	Nias	2,049	15.40
	B. CENTRAL & SOUTHERN SUMATERA		
	1. WEST SUMATERA	1,074	8.07
	Mentawai Islands	2,096	15.75
	2. RIAU AND RIAU ISLANDS	1,349	10.14
	a. Bintan	1,583	11.90
	b. Tanjung Balai Karimun	1,706	12.82
	c. Natuna	2,089	15.70
	d. Anambas	2,149	16.15
	3. SOUTH SUMATERA, JAMBI, BENGKULU (S2JB)	1,046	7.86
	Enggano Island	2,322	17.45
	4. LAMPUNG	1,034	7.77
	C. BANGKA	1,817	13.66
	D. BELITUNG	1,619	12.17
	E. OTHER SMALL ISLAND SUBSYSTEM	2,096	15.75
II	JAVA - BALI	868	6.52
	A. JAKARTA MUNICIPALITY SPECIAL AREA	867	6.51
	Pulau Seribu (Not Connected to Java-Bali Submarine Cable)	2,332	17.52
	B. BANTEN	866	6.51
	Pulau Panjang	2,332	17.52
	C. WEST JAVA	866	6.51

	D. CENTRAL JAVA	868	6.52
	Karimun Jawa	2,332	17.52
	E. EAST JAVA	870	6.54
	1. Madura , Isolated	2,332	17.52
	2. Bawean	1,964	14.76
	3. Gili Ketapang	2,332	17.52
	F. BALI	881	6.62
	Sistem 3-Nusa (Nusa Penida, Lembongan, Ceningan)	1,745	13.11
	G. OTHER SMALL SUS-SYSTEMS	2,332	17.52
III	KALIMANTAN	1,373	10.31
	A. WEST KALIMANTAN	1,655	12.43
	B. SOUTH AND CENTRAL KALIMANTAN	1,203	9.04
	C. EAST AND NORTH KALIMANTAN	1,357	10.20
	D. OTHER SMALL SUB-SYSTEMS	2,332	17.52
IV	SULAWESI AND NUSA TENGGARA	1,421	10.68
	A. NORTH SULAWESI, CENTRAL SULAWESI AND GORONTALO (SULUTTENGGO)	1,696	12.75
	1. Northern Sulawesi (Manado, Gorontalo, Kotamobagu)	1,669	12.54
	2. Toli-Toli	2.206	15.22
	3. Tahuna	2,332	17.52
	4. Palu (Grid Sulbagsel)	1,016	7.63
	5. Luwuk	1,759	13.22
	B. SOUTH SULAWESI, SOUTH-EAST SULAWESI AND WEST SULAWESI (SULSELRABAR)	1,078	8.10
	1. Southern Sulawesi	1,016	7.63
	2. Kendari	1,801	13.53
	3. Bau-Bau	2,137	16.06
	4. Selayar	2,114	15.88
	C. WEST NUSA TENGGARA	1,821	13.68
	1. Bima	1,880	14.12
	2. Lombok	1,629	12.24
	3. Sumbawa	1,978	14.87
	D. EAST NUSA TENGGARA	2,332	17.52
	1. Sumba	1,887	14.18

	2. Timor	2,226	16.73
	3. Western Flores	1,751	13.16
	4. Eastern Flores	2,070	15.55
	E. OTHER SMALL SUB-SYSTEMS	2,332	17.52
V	MALUKU AND PAPUA	2,008	15.09
	A, MALUKU AND NORTH MALUKU	2,305	17.32
	1. Ambon	1,680	12.62
	2. Seram	2,330	17.51
	3. Saparua	1,626	12.22
	4. Buru	1,728	12.98
	5. Ternate - Tidore	1,971	14.81
	6. Sanana	1,811	13.61
	7. Bacan	1,811	13.61
	8. Halmahera (Tobelo, Malifut, Jailolo, Sofifi, Maba)	1,685	12.67
	9. Daruba	1,587	11.93
	10. Tual	1,657	12.45
	11. Dobo	2,063	15.50
	12. Saumlaki	1,686	12.67
	B. PAPUA AND WEST PAPUA	1,802	13.54
	1. Jayapura	1,959	14.72
	2. Sarmi	2,332	17.52
	3. Biak	1,753	13.17
	4. Serui	1,778	13.36
	5. Nabire	1,604	12.06
	6. Wamena	2,332	17.52
	7. Timika	1,786	13.42
	8. Merauke	1,704	12.80
	9. Tanah Merah	1,704	12.80
	10. Manokwari	1,760	13.23
	11. Sorong	1,305	9.81
	12. Teminabuan	2,332	17.52
	13. Fak Fak	2,332	17.52

