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EXPLORATION INSURANCE FOR GEOTHERMAL ENERGY DEVELOPMENT IN INDONESIA

Widjajono Partowidagdo
. Petroleum Engineering Department, Graduate Program in Development Studies,
Bandung Institute of Technology,
Jl. Ganesha No.10 Bandung, Indonesia.

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ABSTRACT

In its diversification policy, the Government of Indonesia has made geothermal one of preferred domestic energy resources. Geothermal energy is a renewable, non-exportable and relatively clean source with a large potential in Indonesia. However, to enter to energy market, the price of geothermal energy must be competitive with other energy prices.

One of the causes of a high geothermal energy price compared to other energy prices is that a contractor has to offer the electricity price before signing an agreement, while the uncertainty is still high because no exploration well has been drilled. The price will be lower if it is decided after exploration and the exploration results show that the geothermal fields can be produced with higher productivity wells or lower costs. However, in order that such a program can be accepted by contractors, there must be exploration insurance funded by the government. The government has to repay the exploration costs when the results of exploration show that the geothermal fields cannot produce electricity at the competitive market price. There are two alternative resources for the insurance, i.e.: (1) geothermal energy tax from producing fields; (2) depletion premium from oil and gas.

The paper discusses the importance of exploration insurance for geothermal development in Indonesia.

1. INTRODUCTION

Indonesia has a wide spectrum of natural energy resources including both nonrenewable such as oil, as and coal, and renewable, such as water, geothermal and biomass.

The natural energy policy favours energy export as a source of foreign exchange earnings and government revenue. To sustain energy export for as long as possible, the government plans to utilize energy sources which cannot be exported to meet the demand for domestic use.

In its energy diversification policy, the Indonesian government has made geothermal one of the preferred domestic energy resources. Geothermal energy is a renewable, non-exportable and relatively clean energy source with large potential in Indonesia. To date, however, only a small fraction of Indonesia's total potential of about 19,000 Mw has been developed.

Geothermal energy price is somewhat high compared to other energy prices. To be competitive, the geothermal energy price has to be reduced. Government support is required to reduce the geothermal energy price in the country.

2. THEORY, ASSUMPTIONS AND DISCUSSION

To promote geothermal development, two key issues must be addressed, First, geothermal developers must have an opportunity to earn a reasonable rate of return on their projects. Second, the price of geothermal energy must be competitive with other energy prices. The role of the government is to establish conditions to promote geothermal energy development.

One of the causes of a high geothermal energy price compared to other energy prices is that a contractor has to offer the price before signing an agreement (pre exploration price), while uncertainty is still high because no exploration well has been drilled. The price can be reduced if it is determined after exploration (post exploration price) and the exploration results show that the geothermal fields can be produced with high productivity wells or low costs.

To simplify the problem, we assume that the life of a project is 30 years, depreciation is linear for ten years and all investment is capital. We also assume that all investments, both for geothermal development and power generation are spent at time zero. The electricity price (P) is determined as follows (Campbell et al. 1998)

$$NPV = (I_E+I_D+I_G) + (P.Q - OC - T)\,(P/A,\ i,n) \quad (1)$$

$$0 = -(I_E+I_D+I_G)+(P.Q-OC-T)(P/A,\ IRR,n) \quad (2)$$

$$T = t.\ TI = t.\ (P.Q-D-OC)$$
$$= t(P.Q-(I_E+I_D+I_G)/n-OC) \quad (3)$$

Combining equations (2) and (3), we have:

$$0 = -(I_E+I_D+I_G) + (P.Q-OC) - t\,(P.Q-(I_E+I_D+I_G)/n - OC)(P/A,\ IRR,\ n)$$

$$0 = -(I_E+I_D+I_G) + (P.Q(1-t)-OC(1-t))\,(P/A,\ IRR,\ 30)+ (t(I_E+I_D+I_G)/10)\,(P/A,IRR,10)$$

$$P.Q(1-t)\,(P/A,IRR,30)=(I_E+I_D+I_G)+ OC(1-t)(P/A,IRR,30) - (t(I_E+I_D+I_G)/10)\,(P/A,IRR,10)$$

$$P = \frac{(I_E+I_D+ I_G)+OC(1-t)\,(P/A,\ IRR,\ 30)}{Q\,(1-t)(P/A,IRR,30)} - \frac{(t\,(I_E +I_D+I_G)/10)\,(P/A,IRR,10)}{Q\,(1-t)(P/A,IRR,30)} \quad (4)$$

$$(P/A,IRR,\ n) = ((1 +IRR)^n-1)\ /\ (IRR(1+IRR)^n) \quad (5)$$

where,

NPV = Net Present Value
i = Discount Rate
R = P.Q
R = Revenue
P = Price
Q = Production
I_D = Investment for Field Development
I_E = Exploration Costs
I_G = Power Generation Costs
T = Tax
TI = Taxable Income
t = Tax Rate
IRR = Internal Rate of Return

