ANALYSIS OF NEW INDONESIAN GEOTHERMAL TARIFF SYSTEM AND IMPACT OF FEASIBILITY OF GEOTHERMAL PLANTS IN EASTERN INDONESIA IN THE NEXT DECADE

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ABSTRACT

In early 2017 the Indonesian government introduced a new ceiling tariff for all renewable energy generation, including geothermal. Geothermal ceiling tariffs are now linked to the annual Average Generation Costs (BPP for its Indonesian abbreviation) for each electrical island/(sub)grid. This will result in very low ceiling tariffs in the main island grids (Java, Bali, and Sumatera) due to the dominance of cheap coal generation. The smaller grids of East Nusa Tenggara and Moluccas have much higher BPPs because these are dominated by diesel-generation (although diesel prices are relatively low at the moment). This study examines how the current tariff regime relates to potential geothermal project costs in East Nusa Tenggara and Moluccas regions. It also explores what might influence future BPPs to provide some insight for future economic feasibility of geothermal power plants in these regions.

As background, first the new geothermal tariff regulations are discussed, as well as Indonesia's Geothermal Roadmap 2017-2026 and the latest Electricity Power Supply Business Plan (RUPTL) by the State Electricity Company PLN. To estimate geothermal project costs, a Geothermal Production Cost Model (GPCM) is used that was originally developed under sponsorship of both the Government of Indonesia and New Zealand. Subsequently, some key parameters are varied in a sensitivity analysis to have a preliminary look at policy options which could support the feasibility of geothermal projects. Finally, the future BPPs are estimated for East Nusa Tenggara and Moluccas, by analysing the component cost of BPP and its relationship to future oil prices.

1. INTRODUCTION

The development of geothermal energy in Indonesia has had a long history. The first geothermal power plant in Indonesia was developed in 1983. To encourage the development of other geothermal fields, the Government of Indonesia allowed private companies to participate by issuing Presidential Decree No. 45 of 1991 and during the 1990s PLN offered high geothermal tariffs (around 7-10 US cent/kWh at that time). Unfortunately, the Asian Financial Crisis of 1997 caused the Indonesian Rupiah to fall dramatically with respect to the US Dollar and compromised PLN's financial position. The Government of Indonesia was subsequently forced to decrease the geothermal tariff to less than 5 US cent/kWh. Consequently, most geothermal projects became unfeasible and many private geothermal companies withdrew from Indonesia. Since then, several attempts have been made by the Indonesian Government to find an optimal geothermal tariff system in Indonesia.

Several regulations regarding geothermal tariffs were issued over time, including the latest MEMR Regulation No. 12/2017 issued in early 2017.[1] According to this new regulation, the geothermal (or any other renewable energy) tariff negotiated in a Power Purchasing Agreement (PPA) between developer and PLN must not exceed the existing Average Generation Cost (in Indonesian : Biaya Pokok Penyediaan or BPP) on the relevant local grid. If the average generation cost of the local grid is lower than the average national generation cost, the tariff can be negotiated between the geothermal developer and PLN.

This policy was designed to reduce the overall electricity subsidies but keep the electricity end-user costs in Indonesia affordable to consumers. The resulting lower maximum geothermal tariffs, make geothermal development become less attractive in several (most) regions with low BPPs, especially the main islands (Java, Bali, Sumatra) where generation is dominated by cheap coal. Even so, the Government of Indonesia is still keen to promote geothermal and other renewable energy, particularly in Eastern Indonesia, where BPPs are significantly higher due to smaller grids and domination of diesel generation. The Government of Indonesia has issued the Electricity Power Supply Business Plan (or RUPTL in Indonesian) and the Indonesian Geothermal Roadmap for the next decade, which aims at significant increases in geothermal generation: by 2026, the participation of renewable energy for electricity generation is targeted to be 23% of total generation.