	14. Kaimana	2,332	17.52
	15. Bintuni	2,332	17.52
	16. Raja Ampat	2,332	17.52
	C. OTHER SMALL SUB-SYSTEMS	2,332	17.52
	NATIONAL BPP	983	7.39

Geothermal electricity price = 100% of local BPP or National BPP where Local BPP < National BPP

*)
Base

d on Minister EMR Decree No. 1404K/20/MEM/2017. BPP for 2016 valid 1 Apr, 2017 -31 Mar. 2018

**) US Dollar Exchange Rate USD 1.00 = Rp. 13,307

Table-3: BPP 2016

EXHIBIT-2>

Geothermal Feed-In Tariff Calculation

Assumptions of FIT calculation based on production cost (economics) are as follows:

1. The unit capacities discussed are: 10 MW, 20 MW, 55 MW and 110 MW.
2. Assumption of cost is for high enthalpy. Assumption of cost for medium/low enthalpy should receive special attention
3. Assumption of cost for green field geothermal development with development period of 7 years (One year for geoscience study, 3 years for infrastructure development, exploratory drilling, well test and resource assessment, and 3 years for financing process and EPC / development
4. Assumption of cost is for 2015, USD real. Inflation rate and market condition should be calculated for the nominal expenditure
5. Technical assumptions are as follows:
 - a. Exploration success ratio 50%, development success ratio 80%
 - b. Exploratory well depth 2,500 m, development 2,000 m
 - c. Depletion rate 4%
 - d. Capacity and availability factor 95%
6. Financial assumptions are as follows:
 - a. 10% Value Added Tax (VAT) has been included in the cost assumption
 - b. Production Bonus (0.5%) has been included in the royalty of 3%.
 - c. It does not include service cost for Environmental Permit
 - d. Company income tax 25%
 - e. Already included tax income incentive (accelerated depreciation, investment allowance, and tax loss carry forward)
 - f. Import duty and tax = 0% (exempted)
 - g. Take-or-pay 90%
 - h. Inflation 2% per annum
 - i. Tariff escalation applied to 25% of tariff or approximately 0.6% per months
7. Targeted Project IRR 16%

Parameters	110 MWe	55 MWe	20 MWe	10 MWe
Project Capital, including VAT				
Exploration (USDx1000)				
1. Initial Survey (3-G)	2,000	1,500	1,000	500
2. Access Road, Pad, Land	20,000	15,000	10,000	5,000
3. Logistic, Support & Facilities	1,000	500	500	500

4. Rig Mobilization	2,000	2,000	2,000	2,000
5. Exploration Well Drilling (Stand Hole)				
a. Number of Well	54	4	3	2
b. Well Depth (m)	2,500	2,500	2,500	2,500
c. Success Ratio (%)	50%	50%	50%	50%
d. Deliverability (MW/well)	8	8	3	3
e. Drilling Cost (USDx1000)	7,500	7,500	2,000	2,000
6. Well Testing for Expl. Well (USDx1000)	2,500	2,000	1,500	1,000
7. Site Operation and General Expenses	5,000	4,000	3,000	3,000
Total Expl. Drilling & Well Testing ('000 \$)	70,000	55,000	24,000	16,000
Feasibility Study (NORC, Enc. Permits)	500	500	500	500
Legal Fee – PLN (PPA)	250	250	250	250
Project Management	4,000	3,000	2,000	1,500
Contingency	-	-	-	-
Preparation Work (Expl. and FS) '000\$	4,750	3,750	2,750	2,250
Steam Field Development				
1. Production Well Drilling				
a. Number of Production Well	16	7	3	2
b. Well Depth (m)	2,000	2,000	2,000	2,000
c. Success Ratio (%)	80%	80%	80%	80%
d. Deliverability (MW/well)	8	8	8	8
e. Drilling Cost ('000 \$/well)	7,000	7,000	7,000	7,000
f. Rig Mobilization and Demobilization	2,000	2,000	2,000	2,000
g. Well Testing Production Well ('000\$)	8,000	3,500	1,500	1,000
Production Well & Well Testing ('000 \$)	122,000	54,500	24,500	17,000
2. Injection Well Drilling - Brine				
a. Number of Well	4	2	1	1
b. Well Depth (m)	1,400	1,400	1,400	1,400
c. Success Ratio (%)	80%	80%	80%	80%
d. Injection Rate/well (kg/s)	450	450	450	450
e. Drilling Cost /well (USDx1000)	5,000	5,000	5,000	5,000
f. Well Testing – Prod. Well ('000 \$)	2,000	1,000	500	500

