CLIMATE POLICY INITIATIVE

Using Private Finance to Accelerate Geothermal Deployment: Sarulla Geothermal Power Plant, Indonesia

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Descriptors

Sector	Geothermal, Renewable Energy, Climate Finance	
Region	Indonesia, Asia	
Keywords	Geothermal; Field Development; Drilling; Finance	
Related CPI Reports	• The Role of Public Finance in Deploying Geothermal: Background Paper • Public Finance and Private Exploration in Geothermal: Gümüşköy Case Study, Turkey • Using Public Finance to Attract Private Investment in Geothermal: Olkaria III Case Study, Kenya	
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About The San Giorgio Group

The San Giorgio Group is a working group of key financial intermediaries and institutions engaged in green, low-emissions, and climate-resilient finance. Established by Climate Policy Initiative in a collaboration with the World Bank Group, CLP (China Light & Power), and the OECD. San Giorgio Group case studies provide real-world examples of how public resources can spur low-carbon and climate resilient growth, what approaches work, and which do not. Through these case studies, which share a systematic analytical framework, CPI describes and analyzes the types of mechanisms employed by the public sector to catalyze and incentivize private investment, deal with the risks and barriers that impede investment, establish supporting policy and institutional development, and address capacity constraints.

About CPI

Climate Policy Initiative is a team of analysts and advisors that works to improve the most important energy and land use policies around the world, with a particular focus on finance. An independent organization supported in part by a grant from the Open Society Foundations, CPI works in places that provide the most potential for policy impact including Brazil, China, Europe, India, Indonesia, and the United States.

Our work helps nations grow while addressing increasingly scarce resources and climate risk. This is a complex challenge in which policy plays a crucial role.

Executive Summary

Geothermal offers considerable potential to contribute to the development of low-carbon energy systems in developing countries. Its ability to provide stable and affordable power make it suitable for replacing fossil fuels as a provider of baseload power to backstop fluctuating supply from other renewable energy sources (GEA 2013).

Indonesia has the world's largest geothermal resource with potential for 29GW of capacity. However, less than 5% of the potential has been utilized. Regulatory barriers, inadequate feed-in tariffs, lack of financing and early-stage exploration risks have frustrated exploitation of the country's large geothermal potential.[1]

Despite these barriers, geothermal deployment in Indonesia still grew 4.8% between 2002 and 2013, compared to global growth of 4.5%. However, the figure is much smaller than the annual growth of 13.6% required to reach the government's target capacity of 7.6GW in 2025 (DEN 2014). Government projections show that meeting its broader energy objectives will require an investment of USD 132 billion over the next 10 years, of which the government plans to contribute USD 69 billion and expects the private sector to cover the remaining amount (PLN, 2015). **Increased private sector participation in geothermal, mobilized by public risk mitigation tools, could help Indonesia meet its deployment target.**[2]

This case study analyzes the Sarulla Geothermal Power Plant (GPP) which, if successful, will be the largest single contract geothermal power plant project in the world with a total capacity of 330MW in 2018. The project has the highest private sector involvement of any geothermal project on a previously undeveloped field in Indonesia,[3] thanks to substantial public support in the form of financing, guarantees and a feed-in tariff.

This case study is part of a series of analyses carried out by Climate Policy Initiative on behalf of the Climate Investment Funds to help policymakers and donors understand which financing and policy support tools can help accelerate geothermal deployment effectively and efficiently.

Key findings for policymakers

- **Access to proven geothermal resources provided a strong incentive for the private developer, Sarulla Operations Limited (SOL), to develop the project.** The significant exploration work already completed by the previous developer, Unocal North Sumatra Geothermal (UNSG), provided SOL with access to high quality exploration data and surveys and reduced their exposure to resource risks significantly. Because of the reduced risk SOL was willing to pay USD 70 million to Indonesian's state-owned utility PLN for the completed exploration (ADB 2015), which included two completed production wells to support the first unit (PGE and SOL 2013).
- **Sarulla GPP delivers power at a comparable cost to other local and international geothermal projects, but in Indonesia is still a more expensive source of baseload power than coal.** CPI estimates that the project's levelized cost of electricity (LCOE) amounts to USD 7.8-8.2 ¢/kWh and would increase by USD 1 ¢/kWh in the absence of public support. The cost, with or without public support, is broadly competitive with various benchmarks for geothermal projects in Indonesia and globally (See Figure 5 in section 5.1.2). However, even when public support is not taken into account, the cost of baseload power from Sarulla GPP is still 40-60% higher than coal in Indonesia if the cost of emissions and health impacts are disregarded.
- **If successful, Sarulla GPP will be able to provide substantial public benefits.** When fully operational in 2018, Sarulla GPP will increase geothermal capacity by 20%, increase

1 One barrier was geothermal's previous categorization as a mining activity which prevented development in conservation areas where many potential sites are located. The Geothermal Law 2014 reclassified geothermal thereby lifting the restriction on accessing conservation areas. More work is required to understand how geothermal locations overlap with high conservation value areas, and the extent to which it could become a driver of deforestation. However, there are opportunities to ensure that resources can be appropriately developed while maintaining natural resources that matter most. Natural Capital Assessments that value land and its resources as part of the real economy, can help policymakers to weigh the value of protecting high value conservation areas and the value of developing geothermal resources. Integrating these into spatial planning processes, together with policies that provide administrators with the right incentives to manage and allocate land according to its best uses, offers the best potential to ensure that development can take place alongside the protection of natural assets.

2 See our case study of Gümüsköy Geothermal Power Plant in Turkey: http://climatepolicyinitiative.org/publication/public-finance-and-private-exploration-in-geothermal-gumuskoy-case-study-turkey/

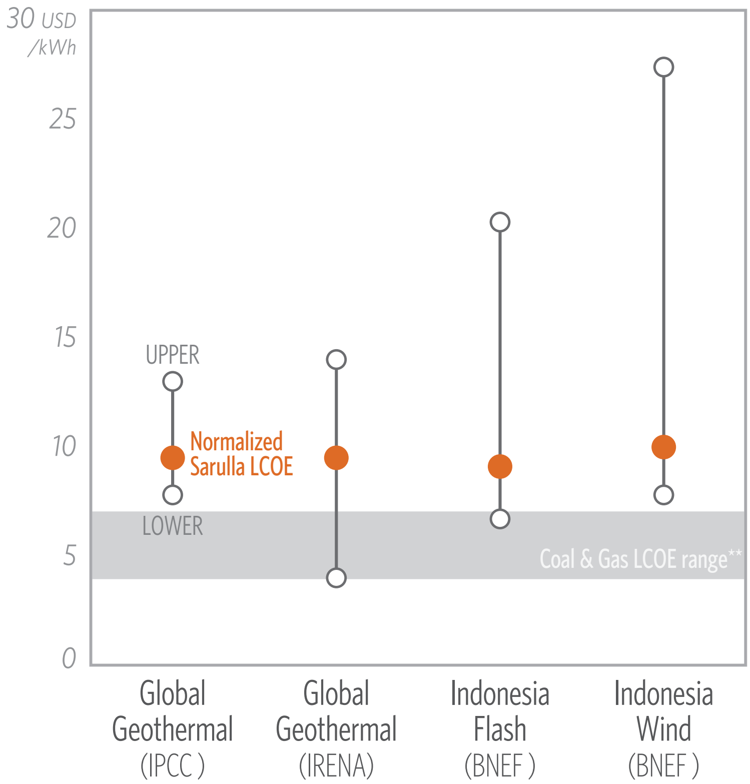
3 Since the introduction of the Geothermal Law in 2013