(Discount Rate which causes NPV = 0)
D = Depreciation
n = Project Period

There are many fields in Indonesia estimated to have an average productive well capacity of 5 Mw (Megawatt) in the proposals (before exploration), but in reality have average well capacities of 10 Mw, 15 Mw or 20 Mw. This means,that a 110 Mw power plant which needs 22 production wells for 5 Mw well capacity in the proposal, only needs 11, 8 and 6 producing wells for 10 Mw, 15 Mw and 20 Mw well capacity respectively. Therefore, the price can be reduced from $ 7.1 cents per kwhr (kilowatthours) to $ 5.3, 4.8 and 4.6 cents respectively. The calculation of electricity prices, as a function of well capacities is shown in Appendix 1.

The contractor may only agree to sell electricity with post exploration price if there is insurance for exploration risks. Only, when results of exploration show that geothermal fields cannot produce electricity at the competitive market price and the field will not be developed, should the government repay all exploration costs. In this case, the government acts as an insurance company. Just like a car insurance company, it only spends money if there is an accident. To lower the insurance risk, the company will only accept insurance for a car in good condition and a driver with a good record. Therefore, the government needs to offer the fields with best potentials to the best contractors if doesn't want a high risk. The government wiould not spend money on fields that are developed, and only lose on those abandoned.

The analysis of insurance fees and costs will not be complete until a distribution is estimated for the likelihood that the post-exploration well capacity will be 5 Mw, 10 Mw, etc. The benefit/ cost to the government and electricity consumers will be very high if most fields yield wells of 15 Mw and more, compared to a lower benefit/ cost if most fields yield wells of, say, 10 Mw and less. Some additional work must be done before such estimates can be made.

The differencee between pre-exploration price and post-exploration price can also be used as a base for negotiations between contractors and the Indonesian government due to difficulties facing the government, as a result of crisis, to fulfill electricity purchasing agreements.

There are two alternative fund resources for the government to carry out the exploration tasks, i.e. : 1. Geothermal energy tax, 2. Depletion premium from oil and gas.

Although using funds from a geothermal energy tax will reduce the government revenue from geothermal sector, the use of geothermal energy to replace oil for domestic consumption will increase oil export, foreign exchange earnings and government revenue from the oil sector. [2]

Depletion premium funds from non-renewable energy, such as oil and gas have to be used to maintain the stock of energy, including that of renewable sources, by using funds for human resources development, research and development and exploration. Depletion premium fund is just like replantation fund for forestry sector.(Partowidago 1998) The calculation example of depletion premium for oil is shown in Appendix 2.

Another alternative for enhancing geothermal energy development in Indonesia is to reduce geothermal energy tax permitting tax holidays and investment tax credit.

However, the main obstacle to energy diversification and conservation programs in Indonesia is the heavy price subsidy on petroleum products. The subsidy has to be reduced. The reduction of the ADO (Automotive Diesel Oil) and IDO (Industrial Diesel Oil) price subsidies will increase gas demand for transportation and electricity demand for industry. The reduction of kerosene price subsidy will increase coal demand for cooking. Subsidy for petroleum products has to be selective, for example only for public transportation. The funds gained from the price subsidy reduction can be used to increase the ability of farmers and small scale industries so that they can get higher income and better living by providing them soft loan and training and also increase the salary of government employees (Partowidago 1998).

3. CONCLUSION AND RECOMMENDATION

It is difficult to maintain geothermal development in Indonesia without appropriate geothermal and energy policies. Government assistance, in the form of providing exploration insurance, is needed to reduce contractor risk of geothermal development in order to reduce the price of geothermal energy.

The petroleum product price subsidy reduction is needed to promote energy diversification and conservation. Without it, it is difficult for geothermal to compete in energy market.

