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The Present and Future Implementation of Geothermal Exploration Risk Sharing Mitigation in Indonesia

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ABSTRACT

Geothermal is a clean and renewable energy source and abundant in the "ring of fire" countries. Geothermal has its biggest natural-inherited risks in the exploration stage which require high risk and significant up-front capital. To allow substantial development, various policy instruments are needed to allow exploration risk mitigation measures and a fair risk allocation between the government and the industry. There are a lot of examples of policy supports from countries with a high-rate of success in developing geothermal as main source of renewable energy production. However, each country has its own context, specific conditions and regulations in such best practice from one country cannot be imitated fully to another country. Although Indonesia has one of the biggest untapped geothermal resources in the world, the additional geothermal generation capacity is not at the expected level. This paper will discuss the present and-potentially-future Indonesia risk sharing mitigation to boost geothermal exploration and exploitation. A background on the risk sharing mitigation facilities by the top geothermal producer countries is also presented.

1. INTRODUCTION

Development of geothermal prospect as source of clean and renewable electricity has stages of activities starting with the need to increase resource knowledge through preliminary surveys, surface studies, and exploration drilling. When the resources have been confirmed and feasible for exploitation as reserves, delineation drilling may be conducted to confirm the extent and productivity of the reservoir. Financing for the project can then be structured to cover additional production drilling and power plant construction. Figure 1 illustrates typical of the risk profiles and capital requirements for different stages of geothermal development.

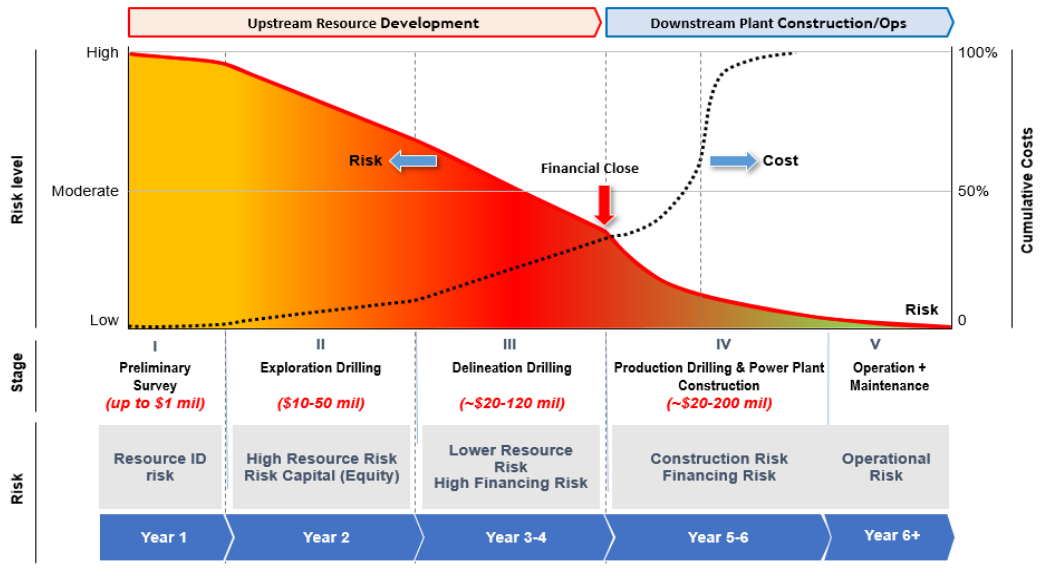

Figure 1: Typical Risk Profiles and Capital Requirements for Geothermal Development (modified from ESMAP/World Bank, 2011)

The high risk and significant up-front capital requirement have made geothermal as a renewable energy type which receives many supports from government around the world. Various incentives and policy instruments to accelerate geothermal development have been developed in many geothermal producing countries based on specific country context and situation. Approaches to mitigate resource risk have been applied in many countries with different degree of sharing risk between government (and its public entities including public developers) and private sector developers.

2. CONCEPTS OF GEOTHERMAL EXPLORATION RISK SHARING MITIGATION

A number of countries has already developed specific schemes to address geothermal resource risks and mobilize required capital for exploration drilling and resource confirmation. The ESMAP/World Bank report (2011) has identified four risk mitigation approaches based on the separation of the development responsibilities and financing burden at different stages of geothermal development cycle between the public and private sectors. A clear risk mitigation scheme has led to shift the resource risk to the party which is better to handle it in a given country. The four types of approach that have been used in various countries to mitigate geothermal resource risk are:

2.1 Government Acting as Total Project Developer

Government, acting as the total project developer from upstream to downstream (exploring, discovering, building and operating the project) and taking on the full resource and other project risks through state-owned enterprises (SOE) or other government-backed entities. Government could also mobilize cheap and concessional public funding to absorb geothermal resource risks and enhance the viability of projects in markets that may not been attractive for private sector with the commercial funding.

Government or SOE that develop full-scale geothermal development of both the upstream (resources) and the downstream (power plants) will absorb all the risks associated with geothermal projects, including the early stage exploration risks. Sometimes, an SOE will require a sovereign guarantee for the mobilized public finance and it also means that the government ultimately bears the risk of project failure. An exception would be when some grants are available for early stage of development from development partners outside the country, in which the resource risk would be borne by the grant provider. However, the size of the grants might not be adequate to finance the full exploration drilling program.