renewable capacity by 5% and meet 10% of the projected geothermal capacity additions in Indonesia between 2013 and 2020. The project is also estimated to save 1.3 mt of CO_2 annually (SOL 2013), create thousands of additional jobs[4] and may spur the local economy through the creation of new business, such as food, transportation and accommodation.

- **Increasing geothermal capacity fivefold by 2025 to meet its 7.6GW target, may require the government to take a larger role - especially in exploration.** Many countries' experience suggests the high risks associated with exploration remain a significant barrier to the scale up of geothermal. In fields where there is little interest in private exploration, government could play a larger role by either performing the exploration itself before tendering out proven concessions to the private sector or providing financial support to the private sector to carry out exploration themselves. Taking on exploration could be beneficial in the long run due to lower returns required by developer, while it could also potentially reduce tariffs by USD 1-3 ¢/kWh (ADB 2015). Sarulla GPP provides a good example of the private sector's willingness to provide compensation for the exploration costs[5] previously carried out to obtain access to proven fields. If private exploration is required, the government may have to provide private developers with concessional financial support or incentives such as soft loans, grants, insurance and sovereign guarantees.

- **Significant public support in the form of guarantees and long-term Feed-in-Tariff (FiT) unlocked access to long-term debt at competitive rates and provided a strong boost to the project's expected equity returns.** CPI estimates that the project's expected equity returns are in line with other geothermal projects in Indonesia where they range from 14-16%. Without public support, equity returns would drop 4% to a level that is likely below the developer's return expectations. The 30-year FiT provides revenue certainty over the project's life cycle, and its provision of a higher tariff in the earlier years of operation allows the project to achieve payback within nine years of all three units becoming operational.

Competitiveness of Sarulla GPP LCOE



Key findings for public finance providers

- **Proven resources, extensive due diligence and a range of risk mitigation measures enabled the lenders to provide debt financing for the plant's three units under a single contract even though the project was in the field development phase where resource risk would still be considered high.** During due diligence, lenders hired a technical consultant to perform detailed reservoir analysis and develop a completion test system, designed to test the plant's ability to meet design specifications, including the plant's target capacity, and to sustain production over the project's life cycle. Sponsors' contingent equity provides additional support in case further works are needed to meet the required specifications. Furthermore, the development of a robust drilling and construction program was crucial to ensure that the project was completed more quickly. Concessional loans provided by

4 Sarulla GPP is expected to recruit 1,800 workers during construction (SOL & PGE 2013).

5 Including a premium

the Clean Technology Fund and the Canadian Climate Fund were crucial for the project to achieve financial close.

- **Commercial lenders have signaled their willingness to fund construction works once key bankability concerns have been resolved, so public finance can focus on activities where funding gaps still exist.** The government's Business Viability Guarantee Letter (BVGL) effectively addressed the project lenders' bankability concerns. The involvement of commercial lenders in field development may not always be replicable in other projects since, in Sarulla GPP's case, significant exploration had already been done and the resource was already proven. Typically, at least 70% of expected capacity must be drilled before commercial financing is available (Audinet 2013). However, using the BVGL for other projects could unlock access to commercial finance for the construction stage. If this proves to be the case, public finance would be more useful if it focuses on supporting those stages in which commercial debt finance is scarce – exploration and field development.

CONTENTS

1. Introduction

This case study of the Sarulla Geothermal Power Plant (GPP) in Indonesia is part of a research program carried out by Climate Policy Initiative on behalf of the Climate Investment Funds. The overall objective of the program is to help policymakers and donors understand which financing tools and policy support to use in order to accelerate geothermal deployment effectively and efficiently. The research will draw on three in-depth case studies and dialogues with multilateral development agencies and the private finance community.

Sarulla GPP is distinguished by its large scale, the high involvement of private finance and the high appetite shown by debt financiers in funding the project's three units under a single contract during field development where resource risks are still considered to be high.

We examine the Sarulla GPP case for a number of reasons.

Firstly, if successful, Sarulla GPP will be the largest single contract geothermal power plant in the world, with a total capacity of 330 MW by 2018. It may provide many lessons on financing and risk mitigation mechanisms for large geothermal projects. The project is also an important milestone in Indonesia's ambitious plan to become a world leader in the sector.

Secondly, the case study shows that a high level of public support made the project profitable enough to attract more private financing than for any other geothermal project on a previously undeveloped field in Indonesia since the introduction of the Geothermal Law in 2003.

And finally, the project's lenders demonstrated a higher appetite than typical in other geothermal projects by funding all of the Sarulla's three units under a single contract while the project was in the field development stage where resource risk is still considered high. This is unique because typically geothermal projects are funded on a unit per unit basis to minimize exposure to resource risk while gradually proving the resource. Furthermore, the majority of debt financing for geothermal globally has focused on the construction phase where the resource risk has been significantly reduced (IFC 2013b).

This case study follows the methodology of the San Giorgio Group. The analysis will feed into the following broader research questions:

- How can the private sector and private finance participate more in the development of geothermal projects, particularly in the early exploration and development stages?[6]
- How do public finance, policy and regulatory frameworks stimulate private sector activity?
- What are the risks, costs and benefits of different project development models?
- How does geothermal add value to the energy system, for example in terms of cost competitiveness and timely deployment?

Section 2 provides an overview of the electricity system and policy and regulatory framework in which the project developed. **Section 3** analyzes the project, its stakeholders, financial contributions, different cost components and the returns achieved. **Section 4** considers how risks were allocated and managed through the project's development. **Section 5** reviews whether the project finance and development model were effective and draws lessons for replication in Indonesia and beyond. **Section 6** concludes with key findings.