2. BPP

The average cost of electricity generation (BPP), is calculated by summating the total generation, transmission, and distribution costs for PLN divided by the total sales of electricity produced – for each island/(sub)grid. Annually the Ministry of Energy and Mineral Resources (MEMR) sets the ceiling geothermal tariff based on the BPP values of the preceding year by referring to PLN's proposal (RUPTL – see Table 1 below for the main island grids[2]).

The higher BPP values of Moluccas and East Nusa Tenggara make these Eastern Indonesian regions more attractive for geothermal development. However, Eastern Indonesia

[1] In August 2017 a new RE-regulation came out (MEMR-No.50/2017), but this only seems to adjust the solar and wind tariffs.

[2] Note that the islands often have many (sub)grids, which can have their own (lower) BPPs. Allocation of PLN costs to (sub)grids still seems to be developing over time.

consists of small islands and grids, which tends to make for more difficult and costly geothermal development there. Hence, our exploration of geothermal production costs and development of tariffs/BPPs could shed a useful light on the feasibility of selected projects in these locations.

Table 1: Geothermal Ceiling Tariffs for the main Islands; 2016 and 2017 based on the BPP values of preceding year.

Region	**BPP / Geothermal Ceiling Tariff** (US cent/kWh)	
	2015 / 2016	**2016 / 2017**
West Java	5.6	6.51
Jakarta	5.7	6.51
East Java	5.8	6.54
Central Java	5.9	6.52
Bali	6.3	6.62
South Sumatera, Jambi, Bengkulu	6.9	7.86
Lampung	6.9	7.77
West Sumatera	7.0	8.07
South and West Sulawesi	8.0	8.10
South and Central Borneo	8.8	9.04
Riau	9.0	10.14
East Borneo	10.0	10.20
Gorontalo, North and Central Sulawesi	11.7	12.75
North Sumatera	12.4	9.28
West Nusa Tenggara	13.5	13.68
Papua	13.7	13.54
Aceh	14.2	10.39
West Borneo	14.5	12.43
Bangka and Belitung	14.7	13.66 & 12.17
Moluccas	16.6	17.32
East Nusa Tenggara	16.9	17.52
National BPP	**7.5**	**7.39**

3. FEASIBILITY OF UPCOMING GEOTHERMAL PROJECTS IN EASTERN INDONESIA

As part of an attempt to formulate a suitable geothermal tariff system, the Indonesian Government requested a joint-study in 2016 to develop a Geothermal Production Cost Model (GPCM) in conjunction with the Government of New Zealand.

The GPCM is a financial model with detailed inputs for all relevant geothermal fields, and makes an accurate assessment of the estimated tariff needed to develop a certain geothermal project. The GPCM was reviewed and discussed by/with the developers, Indonesia's Ministry of finance, MEMR, and representatives of INAGA. All the stakeholders, especially the developers, came to a consensus that the baseline GPCM results in estimated tariffs that could produce a realistic return for the developer. This GPCM is used in this study to assess the upcoming geothermal projects in Eastern Indonesia.

3.1 Upcoming Geothermal Projects in Eastern Indonesia

The Moluccas and East Nusa Tenggara regions have significant geothermal potential distributed over the myriad of islands. RUPTL (2017-2026) and the Indonesian Geothermal Roadmap describe the development of 12 geothermal areas in Moluccas and East Nusa Tenggara. Seven of the most promising geothermal areas were selected to be assessed with GPCM in this study (see figure 1).

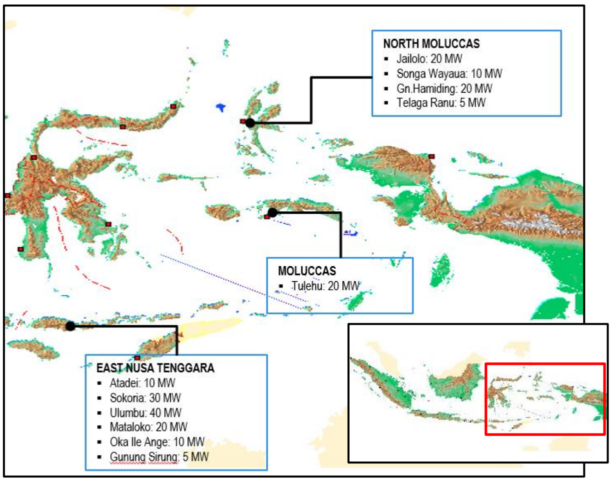

Figure 1: Upcoming Geothermal Projects in Eastern Indonesia.