2.2 Cost-shared Drilling

Cost-shared drilling has successfully reduced resource risk in several countries and has helped in mobilizing financing for geothermal exploration/resource confirmation. Cost-shared drilling between public and private entities is mainly applied with the resource risk shifted to the public sector. Cost-shared drilling typically is applied by sharing the cost of exploration drilling between public and private sectors or the government led exploration drilling to facilitate private project development at later stages.

For the cost-shared of exploration drilling between the public and private sectors, the high-risk capital for early stage of exploration drilling will be provided by the government. This support will be expected to leverage the private finance to cover the remaining exploration fund. It will also reduce the exposure of geothermal developers to the project failure due to resource risk. A common scheme in this scenario is that the government provides a grant to cover some parts of the exploration drilling budget. The grant for exploration drilling aims to sufficiently incentivize the private developers to mobilize private financing to undertake the geothermal development. A concessional loan may also be available from public funding sources through the government to lower the financing cost for geothermal exploration drilling. Recently, a typical geothermal risk mitigation facility with a contingent grant has been developed in some countries and regions. The contingent grant is provided to cover some portion of exploratory drilling and will be forgiven in case for unsuccessful exploration which will not lead to any development in the foreseeable future. For successful exploration projects which will continue to the development, the developer will have to repay the grant with some premium to allow the sustainability of the facility.

For the government-led exploration drilling, the government agencies or SOEs take responsibility to obtain surface data from 3G surveys and subsurface data from exploration drilling to confirm the geothermal resource and reduce the investor risk. It will then facilitate the entrance of private sector to develop the remainder of the project (i.e., through the development of the rest of the steam field, as well as power plant construction and operation). This method was very successfully applied in the Philippines. For a geothermal project with a confirmed resource, the government will offer the development license to the developers. A project with confirmed resource will increase its commercial viability and thus will also attract private developers to bid for the license. In some cases, the developer which obtains the license shall repay part or all of the cost incurred by the government for exploration drilling. The government will then use the recovered cost to fund another exploration project. In this scheme, all the risks during the exploration drilling stage will be borne and absorbed by the government.

2.3 Insurance for Geothermal Resource Risk

There are examples of geothermal drilling risk insurance, which will cover the developers from any drilling problems such as failure of well components, mud losses while drilling, stuck pipe, etc. Geothermal resource risk insurance is designed differently with drilling insurance to insure the productivity of a well and has been less commonly available though it has proven popular in Germany for example. Megawatt capacity or a combination of flow rate and enthalpy can be defined as the parameters of well productivity. Based on the agreed success criteria by the developer and the insurance company, the premium then will be set up by the insurer based on the likelihood of payouts. The developer will pay a premium up-front prior to the exploration drilling.

Upon the completion of exploration drilling followed by various well tests, the actual productivity of well can be compared with the previous agreed success criteria. If the result is lower than the agreed parameter, it will trigger a payment from the insurance company to cover the losses by the developer. However, the application of geothermal resource risk insurance is still limited to date. There are two reasons that made the resource insurance is not popular scheme: (i) geothermal is a small sector compared to oil & gas and insurance company needs a large scale of portfolio to share the risk and made the coverage to be efficient, and (ii) due to the high uncertainty and risk during the exploration phase, the insurance usually offers the resource risk insurance with a high premium which may not be affordable to some developers.

2.4 Incentives for Early-stage Development

The government may provide fiscal incentives for the developers during the exploration stage to reduce the financial exposure by the developers. It can be provided in a form of tax credits, exemption of duties, etc. For the case of Indonesia, the government provides exploration incentives on the exemption of duty on imported material/equipment, tax allowance for the income tax, loss carry forward

for tax deduction, and exemption on sales tax. Though fiscal incentives are not a purely resource risk mitigation scheme, they reduce the amount of risk capital during the exploration stage. These incentives will also reduce the exposure by the developers on the potential losses from unsuccessful exploration. Instead of being considered as risk mitigation facility, fiscal incentives are more appropriate as supporting financial facility on the geothermal exploration. Usually, the amount of fiscal incentives is minor compared to the overall exploration budget. The developers will still hold the major risk on geothermal resource and project failure. The government has only the risk of losing small tax revenue in the exploration stage but can hope for receiving more tax revenue from profitable geothermal projects at later stage. Non-fiscal incentives such as the Feed in Tariff, obligation for utility companies to purchase renewable power, and Renewable Portfolio Standards have also made significant contribution to the accelerated development of geothermal projects in some countries.

3. COUNTRY SPECIFIC GEOTHERMAL EXPLORATION RISK SHARING MITIGATION

By July 2019, the worldwide installed capacity of geothermal power generation has reached 14,900 MW[1]. The world's leading geothermal countries, in terms of installed capacity, are the USA (3,653 MW), Indonesia (1,948 MW), the Philippines (1,868 MW), Turkey (1,347 MW), and New Zealand (1,005 MW). The risk mitigation policies and strategies for the top 5 geothermal countries are presented below. As the geothermal development pioneers, Iceland (755 MW) and Japan (549 MW) are also discussed and adding Kenya (763 MW) as an emerging geothermal producer in Africa. The risk mitigation strategies from different countries (Qadir 2019) will be useful for the comparison and background for the specific discussion on Indonesia's strategy at the next section.