Injection Well & Well Testing ('000 \$)	22,000	11,000	5,500	5,500
3. Injection Well Drilling - Condensate				
a. Number of Well	2	1	1	1
b. Well Depth (m)	1,400	1,400	1,400	1,400
c. Success Ratio (%)	80%	80%	80%	80%
d. Injection Rate /well (kg/s)	250	250	250	250
e. Drilling Cost (USDx1000)	2,500	2,500	2,500	2,500
Condensate Well (USDx1000)	5,000	2,500	2,500	2,500
Construction Cost - EPC				
Steam Field Facilities (USD x 1000)				
Access Road and Well Pads	10,000	7,500	5,000	2,500
SAGS (Piping & Production Facilities)	35,750	19,250	8,000	4,000
General Facilities	4,000	3,000	2,000	2,000
Pre-prod. facilities (permits, lands, etc)	1,000	500	500	500
Commissioning	1,000	500	500	500
Steam Field Facilities Cost	51,750	30,750	16,000	9,500
Power Generation Facilities (M\$/MW)	1.5	1.7	1.9	2.0
Pwr. Plant Cost (Condensing Turbine)	169,400	93,170	37,268	20,497
Dev. & Steam Field Fac. Costs	275,500	157,500	75,250	52,750
Contingency	-	-	-	-
Total Capital Cost (2015 USD)	444,900	250,670	112,518	73,247
Total Cost '000\$/MW (2015 USD)	4,045	4,558	5,626	7,325
Operation & Maintenance Cost				
1. Steam Field (cent/kWh)	0.4	0.5	0.7	0.8
2. Power Gen. Facilities (cent/kWh)	0.7	0.8	0.8	0.8
3. Overhead Cost (cent/kWh)M	0.1	0.2	0.2	0.2
4. Well Workover (per 3 years) USD	2	1	0.5	0.5
5. Major Overhaul Power Plant / 3-yrs \$	2	1	0.5	0.5
6. M/Unit Well (30 yrs)				

a. Number of Well	18	9	4	2
b. Well Depth (m)	2,000	2,000	2,000	2,000
c. Success Ratio (%)	80%	80%	80%	80%
d. Deliverability (MW/well)	8	8	8	8
e. Drilling Cost /well (USD)	7,000	7,000	7,000	7,000
f. Tie-in	12,600	6,300	2,800	1,400
Make-up Well Cost	138,600	69,300	30,800	15,400
Economic Terms				
Capacity Factor	98%	98%	98%	98%
Availability Factor	97%	97%	97%	97%
Capacity & Availability Factor (nett)	95%	95%	95%	95%
Take-or-pay	90%	90%	90%	90%
Depreciation (year)	8	8	8	8
Escalation of Tariff (% component)	25%	25%	25%	25%
Inflation Rate (% per annum)	2.0%	2.0%	2.0%	2.0%
Project Life (year)	30	30	30	30
IRR (%) – Project	16%	16%	16%	16%
IRR on equity	N/A	N/A	N/A	N/A
Price (¢/kWh) at COD (+7 years, 2023)	16.2	18.8	23.1	29.7
MEMR Reg 17/2014, Ceiling Price in 2023	15.0		21.9	28.7
	Region I		Region II	Region III
Fiscal / Tax Terms				
Corporate Income Tax	25%	25%	25%	25%
Royalty + Production Bonus % GR	3.0%	3.0%	3.0%	3.0%
Taxes for Imported Goods	0%	0%	0%	0%
Investment Allowance (5/yr)	5%	5%	5%	5%

*) Source: Indonesian Geothermal Association 2015

Table-4: Geothermal Feed-In Tariff Calculation