3.2 Feasibility Study Results

Some input parameters were taken/updated from RUPTL, Indonesian Geothermal Roadmap, and Indonesian Profile Books which are issued by MEMR (see Annex 1). In table 2 below, the results of the GPCM are compared with the current (2016/17) geothermal ceiling tariff of each (sub)grid and island.

Table 2: Estimated tariff needed for each project Compared to BPP.

Name of Project	**Location (Island and subgrid)**	**Estimated Tariff needed (US cent/kWh)**	**BPP 2016 /2017**
EAST NUSA TENGGARA			**17.52**
Ulumbu 5	Manggarai (West Flores)	8.67	13.16
Ulumbu 6	Manggarai (West Flores)	9.20	13.16
Sokoria 1	Ende (East Flores)	45.26	15.55
Sokoria 2	Ende (East Flores)	18.03	15.55
Sokoria 3	Ende (East Flores)	16.50	15.55
Sokoria 4	Ende (East Flores)	16.64	15.55
Atadei	Lembata (Lembata)	10.80	17.52
Mataloko 2	Ngada (West Flores)	8.74	13.16

NORTH MOLUCCAS			**17.32**
Jailolo	West Halmahera (Halmahera)	22.90	12.67
Songa Wayaua	South Halmahera (Bacan)	19.94	13.61
MOLUCCAS			**17.32**
Tulehu	Ambon (Ambon)	14.67	12.62

According to these results, there are only four geothermal projects which would be economically feasible under the current tariff regulation/BPP-2016/17. These projects are Ulumbu 5, Ulumbu 6, Mataloko 2, and Atedai. These are all brownfield developments: either extensions of existing geothermal fields or re-development of geothermal projects. The fields already have exploratory wells and more confident geoscience data. Moreover, these projects are to be developed by PLN, an SOE with support from the national budget and some international development banks. The lower costs and discount rates result in these projects becoming more feasible. Meanwhile, the other projects, Sokoria 1, Sokoria 2, Sokoria 3, Sokoria 4, Jailolo, Songa Wayaua, and Tulehu, are either categorized as Greenfield and/or developed by private developers/Independent Power Producers (IPPs), with resulting higher costs and/or discount rates.

3.3 Sensitivity/Policy Analysis on Geothermal Costs

A sensitivity analysis was subsequently conducted to see how the costs could vary with regards to input parameters or policy options. Four main parameters/policies were studied:

- Government initiated exploration, e.g. under the new PT SMI initiative. This represents an effective lowering of initial capital investment in the exploration stage, which would only affect the geothermal tariff on greenfield projects, because it is assumed that brownfield projects have already conducted this exploration stage.

- SOE or IPP developer, which would mainly affect the rate of return (IRR/combined discount rate) required. SOEs are usually able to fund projects with lower finance costs, supported by Government and Development Bank/ODA funds. IPPs usually need more risk capital and commercial debt to develop a geothermal project, which leads to a higher expected discount rate and hence higher costs (higher tariff needed).

- Lowering geothermal drilling cost : currently, the geothermal drilling cost in Indonesia is more expensive than the international market price, partly because there are only few geothermal drilling companies in Indonesia reducing competition. Especially now that the oil market is in a slump, the opportunity exists to attract more drilling companies to Indonesia, and hence lower the capital required for geothermal drilling significantly.

- Introduce a carbon price: at present Indonesia has no carbon price, although in the past, geothermal (and other RE) projects have benefitted from selling carbon credits through the previous CDM mechanism. Based on a modest outlook on carbon prices[3], this study uses carbon prices from 6 to 9 USD/tCO_2e for the sensitivity analysis.