3.1 The United States of America

The first commercial geothermal power plant was commissioned in 1960 at The Geysers, which continues to operate successfully until today and has grown into the largest geothermal development in the world with current capacity of 750 MW, down from a peak of over 2000 MW. The country continues to be the world leader in geothermal production with total installed capacity of 3,639 MW as of 2018.

The peak of geothermal development growth with additional capacity more than 2,000 MW took place during 1980s – 1995. In this period, the government (federal and many states) have established various supports to reduce the financial risk of exploration and lower the exploration drilling cost for both power generation and direct use. These supports have been provided in the form of grants, loans, guaranteed loans, or industry cost sharing, and tax incentives (Bloomquist, 2005). Table 1 below summarizes the incentives for geothermal development in the USA.

[1] http://www.thinkgeoenergy.com/global-geothermal-capacity-reaches-14900-mw-new-top10-ranking/

Table 1: The USA Government Supports for Geothermal Development (Source: Bloomquist (2005), Robertson-Tait (2008))

Incentives	Features
A. Loan Programs	
The Geothermal Loan Guarantee Program (GLGP)	Effective in 1975 and became the most successful program. Loan guarantees could be granted for up to 75% of the project costs with the Federal government guaranteeing up to 100% of the amount borrowed. Amended in 1980 to increase the loan size up to 90%. Loans were limited to $100 million per project.
The User Coupled Confirmation Drilling Program	Initiated in 1980 as cost-share expenses for exploration drilling and reservoir engineering. The facility was structured to serve as a loan guarantee. The developers would use its own equity or commercial financing. On a completely unsuccessful project, the government's cost-share was 90%.
Feasibility Study Loans	Loans would be available for up to 90% of the cost for feasibility study and preparing necessary licenses application.
Industry-Coupled Case Studies Program	This cost-share mechanism covered 20% to 50% of the exploration and reservoir confirmation costs. In exchange, developers had to provide drilling and well data.
The Loans for Geothermal Reservoir Confirmation Program	Loans were provided for surface exploration and the drilling of one or more exploratory wells. It was designed to replace the User Coupled Loan Program
B. Financial Assistance Programs	
Technical Assistance Grant Program	To provide assistance to potential developers of geothermal energy who had little or no expertise in the geothermal field to promote the rapid geothermal development.
The Program Research and Development Announcement	Initiated to provide funds for much more detailed feasibility studies such as detailed engineering and economic feasibility studies.
California State	Funding has come from geothermal royalties on state lands and the states' share of Federal royalties. Supports included, for example, resource assessment, drilling, technical assistance, regulatory compliance, technology development and demonstration and enhanced injection.
C. Taxation	
Investment Tax Credit	A Federal tax credit of 10% of new capital investment in renewable power generation.
Production Tax Credit	It provides a tax credit of $0.019 (recently increased from $0.018) per kW-hour of energy generated from renewable sources.
D. Utility Policy	
Public Utilities Regulatory Policy Act (PURPA)	Obligation by utilities to purchase the power output from geothermal power plants at its avoided cost.
Renewable Portfolio Standards (RPS)	Ensuring the electricity suppliers to have a minimum amount of supply from renewable energy including geothermal.
Renewable Energy Certificates or Credits (REC)	These credits accrue to the generator or the utility, and can be traded. Utilities will offer higher prices for RE power if they retain the RECs (rather than the developer).

While PURPA and tax credit approaches have been in use since the 1980s, the RPS, REC and carbon credit mechanisms are relatively new, and probably represent the future of legislative approaches to geothermal risk reduction, though not favored by the current administration.

3.2 The Philippines

The geothermal exploration was commenced in 1960s by the Commission of Volcanology by conducting an inventory of hot springs areas in the country. A significant progress on geothermal exploration happened in 1970s when the Philippines National Oil Company (PNOC) established Energy Development Corporation (EDC) a subsidiary dedicated for geothermal development. A private developer, Unocal Philippines (later became Philippine Geothermal Production Company, Inc and then acquired by Chevron Geothermal Philippines Holding, Inc), also played a major role in the upstream geothermal business. For all geothermal projects at that time, the National Power Corporation (NPC) was initially the only entity to have the right of developing power stations. Later this was relaxed, with the intention of attracting private capital. The combination of public and private participation resulted in significant geothermal development in the Philippines during 1970s until early 1980s.

After a decade without any new development, the geothermal sector was scaling up again after the establishment of the Department of Energy (DOE) in 1992. The government offered power generation contracts to private developers with BOT scheme where the steam would be supplied by EDC and the electricity would be sold to NPC. A major development took place since then on the arrangement that EDC supplying the steam to NPC and private developers which developing and operating the geothermal power stations (ESMAP/World Bank, 2016).

The privatization policy on energy sector was introduced early 2000s. On the geothermal sector, PNOC-EDC was privatized in 2006 and followed by selling some of NPC's geothermal power stations to Aboitiz Power Renewables, Inc (APRI). After privatized, EDC also took over some of NPC's geothermal plants (Ogena, 2011). This policy resulting domination of private sector in the geothermal

industry with minimum government involvement. Later in 2017, Chevron's geothermal assets were sold to the consortium of Ayala Corp and Star Energy Geothermal Holding[2].