6 The San Giorgio Group case study approach aims to systematically explore the role of project stakeholders, their investments and sources of return, the risks involved and arrangements to deal with them, and the lessons on how to replicate and scale-up best practices. It has been applied to a total of nine projects in solar, wind, energy efficiency, climate resilience, and forest conservation.

2. Context for the project

2.1 Renewable energy is expected to play a larger role in meeting Indonesia's increasing demand

Over the next 10 years, demand for electricity in Indonesia is expected to grow significantly, at an average rate of 8.7%. At the same time, the government is pushing to improve electricity access rates from from 84% of the population in 2014 to close to 100% by 2020 (PLN 2015, DEN 2014). This translates to a need for 99.7 GW of installed capacity by 2020, an addition of 50 GW from current capacity. Government projections show that meeting this objective will require an investment of USD132 billion over the next 10 years, of which government plans to contribute USD 69 billion and expects the private sector to cover the remaining amount (PLN 2015).

Until now, Indonesia's power sector has been dominated by the state-owned electricity utility, Perusahaan Listrik Negara (PLN) which provided 70% of total power generating capacity in 2014 (MEMR 2015). PLN has also served as the main offtaker for most power projects in Indonesia. However, if the country's economy continues to grow as expected, the sector will need more private investments to meet growing demand for energy.[7]

Under its National Energy Policy, the government is also prioritizing domestic sources of energy to increase energy security and reduce Indonesia's high reliance on oil imports to produce electricity.

These imports have had a negative impact on the state budget because the electricity bills paid by consumers are subsidized by the government. Electricity subsidies in 2014 reached IDR 71.4 trillion, nearly 4% of the total state budget (MOF 2015).

As a result, the government aims to increase the share of renewable energy in the energy mix from 5% to 23% by 2025. The government expects geothermal to play an important role by contributing 6.1% of the projected energy mix, as Indonesia has large geothermal resources.

7 Indonesia's economy has grown at an average rate of 5.9% annually since 2004 (World Bank 2014)

2.2 Indonesia could benefit from more private participation to reach the geothermal deployment target

In 2003, the Government of Indonesia introduced the Geothermal Law to provide a legal framework for geothermal exploitation for the first time. Since then, geothermal deployment grew 4.8% per year from 0.8 GW in 2003 to 1.3 GW in 2013 (MEMR 2015) – a rate comparable to the global annual growth rate of 4.5% (Micale et al. 2014). Most of the growth has been driven by the public sector. Despite the growth, the sector is still far from living up to its potential: Less than 5% of the geothermal potential of Indonesia has been utilized so far (EBTKE 2015). Meeting the 7.6 GW capacity target by 2025 would require the sector to grow 13.6% annually (DEN 2014).

Asian Development Bank (ADB) projected that the total cost to build the next 3 GW of capacity in Indonesia could reach USD 13.5 billon, with USD 3 billion attributed to exploration. At present, the only known state budget available for geothermal development amounts to USD 300 million, which is dedicated to support exploration through the Geothermal Fund.[8] This means that the majority of the funding gaps may have to come from the private sector. The effectiveness of the present policies and incentives to push private finance in geothermal deployment still remains to be seen.

2.3 Encouraging private actors to take a larger role

Geothermal is a potentially important source of energy for Indonesia, but a complicated regulatory framework, an inadequate electricity tariff, lack of financing and bankability issues have been barriers to greater private sector involvement in the sector's development.

Government has gradually addressed these barriers through a range of policies, with the aim of increasing private sector participation in geothermal.

8 The Government of Indonesia established Geothermal Fund in 2012 and assigned Pusat Investasi Pemerintah (PIP), a public service agency, to manage the fund. The government has so far provided the fund with USD 300 million of capital. However, the fund has made little progress and no disbursement has yet to be made to date due to institutional and governance concerns.

2.3.1 SIMPLIFYING THE REGULATORY FRAMEWORK

One of the main barriers to scaling up the exploitation of geothermal resources was the categorization of geothermal as a mining activity, which prohibited geothermal development in conserved areas where many potential sites are located (Hasan and Wahjosoedibjo 2014). The Geothermal Law of 2014 reclassified geothermal so that it was no longer considered a mining activity thereby lifting the restriction on accessing conserved areas for geothermal development.[9]

Private sector involvement in geothermal development was more challenging under previous regulatory frameworks which limited its participation. Under the first regulatory framework for geothermal development in 1981, geothermal concessions and the rights to develop them were assigned to Pertamina, a state-owned oil and natural gas corporation. In 1991, a new decree enabled the private sector to enter the sector but only to a limited degree. Under this regime, private developers had to enter into a Joint Operating Contract (JOC) with Pertamina to perform exploration and development, and enter into an Energy Sales Contract (ESC) with Pertamina and PLN to sell the power produced. Pertamina also retained the rights to the concessions. The first Geothermal Law in 2003 addressed this by allowing the private sector's participation in geothermal without the need to contract with Pertamina.[10] The private developer could then obtain the concession rights directly through government auction (see table 1).[11]

Table 1: Development of Indonesia's geothermal regulatory framework and development model (MEMR 2014)

REGULATORY BASE	CHARACTERISTICS AND DEVELOPMENT MODEL
Presidential Decree 22 (1981)	• The first framework for geothermal development • All rights to geothermal concessions were assigned to Pertamina • Only Pertamina can perform exploration and development
Presidential Decree 45 (1991)	• Government amended previous decree to allow private participation in exploration and development through contract with Pertamina • Private sector development use JOC-ESC model • Pertamina still hold the rights to all concessions
Geothermal Law 2003	• The first Indonesian Law to focus on geothermal • Private developer can obtain concession rights directly through government auction • Geothermal activities were considered mining activity • Geothermal development was prohibited into accessing conserved forest areas
Geothermal Law 2014	• Geothermal no longer considered as mining activity • Restriction to access conserved areas for geothermal development is lifted

9 More work is required to understand how geothermal locations overlap with high conservation value areas, and the extent to which it could become a driver of deforestation. However, there are opportunities to ensure that resources can be appropriately developed while maintaining natural resources that matter most. Natural Capital Assessments that value land and its resources as part of the real economy, can help policymakers to weigh the value of protecting high value conservation areas and the value of developing geothermal resources. Integrating these into spatial planning processes, together with policies that provide administrators with the right incentives to manage and allocate land according to its best uses, offers the best potential to ensure that development can take place alongside the protection of natural assets.

10 Around this time, Pertamina returned 18 of its 33 concessions to the government. In 2006, Pertamina established a subsidiary, Pertamina Geothermal Energy, to manage all the concessions previously assigned to Pertamina.