Preliminary results show that the most influential parameter is the type of developer. The tariffs can decrease significantly by more than 30% by choosing an SOE as the developer instead of an IPP. This is caused mainly by the different value of discount rates which SOE and IPP use. It is assumed that SOEs need discount rates/returns of 8% for brownfield and 11% for greenfield, while IPP needs 13.5% and 16.5% respectively. Using different assumptions, WestJEC (2016b) found a similar result that shows IRR values heavily impact the geothermal project cost. There are several options to reduce the IRR value, e.g.: the government and/or Development Banks could provide soft-loans to geothermal developers or stimulate public-private joint ventures. Another option could be that the government could conduct the exploration stage so the development risk is reduced and IRR can decrease.

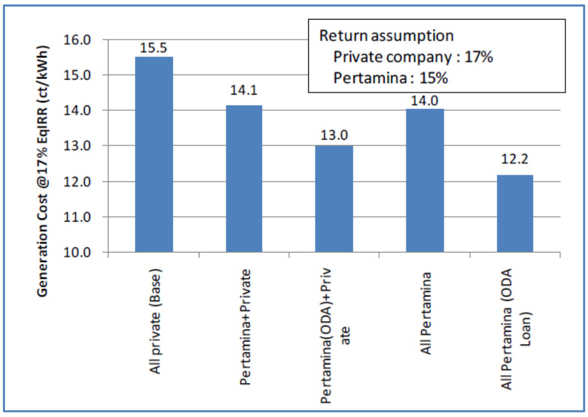

Figure 2: the effect of developer on generation cost (WestJEC, 2016b)

The changes in drilling costs result in variable impacts on the different fields, as the number of wells required for each field will be different according to the characteristics of the resource and the total installed capacity. The bigger capacity installed or the smaller well productivity will require more wells to be drilled, and hence, the impact on drilling costs will also increase.

4. PRELIMINARY ANALYSIS OF FUTURE BPP

Electricity generation in Eastern Indonesia is dominated by diesel power plants, leading to high regional BPP (see table 1) despite presently relatively low diesel prices. Figure 3 below shows how the NPPs for Moluccas and ENT (right-axis) correlate well with average Indonesia and World oil prices (left-axis) over the last 7 years.

[3] According to World Bank (2016), in April 2016, the average carbon price on New Zealand ETS was 8 USD/tCO2e, the EU ETS price was 6 USD/tCO2e, and the Japan carbon tax was only 3 USD/tCO2e.

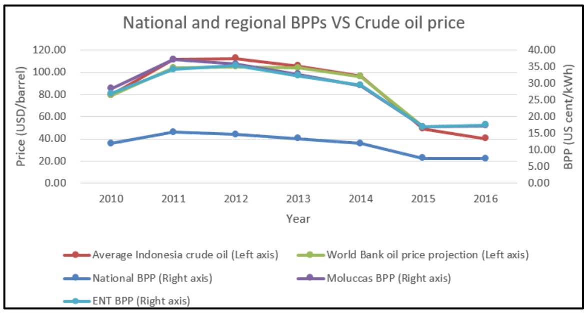

Figure 3: Comparison between national and regional BPP with crude oil prices.

Looking closer at what constitutes the BPP in Moluccas and ENT, figures 4 and 5 highlight PLN's fuel cost, purchase of electricity (a new phenomenon) and other/overhead costs (O&M, administration, financial and other costs). The fuel costs portion fluctuates and has decreased since 2014, largely due to lower diesel prices, while other/overhead costs are more stable. Changes in cost allocation are obscuring trend analysis to some extent, especially PLN's shift in 2017 to purchase electricity from local generators (MEMR, 2017a), instead of renting diesel-generators, buying the diesel fuel and operating these units themselves. It is likely much of the 'purchased electricity' costs is still made up of diesel fuel costs. The average portions of diesel costs over the last seven years in both regions is estimated *at least* 50% of the BPP.