The Renewable Energy Act was issued in 2008 to provide additional fiscal and non-fiscal incentives to further develop all renewable energy sources of energy, including geothermal. While the government still owns the geothermal resource and has full control and supervision over the exploration, development and utilization of the geothermal resource, an eligible developer may obtain Geothermal Service Contract / Operating Contract from the DOE. The Act incorporates a number of non-fiscal incentives such as the Feed in Tariff (but not including geothermal), Renewable Portfolio Standard, net metering, green energy option, and priority dispatch. On the fiscal incentives, the government provides Income Holiday Tax, Duty Free Importation, Special Realty Tax, Net Operating Loss Carry Over, Corporate Tax Rate, Zero Percent Value Added Tax Rate, Accelerated Depreciation, Cash Incentives for Missionary Electrification, Tax Exemption on Carbon Credit, and Tax Credit on Domestic Capital Equipment and Services. The government also provides preferential financing packages for geothermal development through the Development Bank of the Philippines, Land Bank of the Philippines, and Philippines Exim Bank, as duly recommended and endorsed by the DOE (Penarroyo, 2010).

In many ways, the geothermal development experience from the Philippines brings a good example of a balance between private and public partnerships and appropriate allocation of risk that influenced the major scale-up geothermal development.

3.3 Turkey

The geothermal exploration was started in early 1960s by the government focusing on high enthalpy projects for power generation. A number of medium – high enthalpy prospects were discovered in 1970s – 1980s. Later, the central government was gradually withdrawing from power generation business and let the private sector to take more roles on this sector (Serpen et al., 2010). The early work on the exploration drilling was carried out by the General Directorate of Mineral Research and Exploration (MTA). In 1998, the Turkish Petroleum International Company (TPIC) was established by Turkey's national oil company with additional mandate to conduct geothermal drilling (Kaya, 2012). Exploration and drilling surveys rapidly increased since 2005 supported by continuous budget increased. Three new drilling rigs were purchased to accelerate geothermal exploration drilling (Dagistan, et al., 2015). Nevertheless, the geothermal development was still growing in slow pace. Until 2010, only less than 100 MW of geothermal power stations were installed.

The significant progress on geothermal development happened after the issuance of Renewable Energy Resources in 2005 which introduced a Feed in Tariff for geothermal at US$ 10.5 cents/kWh. A privatization policy later was implemented under the Geothermal Law issued in 2007, allowing the private sector to play a major role in the sector. All the geothermal prospects which have completed the exploration surveys and drilling in various degrees shall be tendered out by MTA to private developers. The initial role of MTA during early stage exploration has mitigated some resource risk of the geothermal projects. As of 2018, installed geothermal power capacity in Turkey has reached 1347 MW and made Turkey as the 4th largest geothermal producer in the world.

The European Bank for Reconstruction and Development (EBRD) and the Clean Technology Fund (CTF) developed the PLUTO program in 2015 to support exploratory drilling investments in Turkey (US$ 100 million from the EBRD and US$25 million from the CTF). The main objective is to help mitigate the early risks of geothermal projects and to provide comfort to lenders interested in providing finance at early and later stages of geothermal project development, with expectation of result at least 60 MW geothermal power projects to be developed. **Phase 1** will finance exploratory drilling, utilizing the CTF funds, and will be provided for the exploration stage. Soft loans of up to US$5 million for each project are offered with a 3-year grace period and a 7-year repayment period. PLUTO will provide up to US$2 million per well, with the developer required to provide at least 50 percent equity. If initial drilling is successful, EBRD will be available to finance the final stages of the drilling and the construction of the power plant as the second phase. **Phase 2** will provide loans to private-sector investors as a bridging fund at the early stage of development of geothermal power plants.

With the on-going Turkey Geothermal Development Project, the World Bank is currently supporting Turkey's geothermal sector in providing a risk sharing mechanism for resource validation in the early stage of exploration and confirmation drilling. The project also provides financing for the production drilling stage, steam gathering facilities, and power plant construction stage[3].

3.4 New Zealand

Three government entities worked together in commencing the geothermal exploration and development after the World War II. The Department of Scientific and Industrial Research (DSIR) conducted the exploration, the Ministry of Works performed the design and construction of field facilities, and the Electricity Department developed the stations and facilities for the transmission and distribution of electricity. This effort was successfully resulting in commissioning of Wairakei power plants in 1958 as one of the first geothermal power plant in the world. The development of geothermal resources by the government entities continued until 1990s. In 1987, the Electricity Department had been reorganized as the state-owned Electricity Corporation of New Zealand (ECNZ). Another state-owned entity, Contact Energy Ltd, was established in 1996 for the development of geothermal and given Wairakei and Ohaaki projects. The Electricity Industry Reform Act of 1998 had caused privatization of Contact Energy and splitting of ECNZ into 3 state-owned entities (GeothermEx, 2010).

The government continues its support for geothermal exploration and development through GNS Science (formerly DSIR) and Mighty River Power (one of the ECNZ's successors). Major geothermal development happened because of the government involvement, through its entities, in conducting reconnaissance and exploration drilling. The resource risk associated with exploration drilling was borne by the government. Some of those entities are still undertaking geothermal exploration projects today. The resource

[2] http://www.thinkgeoenergy.com/sale-of-chevrons-geothermal-assets-in-the-philippines-concluded/
[3] http://projects.worldbank.org/P151739?lang=en

risk for current existing geothermal projects was covered by the government through surface exploration, drilling of exploratory wells, and resource assessment made by DSIR and Ministry of Works in the decades of the 1950s through early 1980s.