11 The development model of a geothermal project is dependent on when the concessions were issued. Concessions issued prior to 2003 are still owned by Pertamina and can be developed by private developer through JOC-ESC model. In concessions issued after 2003, private developer and Pertamina have to enter into competitive auction to obtain the rights to concessions and no longer require the JOC-ESC model. The Sarulla concession was issued in 1993 and, therefore, its development must follow the JOC-ESC model.

2.3.2 INCREASING INCENTIVES FOR PRIVATE GEOTHERMAL INVESTMENT

Access to project finance is a large barrier for power plant projects in Indonesia because of potential lenders' concerns that PLN's role as the main offtaker in many power plant projects negatively impacts bankability. PLN's continuing financial deficits, due to its legal obligation to subsidize end consumers' electricity bills and thereby charge less for the power than it costs the company to produce, are the source of lenders concerns. The Indonesian government has addressed this by introducing a Business Viability Guarantee Letter (BVGL). The BVGL serves to backstop the creditworthiness of PLN, which serves as the main offtaker in power plant projects and to provide more confidence to investors to participate in power projects.

The Indonesian government has also gradually increased the tariff for geothermal power plants. Until 2012, geothermal tariffs were solely negotiated with PLN on a case-by-case basis. Under the latest framework, government requires that the proposed tariff be included as part of the tender documents. This means that developer no longer need to negotiate with PLN as the tariff has been determined upon winning the tender. The latest Feed-in-Tariff (FiT) was issued in 2014 which sets the price ceiling based on regions and the commercial operating date (COD) of the plant. Depending on location, the tariff ceiling ranges from 11.8 to 23.3 USD ¢/kWh, except for remote areas in which the ceiling ranges from 25.4 to 29.6 USD ¢/kWh (MEMR Regulation 17/2014) (See table 2).

Table 2: Development of Feed-in-Tariff Regimes in Indonesia

FEED-IN-TARIFF REGIME	CHARACTERISTICS AND DEVELOPMENT MODEL
MEMR Regulation 32 (2009)	• Tariff ceiling at USD 9.7 ¢/kWh • PPA tariff negotiated with PLN
MEMR Regulation 22 (2012)	• Tariff determined based on producing region • Tariff ranged between USD 10-17 ¢/kWh, depending on location • Tariff proposal part of tender documents, and becomes binding upon winning a tender
MEMR Regulation 17 (2014)	• Tariff ceiling based on producing region and the year of Commercial Operation Date (COD) • Tariff ranges between USD 11.8-25.8 ¢/kWh, depending on location and year of COD • Tariff proposal part of tender documents, and becomes binding upon winning a tender

3. Financing Sarulla GPP

- The project has the **highest private sector involvement of any geothermal project** on a previously undeveloped field in Indonesia since the introduction of Geothermal Law in 2013.
- Substantial public support in the form of guarantees on the creditworthiness of the offtaker, a feed-in tariff, and financing were crucial in making the project financially feasible.

3.1 Project background and main characteristics

Sarulla GPP is developed by Sarulla Operations Limited (SOL), a private consortium of Medco Power Indonesia, Itochu Corporation, Ormat International and Kyushu Electric Power Company (Project Sponsors).[12] **If successfully developed, Sarulla GPP will be the largest single contract geothermal power plant in the world, with a total capacity of 330 MW by 2018.**

The project will be developed as three separate units, each utilizing combined cycle technology, a combination of single flash and binary ORC technology developed by Ormat International, to capture steam and brine from Namora-I-Langit and Silangkitang fields, located in North Sumatera Province, Indonesia. The first unit is scheduled to be commissioned in 2016 and all three units are expected to be fully on-stream by 2018.

The combined cycle technology was chosen after taking into account the high temperature of the reservoir, the amount of brine which can be exploited and its ability to allow nearly 100% injection of the geothermal fluid back into the reservoir which thereby maintains the sustainability of the resource and minimizes leaks of Non-Condensable Gas (NCG). Sarulla GPP will be the first geothermal plant in Indonesia to utilize the combined-cycle technology.

Table 3: Technical features of the Sarulla GPP

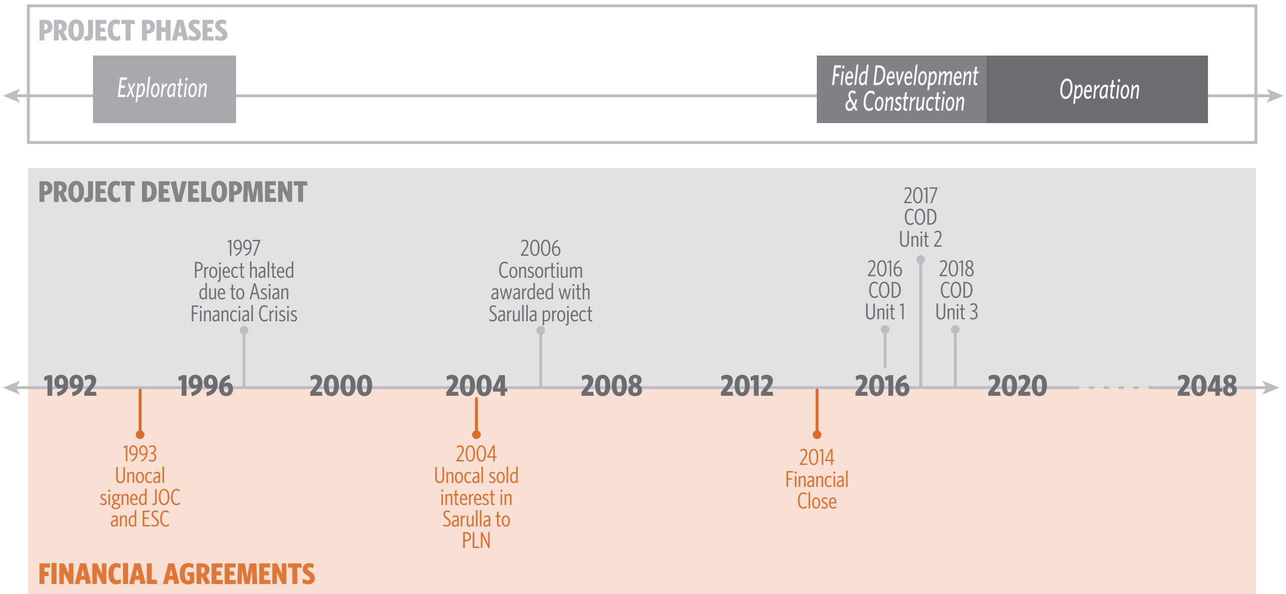
Technology	Combined Cycle (Single Flash and Binary ORC)
Reservoir temperature • Silangkitang • Namora-I-Langit	 300°C 260°C
Installed capacity (expected)	330 MW

The Sarulla concession is owned by Pertamina Geothermal Energy (PGE), a subsidiary of the national oil and gas company, Pertamina. In 1993, Unocal North Sumatera Geothermal (UNSG), a private company, obtained the rights to develop the project, and between 1994 and 1998, performed exploration activities in the Sarulla concession that resulted in 330MW of proven resources. UNSG later suspended its works in 1998 when the financial crisis hit Asia and eventually sold its development rights to PLN in 2004. The development rights to the project were subsequently re-auctioned and SOL won the bid in 2006 (see Figure 1 for detailed timeline). Upon winning the tender, SOL paid USD 70m to PLN to compensate for the exploration works previously undertaken (ADB 2015).