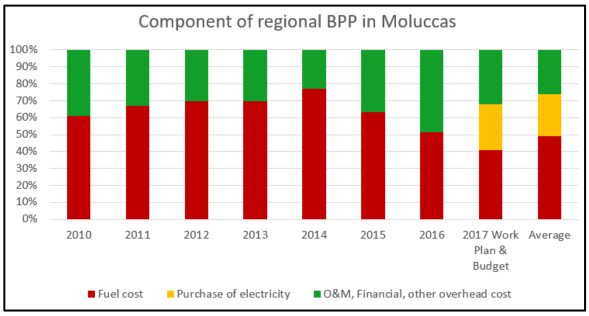

Figure 4: The portion of fuel cost from regional BPP in Moluccas.

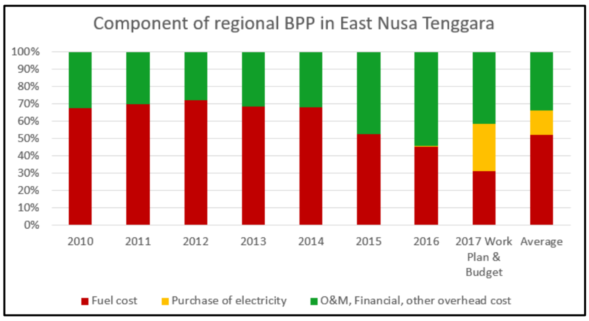

Figure 5: The portion of fuel cost from regional BPP in East Nusa Tenggara.

With the above background, we can make a first order approximation, assuming that the average weight of diesel costs in BPP will be 50% and other costs will be relatively constant for the next ten years. A first order approximation of future BPP can then be based on the existing BPP and the expected variation in oil price, weighted by 50%:

$$Future\ BPP = BPP\ 2016\ x\ (1 + \frac{future\ oil\ price - 2016\ oil\ price}{future\ oil\ price} x\ 50\%\ of\ estimated\ weight)$$

Figure 6 shows these first order estimates for the future BPPs of East Nusa Tenggara and Moluccas regions according to the projected oil price based on World Bank database (2017) and BPP profile cost.

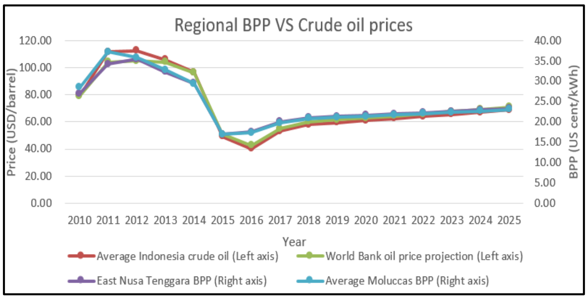

Figure 6: Projected BPPs based on world oil price.

According to World Bank database (2017b), the average oil prices are estimated to gently increase for the next decade and will reach 71 USD/barrel (real prices) in 2025. Hence, our BPP projections also gently increase to around 23 US cent/kWh in 2025. This level of BPP prices would still be relatively high and might be interesting for geothermal developers. Geothermal developers can estimate when they are going to start generating electricity and can ask for tariff renegotiation if there are any changes in the technical design related to the capacity resources.

4.1 Sensitivity Analysis on Future Oil Prices

As future oil price projections are subject to considerable uncertainty, a sensitivity analysis was conducted on the basis of four scenarios: the baseline World Bank global oil price scenario; 20% additional oil price reduction; 20% additional oil price increase; and (an extreme) 50% additional oil price increase. Figure 6 shows the resulting global oil prices for each year.

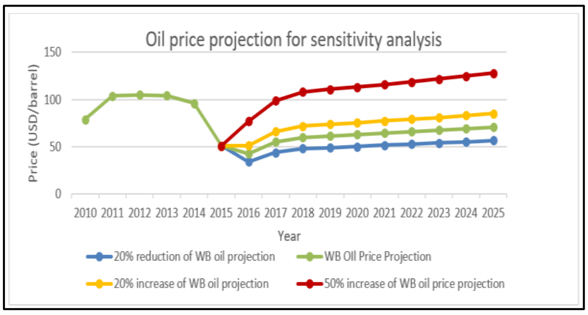

Figure 7: Future Oil price projection for sensitivity analysis.