3.5 Other Countries

Iceland. Commencing in 1940s, the government has encouraged geothermal exploration and research for the geothermal utilization. The work started by the State Electricity Authority, which later continued by the National Energy Authority (Orkustofnun) which was established in 1967. The work has been able to acquire geothermal resource knowledge and led to the utilization for geothermal power and space heating. While the National Energy Authority is still responsible for state sponsored exploration, a new state institute namely Iceland GeoSurvey is now becoming a key player to conduct survey for private energy developers (Orkustofnun, 2010).

The Icelandic government has also set up a Geothermal Fund in 1961 to encourage geothermal development. The fund provides grants to the State Electricity Authority to conduct reconnaissance and exploration drilling. It also provided loans to communities and farmers for exploratory and appraisal drilling covering up to 60% of the drilling expenses (noting that there is a good deal of small-scale direct use). The loan would be converted to a grant for unsuccessful drilling. The fund was merged with the Electricity Fund and named the Energy Fund in 1967. Over 350 loans have been issued since its early establishment in 1940s that led to the use of geothermal across Iceland (Ketilsson et. al, 2015).

Japan. The country is considered one of the pioneers in geothermal development when the first shallow well was drilled in 1919 and followed by the geothermal power production of 1.12kW in Beppu, Kyushu Island in 1925 (Nakashima et al., 2015). significant geothermal development happened during 1970s until 1999 resulting in more than 500 MW geothermal power generation capacity. Government provided support with cost-shared drilling scheme and it was successfully stimulated geothermal projects during that period. NEDO, a government enterprise, also provided support on the nation-wide survey and technology development. The government suspended budget support for geothermal technology development in 2003 and other budget support for geothermal was rapidly declined. Consequently, there was no new development in Japan for about 20 years and the installed geothermal power capacity remained at 536 MW against total potential resource of 23.47 GW.

The Fukushima earthquake and subsequent closure of nuclear power plants in Japan have renewed government policy on the geothermal energy. This renewable energy has been expected to replace the nuclear power as a base load energy. The government introduced the Feed-In Tariff for several renewable energy including geothermal depending on the size of the project. FIT of 27.3JPY/kWh (USD 0.25) during first 15 years is given to geothermal projects with capacity higher than 15,000kW with large conventional flash power plant. A higher FIT rate at JPY42/kWh during first 15 years is given to projects with capacity below 15,000kW with small binary power plant (Yanagisawa, 2013).

Considering the high-risk profile of early geothermal development, in 2012 the Government assigned JOGMEC (Japan Oil, Gas and Metals National Corporation), a government enterprise, to take additional function to support geothermal resource development. JOGMEC support on resource development includes a) Promotion and support for geological surveys (providing subsidies for geothermal resource development surveys by Japanese companies), b) Provision of financial assistance to Japanese companies (providing equity capital and liability guarantees for exploration and development of geothermal resource by Japanese companies), c) Collecting and providing information (collecting and providing information related to geothermal resources), and d) Technological developments (developing of technologies related to the exploration, drilling, evaluation and management of geothermal reservoirs). Table 2 below provides detail of government financial support for geothermal development.

Table 2: JOGMEC's Financial Support for Development (Source: Nakashima et al (2015))

Stage	Support	
	National Company	Local Company
Surface Survey	Subsidy up to 75% of the survey cost.	Subsidy up to 100% of the survey cost.
Investigation Wells (Early Exploration Drilling)	Subsidy up to 50% of the survey cost.	Subsidy up to 100% of the survey cost.
Additional Exploration Drilling	Investment up to 50% of the equity capital of the company	
Development (Production Drilling & Power Plant)	Provision of liability guarantee up to 80% of the development expenses.	

As of March 2018, JOGMEC has provided subsidy program to a of total 27 projects and has been helping new geothermal energy development at Japan.

Kenya. The geothermal development commenced since 1950s and reached installed capacity of power generation at 676 MW as of 2018, against total potential of about 10 GW. During 2010 – 2018, a growth of over 300% has increased by 500 MW geothermal plant capacity. Additional 560 MW is expected from Olkaria project through PPP arrangement between Kenya Electricity Generating Company (KenGen) and private sector. KenGen and the Geothermal Development Company (GDC) are the government enterprises which have been playing major roles in the geothermal development (Omenda & Mangi, 2016). GDC was established as a government's Special Purpose Vehicle to undertake surface studies, exploration, appraisal and production drilling, develop and manage proven geothermal fields, and enter into steam sales or joint development business with IPP developers. KenGen, which was established earlier to develop power generation facilities, also plays a major role in the geothermal sector in Kenya. In the latest development, both entities offer the IPP developers to construct the power plants on Built-Operate-Transfer (BOT) or Built-Operate-Own-Transfer (BOOT) scheme (Omenda, 2012).

The government is responsible to conduct surface studies and exploration drilling before offering the geothermal prospects to IPP developers. The exploration program includes drilling of at least 3 deep wells. The government also takes responsibility of resource assessment by drilling additional 6-9 wells to reach 30-50% of required steam capacity (Mariita, 2007). KenGen and GDC are the government entities which are assigned to conduct those activities.