The project reached financial close eight years after the award of the development rights. The long lead time was largely due to a renegotiation of the tariff with PLN, negotiation with government over guarantees and support, and due diligence exercise undertaken by the lenders. Between 1998 and financial close in 2014, no drilling activities were conducted in the concession.

12 Dates and figures presented in section 3 and 4 are CPI's own calculations and views after taking into account information collected from publicly available data and interviews with the project's developer, financiers and legal counsel. The project's developer and stakeholders did not perform any verification regarding each data and information presented in this report and therefore are not responsible for the correctness and accuracy of various data and descriptions.

Figure 1: Project timeline and key milestones



3.2 Project stakeholders and financing

The Sarulla project has the highest private sector involvement of any geothermal project on a previously undeveloped field in Indonesia since the introduction of Geothermal Law in 2013, thanks to substantial public support in the form of financing, guarantees, a feed-in tariff and financing.

The project is financed through a combination of debt, equity and pre-completion revenues (see Table 4). It reached financial close in May 2014 and raised USD 1.2 billion[13] of 20-year limited recourse project finance loan from a group of lenders, including USD 328 million from syndicate of private lenders,[14] USD 742 million in senior loans from ADB and the Japan Bank For International Cooperation (JBIC), and a USD 100 million concessional mezzanine loan from the Clean Technology Fund (CTF) and the Canadian Climate Fund (CCF) administered through ADB. Other financing sources include equity, contingent equity covering potential cost overruns and pre-completion revenues which will trap revenues collected from unit 1 and 2 to fund the construction of unit 3. The total project costs are estimated to reach USD1.6 billion.

The government, through the Ministry of Finance, provides a 20-year Business Viability Guarantee Letter (BVGL). This letter serves to guarantee the financial performance of PLN, including offtake obligations and the building of the substation that will connect transmission lines installed by SOL from the plant's three units. The loan covered by commercial lenders is backed by political risk guarantees from Japan Bank for International Cooperation (JBIC).[15] One of the main

Table 4: Capital structure and financing sources of the Sarulla GPP (USD million)

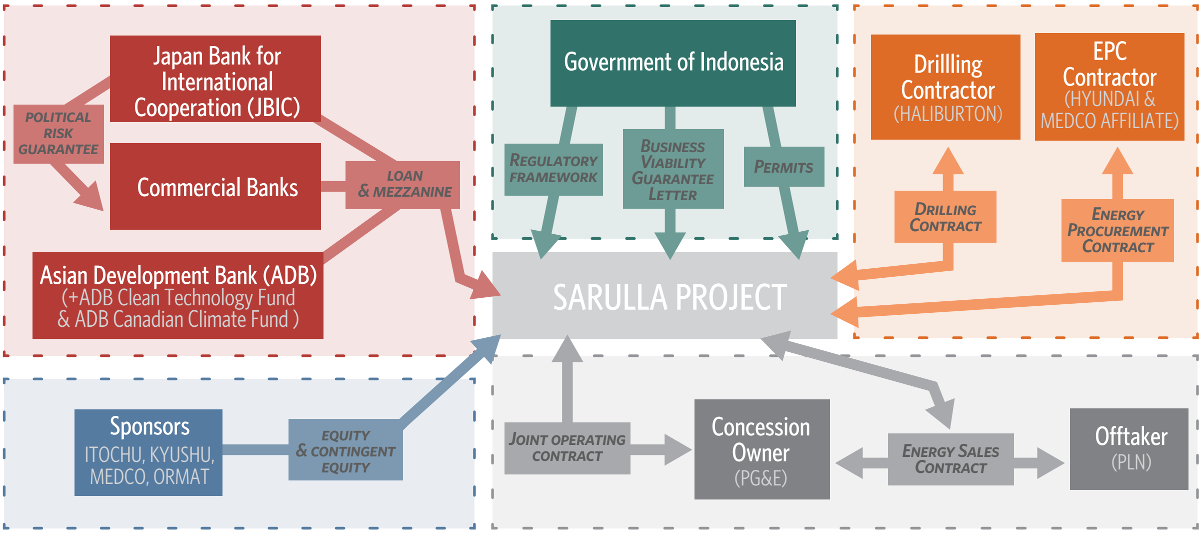
DEBT			
Japan Bank for International Cooperation (JBIC)	Senior Loan	Public	492
Asian Development Bank (ADB)	Senior Loan	Public	250
Commercial Banks Syndicate	Senior Loan	Private	328
Clean Technology Fund (CTF)	Mezzanine Loan	Public	80
Canadian Climate Fund (CCF)	Mezzanine Loan	Public	20
EQUITY			
Project Sponsors*	Equity	Private	N/A
OTHER			
Pre-Completion Revenue			N/A
TOTAL PROJECT COST			**~1.600**

13 All debt is denominated in US Dollars.

14 Commercial banks syndicate include Bank of Tokyo-Mitsubishi UFJ, ING Bank, Société Générale, Sumitomo Mitsui Banking Corporation, Mizuho Bank and National Australia Bank.

15 Four points of political risk guarantees covered by JBIC: war, expropriation, change of law and non-payment by Government of Indonesia.

Figure 2: Project development model and stakeholder map



features of the guarantee includes the coverage of non-payment by government on its obligations as stipulated in the BVGL.

Other public sector stakeholders include the Ministry of Energy and Mineral Resources (MEMR), which provides the regulatory framework for geothermal development, FIT as well as providing permits and licenses to carry out development and construct the power plant.