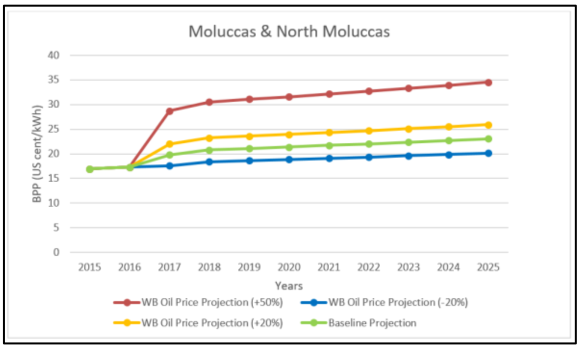

Figure 8: BPP projection for Moluccas and North Moluccas.

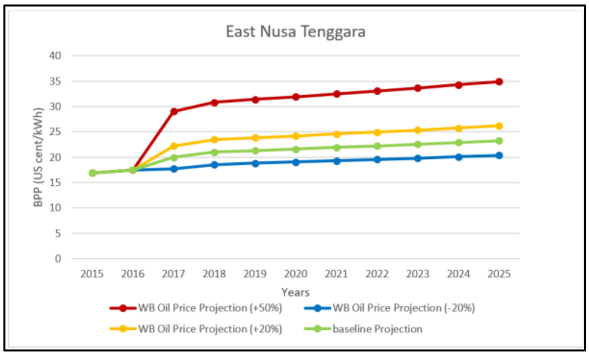

Figure 9: BPP projection for East Nusa Tenggara.

Figures 8 and 9 show that the future BPP values are likely to increase in all scenarios. Even in the lowest oil price scenario, 20% reduction of World Bank oil projection, our BPP projections still reach 20 US cents/kWh. Meanwhile, in the higher oil price scenario, the BPP projections can reach 25 US cents/kWh for the 20% Increase Scenario and 35 US cents/kWh for the 50% Increase Scenario, making most of the projects in Table 2 potentially economically viable.

6. CONCLUSIONS AND RECOMMENDATIONS

Indonesia has a vast potential for geothermal power generation, both on the main and the Eastern Islands. Since the 1990s the Government of Indonesia has been varying tariff regulations in search of an optimum between promoting geothermal (and other renewable) resources, and limiting the amount of subsidies to keep power prices affordable for end consumers and limit fiscal costs.

In early 2017, the Government of Indonesia introduced a new tariff system (MEMR regulation No.12/2017) that sets a ceiling tariff for geothermal PPAs negotiated between PLN and developers in a certain year. This ceiling tariff is linked to the Annual Average Costs of Generation (BPP) of the previous year, to be calculated for each island/sub-system. Due to the predominance of cheap, coal-fired generation on the main islands, geothermal ceiling tariffs will likely be so low as to make most future geothermal contracts/power plants economically unattractive.

In the Eastern Islands, especially Moluccas and East Nusa Tenggara, the local electricity generation is dominated by diesel generation, which leads to significantly higher BPPs, even under presently low (global and Indonesian) oil prices. Despite higher production/development costs for small, remote geothermal power projects, 3 out of the 7 main geothermal projects/fields reviewed for Moluccas and ENT would be economically feasible under the present BPP (2016/17).

A preliminary sensitivity analysis simulating some non-tariff policy options, showed that policy options lowering IRR/discount rates (especially SOE/state-sponsored developers, but also low-rate financing for private developers and public-private joint-ventures) would significantly lower geothermal production costs for the 7 fields reviewed and make several more economically viable.