The government of Kenya provides significant financial support for the geothermal development, particularly during early stage of development and exploration. The financial support from state budget is transferred to KenGen and GDC to conduct geothermal drilling and purchase of equipment, including drilling rigs. The government also facilitates geothermal development with tax exemptions on equipment / machinery, grants, concessional climate funds, and soft loans from multilateral and bilateral development banks. A Feed in Tariff policy was also introduced by the government in 2008 and was revised in 2012 to include a fixed tariff for geothermal (Shammah et al., 2017).

4. INDONESIA GEOTHERMAL EXPLORATION RISK SHARING MITIGATION

Indonesia is currently in the second position on the top geothermal producing countries, with capacity of 1948 MW, after USA. By the end of 2019, it is expected that the generation capacity will reach more than 2,000 MW with additional capacity from Lumut Balai 55 MW, Muara Laboh 80 MW, and Sorik Marapi 40 MW. During the last 10 years, 760 MW capacity has been added with 430 MW by public sector development and 330 MW by private sector development. Figure 2 below shows the generation capacity development in Indonesia from 1980 until now.

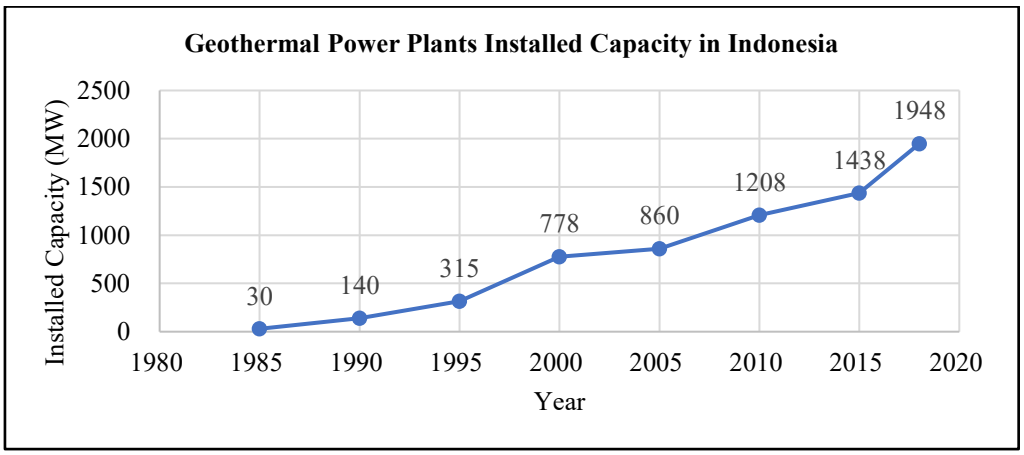

Figure 2: Installed Geothermal Generation Capacity in Indonesia by Years

4.1 Early Scheme

Early geothermal development in Indonesia was commenced in 1919 by Volcanological Society of Netherland East Indies with 5 shallow wells were drilled during 1926 – 1928 at Kamojang. There was no more study until 1971 when the Volcanological Society of Indonesia, national oil company Pertamina, and Geothermal Energy of New Zealand Ltd continued studying the Kamojang Project. Some additional wells were drilled and resulted in operation of the first geothermal power plant with capacity 250 kW in 1978 (Swandaru, 2015).

Indonesia saw successive geothermal exploration drilling done through Government entities in 1970s-1980s, mostly an assignment to Pertamina. Pertamina at the time was both a Government entity and a corporation. Several multinational companies were interested to develop geothermal powerplant in 1980s namely Amoseas Indonesia Inc and Unocal Geothermal Indonesia (later acquired by Chevron Indonesia). However following Indonesia reformation in 1998, several new Laws were enacted: Oil & Gas Law (2001) and State-Owned Enterprise Law (2003). These laws effectively limit Pertamina's role only as a corporation, mainly focus in oil & gas sector, and ceased to conduct Government-supported exploration activity. Government then took over the geothermal sector authority from Pertamina, and leaving 14 prospective geothermal projects to Pertamina, when the first Geothermal Law (2003) was enacted.

Under first Geothermal Law 2003 regime, the geothermal exploration responsibility was covered by the government and the developers. Government might carry out surface studies (geology, geophysics, geochemistry) and tendered out the concession to both public and private developers. The concession holder as an Independent Power Producer (IPP) and the National Electricity Company (PLN, a state-owned enterprise, as the sole electricity off-taker) will then enter Power Purchase Agreement (PPA) in which offtake tariff commitment is secured. The risk of exploration drilling, thus commercial risk, was then borne by the winning of the concession tender, creating hindrance in geothermal development by private. Still government had no intention to sponsor exploration drilling, mainly because it adopted deficit-based annual budgeting which is not a nature of exploration drilling.

A Geothermal Fund Facility (GFF) was established by the Government in 2011 to provide loan to local government and geothermal developers in carrying out exploration program. While the facility could be an incentive for exploration financing which is not available in commercial financing, the facility was not equipped with the risk mitigation facility which is highly needed during exploration stage. The GFF was managed by Government Investment Centre, an entity under Ministry of Finance (MoF). Since it was managed by government entity, provision of risk mitigation facility could mean a "state's financial lost". The terms of the facility were also considered not attractive by the developers.