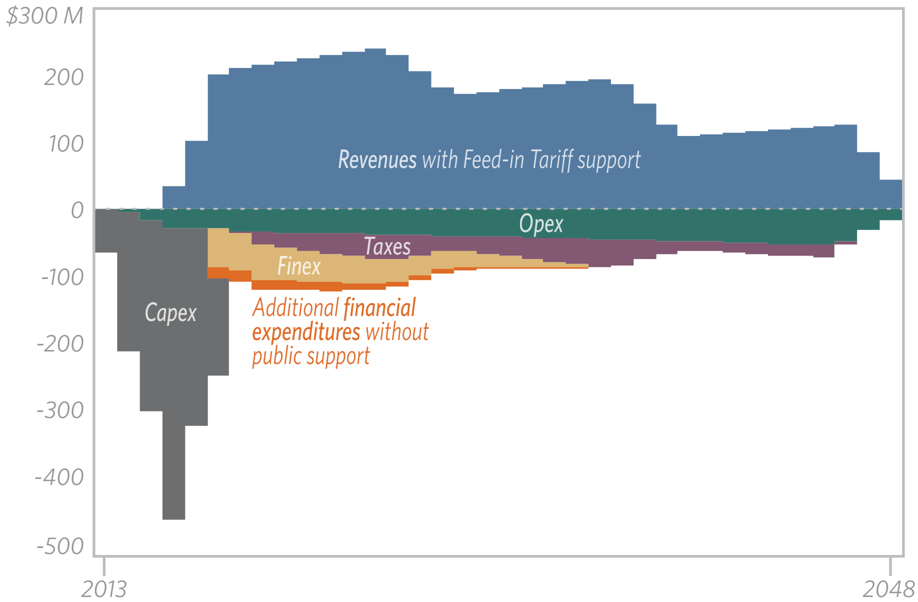
The concessional loans provided by CTF and CCF were crucial in achieving financial close. The availability of below-market interest rate is able to minimize the risk of interest payments, which otherwise might put too much pressure on the project's cash flow.

A final characteristic of the project development model and financing of Sarulla GPP that is interesting, because it is uncommon, is the involvement of state-owned PGE as the concession owner (see Figure 2). Because the project must comply with regulatory framework preceding 2013's Geothermal Law, SOL entered into Joint Operating Contract (JOC) with PGE to obtain the right to use the concession and develop the power plant. SOL also entered into a tripartite agreement with PGE and PLN, in the form of Energy Sales Contract (ESC), under which SOL will sell the electricity to PLN and provide royalty payments to PGE.

3.3 Project costs and returns[16]

We use a simulated discounted cash flow analysis of the project's financial profile to analyze revenues, costs, profitability and levelized cost of electricity (LCOE), and the benefits that the project brings to the public.

Figure 3: Estimated Cash flow projection of the Sarulla Geothermal Power Plant



16 Calculations made in this section are based on CPI's own estimates and assumptions based upon publically available data and therefore may not reflect the views of the project's stakeholders. The projections assume that the project will fulfill its targeted 330MW. Actual results may differ from our analysis. Any mistakes are CPI's.

Table 5: Summary of estimated revenues and costs

SARULLA GEOTHERMAL POWER PLANT	VALUE	UNIT	COMMENT
ANNUAL ELECTRICITY GENERATED	2.6	TWH	Annual power generation is estimated based on expected capacity of 330 MW and capacity factor of 90%.
AVERAGE ANNUAL ELECTRICITY REVENUES	160	USD M	Annual revenues are entirely collected from the sale of electricity. Revenues are higher in the early period which benefit from higher tariff.
INVESTMENT COSTS	1,600	USD M	Investment cost equals to USD 5 m / MW. This is higher than other geothermal projects in Indonesia (see Table 9 in section 5.2) for comparison).**
COST OF ELECTRICITY GENERATION	7.8 - 8.2	USD¢/ KWH	The 7.8-8.2 USD ¢/kWh is represented by a simulated Levelized Cost of Electricity (LCOE) calculation, by discounting estimated future costs with Equity IRR.
• CAPEX	58	%	
• OPEX	25	%	
• FINEX	17	%	

*All figures are estimates based on the assumption that the project will achieve the expected capacity of 330MW for 30-year operation.
**Total costs also include costs associated with drilling, construction, financing fees, due diligence, working capital, reimbursement of exploration costs and reserve accounts.

3.3.1 SOURCE OF REVENUE AND COSTS BREAKDOWN

The only source of revenue calculated in the cash flow projection is the sale of electricity to PLN for 30 years.[17] The way the actual tariff is structured allows the project to collect revenues at higher tariff during early years of operation and achieve payback of investment costs within nine years after all units are operational.

The project's **capital expenditures (CAPEX)** amount to USD 1.6 billion, equivalent to USD 5 million per installed MW, with **field development and construction making up 59% of total CAPEX.**[18] On a levelized basis, CAPEX makes up 58% of total costs (discounted with equity IRR). This falls within the profile of a typical geothermal power plant projects where CAPEX normally makes up more than 60% of LCOE (Micale et al 2014).

Operational expenditures (OPEX) mainly cover make-up wells, personnel costs, office rent and insurance. On a levelized basis, OPEX over the project's 30-year life cycle amount to USD 140 million, equivalent to 25% of total project costs (discounted with equity IRR). The low operating costs demonstrate another advantage of geothermal which is that it does not rely on ongoing fuel to run the plant.

Financial expenditures (FINEX) amount to USD 100 million, contributing 17% of the project's total costs (discounted with equity IRR). The project benefits from the availability of public support, e.g. 30-year FIT, 20-year BVGL and political risk guarantee, which helped in obtaining long-term loans at competitive market rates. Figure 3 shows the impact of public policy in reducing the project's estimated cost of debt by 150-250 basis points.[19]

Public support allowed access to private finance and long-term funding at competitive rates that helped improve the developer's expected returns by 4%.

17 USD 6.79 ¢/kWh is the official published tariff , calculated on a levelized basis using PLN's internal formula. The actual tariff is different and is structured in a step down approach with three declining reference rates. Escalation of the tariff is also allowed to compensate for inflation.

18 Total upfront capital expenditures include costs associated with, among others, drilling, construction, financing fees, due diligence, working capital, reimbursement of exploration costs and reserve accounts.

19 JBIC, ADB, commercial banks, CTF and CCF negotiated separately with the project developer on loan terms, resulting in different interest rates for each loan agreement. The reduction in cost of debt is CPI's own estimation based on the support and guarantees provided by public actors and does not indicate that all financiers are providing loans at below market rate.

3.3.2 PROFITABILITY AND LEVELIZED COST OF ELECTRICITY

Our cash flow projection indicates that the expected Internal Rate of Return (IRR) on equity for the project is in line with the benchmark equity returns for geothermal projects in Indonesia which typically range from 14 to 16% (World Bank 2008b). **In addition to the expected equity returns, the developer also benefits from the high certainty of the project's revenue stream backed by public support**, e.g. 30-year feed-in tariff, 20-year BVGL and political risk guarantee.