Other policy options include: government-initiated exploration (depending on how exploration costs are recuperated) and lowering/opening the market costs for drilling, which should have a significant impact in the present global environment of low global/petroleum drilling activity and costs. The impact of introducing a carbon price would seem limited, especially at the present, modest international carbon prices (up to 9 USD/tCO_2e), but could increase significantly if global climate change initiatives increase again.

To understand possible future BPP trajectories (and hence geothermal ceiling tariffs) in Moluccas and ENT, a study was made how the BPP is calculated over the years. This is made more difficult because the method and cost allocations to calculate the (regional) BPPs still seem to change year-by-year. With a conservative estimate that at least 50% of the Moluccas and ENT BPPs are made up of diesel costs, and other costs will stay stable (in real terms) over the coming decade, a first-order-estimate was made about BPP-trajectories under different oil price scenarios out to 2025. Under all 4 scenarios (baseline World Bank global oil price projections, +/-20%, and +50%), the BPPs for Moluccas and ENT would be expected to increase from 2016-levels. In the +50% scenario, all-but-1 of the geothermal projects studied would become economically feasible.

Some recommendations from this preliminary study include:
- Further investigate the assumptions and opportunities underlying the economics of geothermal power generation in Eastern Indonesia, in collaboration with various government agencies and developers (SOE and private);

- Create more clarity and transparency in the methods underlying the BPP-calculations and potential future (ceiling) price trajectories, as this would help developers (SOE and private) estimate future opportunities and uncertainties better;

- An important contracting aspect is how escalation/inflation is treated under the new regulation[4] and PPAs. Escalation clauses seem normally allowed during the contract term (from COD/production onwards), but not necessarily between PPA signing and COD, which could mean a 3-5 year 'inflationary erosion' of the negotiated tariff. There seems to be some concern about the lack of transparency/ consistency on how this is treated in contracts, which can erode contract/tariff value and trust. This is worth further investigation.

[4] The previous (2014) ceiling tariffs had a predetermined inflation/escalation trajectory to 2024, linked to COD-date.

- Further explore non-tariff policy options, especially those relating to financial/discount costs, like SOE-development, public-private partnerships/joint ventures, soft loans to reduce financial costs for developers; and those relating to reducing drilling costs;

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Annex 1. Input Parameters for Production Cost Model

Name of Project	Location (Island and Subsystem)	Estimation of COD	Planned Capacity (MW)	Difficulty of Access	Type of Enthalpy	Planned developer	Planned explorer	Type of power plant	Type of field development
EAST NUSA TENGGARA									
Ulumbu 5	Manggarai (West Flores)	2019	20	Medium	High	SOE	Developer	Modular	Brownfield
Ulumbu 6	Manggarai (West Flores)	2024	20	Medium	High	SOE	Developer	Modular	Brownfield
Sokoria 1	Ende (East Flores)	2018	5	Medium	Medium	IPP	Developer	Modular	Greenfield
Sokoria 2	Ende (East Flores)	2019	5	Medium	Medium	IPP	Developer	Modular	Brownfield
Sokoria 3	Ende (East Flores)	2020	10	Medium	Medium	IPP	Developer	Modular	Brownfield
Sokoria 4	Ende (East Flores)	2021	10	Medium	Medium	IPP	Developer	Modular	Brownfield
Atadei	Lembata (Lembata)	2020	2x5	Medium	Medium	SOE	Developer	Modular	Brownfield
Mataloko 2	Ngada (West Flores)	2020	2x10	Medium	High	SOE	Developer	Modular	Brownfield
NORTH MOLUCCAS									
Jailolo	West Halmahera (Halmahera)	2025	20	Medium	Medium	IPP	Developer	Modular	Greenfield
Songa Wayaua	South Halmahera (Bacan)	2020	2x5	Medium	Medium	SOE	Developer	Modular	Greenfield
MOLUCCAS									
Tolehu	Ambon (Ambon)	2020	2x10	Medium	Medium	SOE	Developer	Modular	Greenfield

Annex 2. Sensitivity Analysis on Tariff Estimation