4.2 Present Scheme

The revised Geothermal Law was issued in 2014 to improve the sector and accelerate more geothermal development. Under this regime, the government and both public/private developers play different roles in geothermal exploration stage. There are 4 pathways in conducting exploration as below:

a) The government conduct surface studies and continue with government exploration drilling. Later, a concession tender will be carried out based on surface and subsurface information (pathway 1).
b) The government assigns public developers (Pertamina Geothermal Energy, Geo Dipa Energi, and PLN) to undertake geothermal exploration and exploitation (pathway 2).
c) The government conducts surface studies through Geological Agency and tendered out the concession. The winning developer will be granted geothermal license and conduct exploration drilling at its own risk (pathways 3 and 4).
d) The government appoints private developers to conduct preliminary survey and exploration drilling. The developer will have a privilege to win the concession tender at later stage (pathway 5).

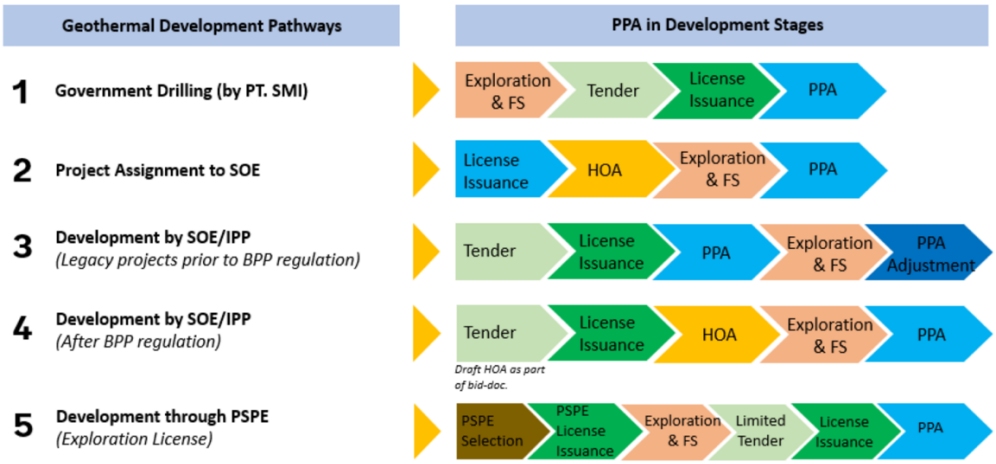

Figure 3: Geothermal Development Pathways under Geothermal Law 2014

As the GFF was deemed ineffective, MoF transferred the fund to PT. Sarana Multi Infrastruktur (PT SMI, a non-bank financial institution and a Special Mission Vehicle of MoF) in 2015. This fund is regulated under MoF Regulation No. 62 Year 2017. The Infrastructure Financing for Geothermal Sector (IFGS), a new label of GFF under PT. SMI, is aiming to provide funding for 1) provision of geothermal data and information through government exploration drilling or public developers exploration drilling; 2) loan facility for public and private developers for the downstream development (steam facility and power plant) and 3) equity participation by PT. SMI into a geothermal developer. The risk mitigation facility for geothermal exploration is included in the provision of geothermal data and information. Under this category, the fund can be used for the financing of government sponsored drilling prior to concession tender. Ministry of Energy and Mineral Resources (MEMR) will send a request to MoF for the financing of government drilling program for specific projects. A Joint Committee between MEMR and MoF was established to take strategic decisions and supervise the implementation of government drilling program. PT. SMI is assigned to carry out exploration drilling activity. Upon successful drilling and confirmed resources, PT. SMI will provide the data to MEMR for the concession tender. The winning bidder shall pay the geothermal data and information to PT. SMI. MoF will cover the risk of unsuccessful drilling and pay the drilling expenses to PT. SMI. Public developers can also access the fund for their exploration program. Any unsuccessful exploration by public developers, MoF will provide forgiveness up to 50% of the exploration loan. A full loan should be repaid back by the public developer to PT. SMI for successful exploration drilling. However, private developers do not have access to this exploration financing facility managed by PT. SMI. The facility can only provide loans to private sector for the development of geothermal power plants.

Under the on-going Geothermal Energy Upstream Development Project (GEUDP), the World Bank is supporting PT. SMI for the government drilling at 4-5 geothermal sites and leveraging the facility with additional Climate Funds (Clean Technology Fund, CTF and Global Environment Facility, GEF). A total of US$ 104.25 million has been committed for this project, comprising of US$ 6.25 million from GEF for project preparation facility (additional surface surveys, environmental & social documentation, drilling plan) and US$ 98 million from CTF and PT. SMI's IFGS for drilling related activities (infrastructure development, slim hole and standard hole drilling, well testing). Two geothermal projects have been officially assigned for the GEUDP: Waesano (Flores Island) and Jailolo (Halmahera Island). It is expected that the first drilling at Waesano will take place at 2020.