In the longer term, lower-cost loans are crucial to ensure that return expectations are met, without which expected equity returns would drop by 4.1%, a level that is likely to make the project unviable. In the scenario analysis, we estimate that a loan tenor of at least 15 years is required to ensure that the project's cash flows remain positive throughout the project life cycle. Negative cash flows would likely mean the developer would need to invest additional equity in the project. The availability of long-term loan is particularly important as commercial loans in Indonesia typically offer tenor below 10 years (ADB 2015).

Our estimate shows that the developer's cost of generating electricity, represented by Levelized Cost of Electricity (discounted with equity IRR), amounts to around 7.8 - 8.2 USD ¢/kWh. **Without longer-term, lower-cost public loans, generation costs would rise to around 9 USD ¢/kWh.**

3.3.3 PROJECT OUTCOMES TO THE PUBLIC

Sarulla GPP is expected to bring many benefits to Indonesia and particularly to North Sumatra. The 330 MW plants, are estimated to supply 2.6 TWh annually into the grid once it is fully operating, and would help to close the deficit between power demand and supply in Sumatera and reduce the country's dependence on fossil fuel plants. It is estimated that Sarulla GPP will save 1.3 mtCO2 annually (ADB 2013).[20]

Sarulla GPP will also positively impact the local economy and community. It is estimated that the project will create 1,800 additional jobs upon construction and operation phase and may spur local economy through the creation of new businesses, especially in accommodation, transportation, and food (PGE and SOL 2013).

Table 6: impact of public support on expected returns and cost of electricity generation

	EQUITY IRR	LCOE (USD ¢/KWH)
PROJECT SCENARIO	14 - 16%	7.8 - 8.2
HIGHER COST OF DEBT (+150-250 BPS)	-2.3%	+0.5
SHORTER DEBT TENOR (-5 YEARS MATURITY)*	-2.6%	+0.7
SHORTER DEBT TENOR AND HIGHER COST OF DEBT (+150-250 BPS, -5 YEARS)	-4.1%	+1.1

*The 15 year tenor is chosen because, according to our estimation, is the minimum tenor required by the project to maintain positive cash flows over the loan duration. It is, therefore, not an indication of market practice.

20 This represents 1.2% of emissions coming from Indonesia's power sector in 2005. No recent data is available

4. Risk allocation in Sarulla GPP

Risk is an important element that investors consider before participating in a project. Generally, the riskiest stage of geothermal power plant development occurs during the exploration phase, which involves committing large amounts of capital with highly uncertain outcomes. Furthermore, the long lead time between making the initial large investment and the operational phase increases the level of risk that must be borne by the stakeholders (ESMAP 2012, Micale et al. 2014).

In the case of Sarulla GPP, risks related to the exploration phase were significantly reduced as UNSG had concluded early exploration and proved that the resources were suitable for power production before SOL was awarded with the project in 2006. However, other risks associated with development and operational phases still remain. These risks are still very relevant and will be the subject of the discussion in this section.

4.1 Risk identification and assessment

In this section, we describe key risks which were present upon the award of the project in 2006 before they were mitigated through certain risk instruments. Risks are classified according to the stages during which they occur (development and operation). Then, each risk is analyzed based on probability of occurrence (low/moderate/high) and its impact on the project's financial and non-financial results (low/moderate/high).

4.1.1 RISKS IN DEVELOPMENT

Resource Risk – High Risk Event: The global success rate associated with finding geothermal resources suitable for power generation during the field development stage is estimated to be 74% (IFC 2013a). This demonstrates that results from exploration do not completely remove the risk of finding enough resources to support the expected plant capacity. Success rates in Indonesia are comparable to the global rate but the resource risk is lower than in other parts of the world because developers spend less money on drilling in Indonesia than in other countries to obtain the same target capacity.[21] Even so the large amounts of capital involved in developing this project still make this risk very relevant.

21 Resource risk is relatively lower in Indonesia than that in other countries because (1) the country has more fields with large resource base; (2) well capacity in Indonesia tends to be larger and (3) smaller drilling cost per well (GeothermEx 2010, Sanyal et al. 2011).

Delay and Cost Overruns Risk – Moderate Risk Event: Unexpected events during drilling and construction can lead to prolonged delays and incur high costs. During drilling, drill pipe can get stuck in the borehole due to formation irregularities, while inability to maintain the right mud pressure can lead to blowouts (Schlumberger 1999). In the construction phase, the developer relies on the contractor, along with its subcontractors, to construct the plant as designed within the agreed time and ensure that the key components of the technology perform as expected.

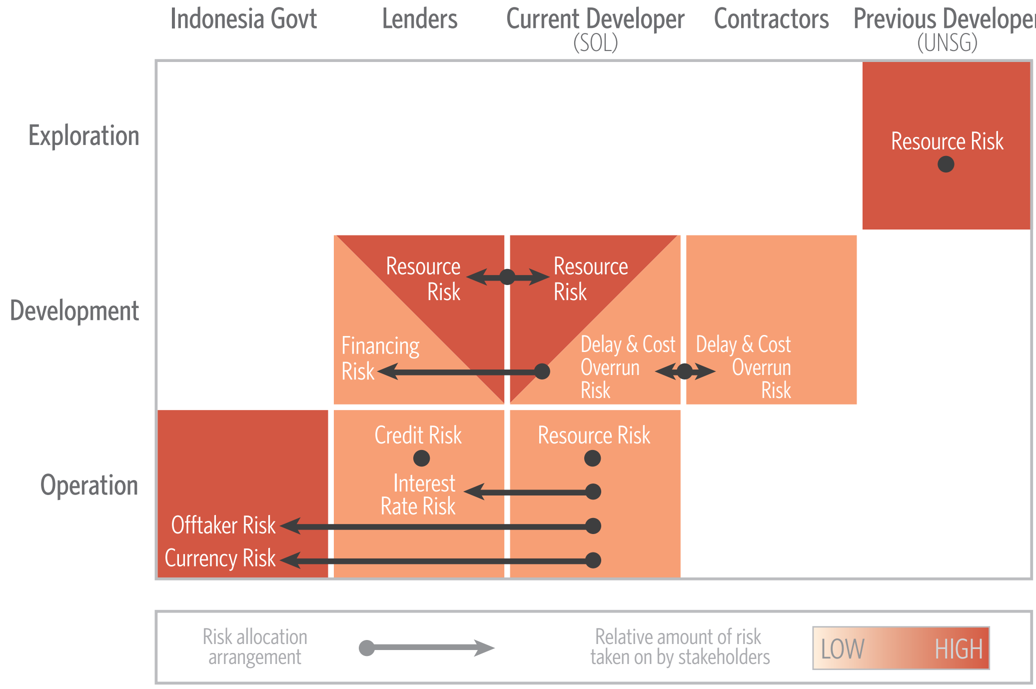
Financing Risk – High Risk Event: Debt financing for geothermal projects generally occurs after the developer completes the field development phase where resource risk has been significantly reduced (Audinet 2013, Ho 2013). This was also the case in Indonesia, where geothermal activities was relatively scarce between the award of the project and financial close. In addition, the project's mandatory compliance with the regulatory framework which pre-date Geothermal Law 2003 made access to financing even more difficult. Under this framework, ownership of the Sarulla concession must remain with PGE rather than with the developer, which made it complicated for the stakeholders involved to put together a bankable project financing structure.