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APPENDIX 1 CALCULATION OF ELECTRICITY PRICES VERSUS WELL CAPACITIES

Cost Estimate for 110 Mw Geothermal Power Generation :

I_{ES} = Exploration Survey and Study Costs = $ 3,500,000
I_{EW} = Exploration Well Costs = 5 Wells x $ 2,750,000 = $ 13,750,000
I_{IW} = Injection Well Costs = 5 Wells x $ 2,250,000 = $ 11,250,000
I_{DW} = Development Well Costs = N_{DW} x $ 2,500,000 / Well
I_{MW} = Make Up Well Costs = N_{MW} x $ 2,000,000 / Well
I_G = Power Generation Costs =$ 110,000,000
t = Geothermal Tax = 34%
OC_U = O & M up stream = 3% x Production & Injection Well Investment

$$OC_U = 3\% \times \left(\frac{110\ \text{Mw}}{WC} \times \$\,2.5 + \$\,11.25\right) \times 10^6$$

OC_D = O & M down stream = $ 3 mills /kwhr
WC = Well Capacity, Mw
OC = $OC_U + OC_D$
I_E = $I_{ES} + I_{EW}$
I_D = $I_{IW} + I_{DW} + I_{MW} + I_{PF}$

Notes :

I_{PF} = Production Facility Costs
N_{DW} = Number of Development Wells
N_{MW} = Number of Make Up Wells
Exploration wells success ratio = 80%
Development wells success ratio = 60%
IRR = 15%
(P/A, 15%,30) = 6.56
(P/A, 15%,10) = 5.02

Power Generation of 110 Mw will produce :
Q = 80% x 110 x 10^3 kw x 24 hrs/day x 365 days / year
= 771 x10^6 kwhr/year
OC_D= 0.003 mills/kwhr x Q
= 0.003 mills/kwhrx771x10^6 kwhr/year
= $ 2.3 x 10^6/year

Cost Estimate of 110 Mwatt at 5 Mw Well Capacity :
$I_E + I_D + I_G$ = $(3.5 + 13.75 + 11.25 + 114 + 10 + 110) x 10^6
= $ 262.5 x 10^6
OC_U = 3% x $ (110/5 x 2.5 +11.25) x 10^6 = $ 2 x 10^6/Year
OC = $ (2 + 2.3) x 10^6 = $ 4.3 x 10^6/ Year

By using equations (4), the Electricity Price can be calculated as follows,

$$P = \$\ \frac{(262.5 + 4.3\,(1-0.34)\,(6.56) - (0.34)\,(262.5/10)\,(5.02)) \times 10^6}{(771 \times 10^6)\,(1-0.34)\,(6.56)\text{kwhr}}$$

$$P = \$\ \frac{262.5 + 18.6 - 44.8 \times 10^6}{3{,}338 \times 10^6 \text{ kwhr}} = \frac{\$\ 236.3}{3{,}338 \text{ kwhr}} = \$\ 0.071/\text{KWH}$$

Electricity Prices as a Function of Well Capacities are shown in Table 1.

Table 1. Electricity Prices Versus Well Capacities

WC (Mw)	N_{DW}	N_{MW}	$I_{DW}+I_{MW}$ (10^6)	OC_U (10^6/yr)	I_{PF} (10_6)	P ($/kwhr)
5	28	22	114	2	10	0.071
10	12	12	54	1.2	6	0.053
15	7	8	33.5	0.9	4.5	0.048
20	5	6	24.5	0.8	4	0.045

APPENDIX 2 CALCULATION EXAMPLE OF DEPLETION PREMIUM FOR OIL

Depletion premium is the net present value of the difference between the oil price in the future, if the government has to import oil as a result of not using depletion premium funds for energy development, and the oil production cost in the future, if the government still can enjoy the domestic oil production as a result of using the funds.

$$DP = \frac{P - C}{(1 + i)^r}$$

DP = Depletion Premium, $/B
P = Price, $ 15/B
C = Cost, $ 6/B
i = Discount Rate, 10%
r = Proven Reserves (PR) to Production (Q) Ratio

In the case of Indonesia :
PR = 5 x 10^9 B and Q = 0.5 x 10^9B/year
therefore r = 10 years.

$$DP = \frac{\$\ (15-6)/B}{(1+0.1)^{10}} = \frac{\$\ 9/B}{2.59} = \$\ 3.5\ /B$$

Therefore the Indonesian Government should spend $ 3.5 per barrel of oil produced, or 23 percent of all oil revenue in the country, on energy development if the government wants to maintain a sustainable energy supply.