The government also share the resource risk on geothermal development with public developers through project assignment (pathway 2). PLN has recently received 8 geothermal projects assignment: Tangkuban Perahu, Songa Wayaua, Atadei, Ungaran, Kepahiang, Gunung Sirung, Oka Ile Ange, and Danau Ranau. These projects are additional to several geothermal projects under PLN's existing portfolio: Ulumbu, Mataloko, and Tulehu. Geo Dipa Energi has received 2 projects assignment: Umbul Telomoyo and Arjuno Welirang as additional project to its portfolio: Dieng and Patuha. Pertamina Geothermal Energy also received a project assignment: Kotamobagu. These public developers will take resource risk during exploration stage and could continue for next stage development after successful exploration. PT. SMI's IFGS, with loan forgiveness from MoF for unsuccessful exploration, is accessible by public developers.

The private sector takes fully resource risk on some geothermal projects through pathways 3, 4, and 5. The government conducts surface studies through Geological Agency and tendered out the concession. The winning developer will be granted geothermal license and conduct exploration drilling at its own risk. Currently there are active 12 geothermal licenses in which the private developers are fully taking the resource risk. Pathway 5 shows that the government appoints private developers to conduct preliminary survey and exploration drilling. The developer will have a privilege to win the concession tender at later stage. There are 8 PSPE licenses at this moment.

Table 3: Geothermal Projects Based on the Resource Risk Mitigation Approaches

Resource Risk Mitigation Approaches	Projects
Government exploration drilling (Pathway 1)	Waesano, Jailolo
Projects assignment to public developers / SOE (Pathway 2)	Tangkuban Perahu, Songa Wayaua, Atadei, Ungaran, Kepahiang, Gunung Sirung, Oka Ile Ange, Danau Ranau, Umbul Telomoyo, Arjuno Welirang, Kotamobagu
Private developers take resource risk after concession tender and obtaining geothermal license (Pathway 3 and 4)	Jaboi, Sorik Marapi, Muara Laboh, Rantau Dedap, Rajabasa, Baturaden, Ijen, Ngebel, Sokoria, Rawa Dano Banten, Way Ratai, Gunung Talang – Bukit Kili.
Private developers take resource risk through PSPE license (Pathway 5)	Graho Nyabu, Bonjol, Klabat Wineru, Hu'u Daha, Tanjung Sakti, Gunung Hamiding, Suoh Sekincau, Gunung Geureudong

MEMR issued a Regulation No. 50/2017 to cap the renewable electricity tariffs at the average regional electricity generation cost (Biaya Pokok Penyediaan, or BPP) for the local grid. The policy was designed to reduce the overall electricity subsidies and keep the end-user tariffs affordable to consumers. Thee BPP rule presents attractive tariffs in the diesel-based systems of the small and medium size islands in eastern Indonesia; however, it may be challenging for geothermal to compete in the coal-dominated main power markets of Java-Bali and Sumatra where the average generation cost is much lower. There are a number of legacy projects where developers – both SOEs and independent power producers (IPPs) – have grandfathered PPAs that would not be affected by the BPP cap (pathway 3). For the new geothermal projects with the licenses issued after the Regulation No 50/2017, the development stages shall follow pathway 4. Not only fully taking the resource risk, the private sector has additional commercial risk since the PPA will be signed with PLN as the only off taker after the resource has been proven through exploration drilling.

4.3 Future Scheme

The IFGS Fund managed by PT. SMI could provide exploration financing to public developers, but this facility is not available for private developers. Geothermal development plays an important role for the achievement 23% target of renewable energy by 2025. Currently there are 31 projects, including 20 private sector projects with geothermal license and PSPE license, and estimated cumulative capacity of more than 1000 MW, for which exploration drilling will be conducted in the next 3 years. Aligning with MEMR's objectives in the development of renewable energy, an exploration financing facility with a feature of resource risk sharing for private developers to accelerate the exploration stage is being prepared by MEMR, MoF, and PT. SMI with support from the World Bank. PT. SMI plays an intermediary financing role for the World Bank loan and Climate Funds to public and private developers.

The risk sharing facility will be provided through Geothermal Resource Risk Mitigation (GREM) Project. The facility will be accessible to eligible public and private developers. The risk sharing facility for public developers will align with the role of PT. SMI to provide financing for SOE exploration drilling. The exploration loan to public developers will comprise of a mix World Bank loan and IFGS loan, with loan forgiveness on unsuccessful drilling will come from MoF. The facility for private sector will be provided by PT. SMI in two forms: vanilla loan from the World Bank and Financial Instrument from the Climate Funds (Green Climate Fund, GCF and Clean Technology Fund, CTF). A maximum of US$ 40 million exploration budget for each project is provided with 25% of the budget should be covered by the equity of private developers. The risk mitigation facility for private developers will be provided from the Climate Funds. For a package of facility provided to private developer, the loan and Financial Instrument shall be in equal amount.

The amount of loan forgiveness to private developers will depend on the result of exploration: success, partial success, and unsuccessful exploration. For successful project, the Financial Instrument shall be repaid after 4 years with success premium of 30%. There will be no repayment of the Financial Instrument for unsuccessful exploration. For partial success, repayment of the Financial Instrument will be determined based on the Developer Fair Market Value (DFMV). A model to calculate the DFMV of the Project Company will be agreed upfront with developers. After exploration, actual parameters on steam yield will be updated to obtain DFMV.

The GREM Project is currently under preparation and expected to be effective by the end of 2019. Geothermal projects development by eligible public and private developers, with more than 1,000 MW capacity, are the potential beneficiaries of this facility to allow accelerated geothermal development in Indonesia.

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