4.1.2 RISKS IN OPERATION

Resource Risk – Moderate Risk Event: At the operational phase, the drilling success rate has improved significantly as more wells have been drilled and with the effect of learning (IFC 2013a). However, risk associated with managing the reservoir still remains. Drilling activities around the site by SOL and other developers must be managed carefully so as not to interfere with the stability of the reservoir system. Failure to do this may cause unexpected depletion of the reservoir and eventually lead to a shortened project life.

Credit Risk – Moderate Risk Event: As the project uses limited-recourse project finance, lenders are dependent on the project's ability to generate sufficient cash flow to service principal and interest payments (Milbank 2014). This means that lenders will also depend on the developer's ability to manage operational cost and avoid unexpected depletion of the reservoir which may affect the project's cash flow.

Figure 4: Risk allocation among stakeholders in Sarulla GPP



Interest Rate Risk – Moderate Risk Event: The interest rates applied to the loans extended to the project are referenced to the London Interbank Offered Rate (LIBOR) plus a fixed margin for different periods of time. As LIBOR is driven by the market, any global economic and political event may cause the interest rate to spike and put significant pressure on the project's cash flow and eventually on the developer's returns.

Currency Risk – Moderate to High Risk Event: Currency fluctuation poses a significant risk to PLN as its source of income has mainly come from electricity bills payments by consumers denominated in Rupiah (IDR), while its offtake obligations for the Sarulla GPP are denominated in USD. Since 2010, the value of IDR has depreciated around 28% compared to the U.S. dollar (BI 2015). Further sharp decline in the value of Rupiah may affect PLN's ability to meet its offtake obligations.

Offtake Risk – High Risk Event: In general, PLN maintains an effective monopoly over electricity distribution because it serves as the main offtaker for most power generators in Indonesia (EIA 2014). As the government regulates the tariff that the consumer pays for electricity, PLN is forced to accept losses and receives a regular subsidy to sustain its operations. Any event which causes both PLN and the government to experience severe financial distress would negatively impact PLN's ability to meet its offtake obligations.

4.2 Risk analysis, allocation and mitigation

In Sarulla GPP, tailored risk allocation and risk mitigation instruments have been designed to shift certain risks to those who are better able to bear them. The dynamic risk matrix (Figure 4) shows where the risks occur during the project's life cycle and how they are transferred to and/or allocated among the stakeholders through different risk instruments.

4.2.1 RISK ALLOCATION TO THE PROJECT DEVELOPER

Public guarantees & feed-in tariffs helped in mitigating risks associated with offtake and financing, and improved the bankability of the project which led to the achievement of financial close.

The fact that the resources had been proven upon winning the tender was crucial for the project developer in avoiding early-stage resource risk. The developer's appetite to take on the project was shown by its willingness to pay substantial amount (USD 70 million) in order to have access to high quality exploration data and surveys (ADB 2015).

Resource risks associated with field development and operation continue to be borne by the developer. In field development, the developer is able to share this risk with the project lenders. The resource risk at field development stage has also been reduced to a certain extent as the resource from Silangkitang field, where the first unit will be constructed, is considered to be more proven, with two of the four production wells targeted already drilled by UNSG (see Table 7). Lenders' willingness to share the risk at this stage means that the developer is able to spread its capital commitment more efficiently over the development phase and utilize debt as a cheaper source of funding.

The risk of delay and cost overrun are mainly shared between developer and the contractors through the drilling contract and EPC contract, which specify the target completion date and compensation clauses in the case of delay. In addition, the developer has also committed a significant amount of contingent equity support which serves as an extra source of funding in case the project experiences cost overruns.

Table 7: Drilling Plan in Silangkitang and Namora-I-Langit field (SOL & PGE 2013)*

WELL PAD	NUMBER OF WELLS			OUTPUT CAPACITY TARGET (MWE)	AVERAGE WELL CAPACITY TARGET (MWE/WELL)
	EXISTING**	NEW	TOTAL		
Silangkitang					
Production	2	3 (including 1 failure)	5	110	28
Reinjection	0	5	5		-
Namora-I-Langit					
Production	0	20 (including 2 failures)	20	220	13
Reinjection	0	6	6		-

*Number of wells to be drilled may change subject to well testing results
** Wells previously drilled by UNSG to be utilized as production wells

4.2.2 RISK ALLOCATION TO CONTRACTORS

The developer entered into separate contracts for drilling and construction works. Halliburton is responsible for the drilling activities, while Hyundai Engineering & Construction will construct the steamfield and the power plants. Both contracts include compensation clauses which should encourage the contractors to complete their works within the agreed time. Furthermore, the budget allocated for both works also include contingency to cover unforeseen costs.

However, as the start of the construction is also dependent on successful drilling and well testing, coordination between contractors also plays an important role to avoid long delays. The developer and contractors developed a robust drilling and construction schedule, which include reporting and monitoring mechanism, to coordinate and expedite the development phase.

4.2.3 RISK ALLOCATION TO LENDERS

Thorough due diligence, the development of a detailed completion test system and the planning of a comprehensive drilling and construction program helped in getting lenders' buy-in to finance all three of the project's 110MW units under a single contract and to fund the field development phase, where resource risk is typically still considered high.

In Sarulla GPP, **lenders have demonstrated their appetite to take on some of the resource risk in field development and to provide debt finance for the three generating units in a single contract.** Lenders high involvement in field development is not often seen in geothermal development globally as traditionally they tend to focus on the construction stage where the steam has already been proven (Micale et al. 2014). Furthermore, the integrated nature of the financing is also rather unusual as large scale projects are generally developed and financed on a unit-by-unit basis to minimize exposure to resource risk.

Getting the lenders' buy-in to take on resource risks in field development was one of the biggest challenges to reach financial closing. Although part of the resource risk was already reduced as the resource from Silangkitang field was considered to be more proven, lenders still needed to mitigate their exposure to the remaining resource risk. This meant that they needed to overcome their knowledge gap and get comfortable with the technical complexities of the project. Lenders spent more time on due diligence, including hiring a technical consultant to conduct detailed reservoir analysis, and develop a detailed completion test system designed to test the plant's ability to reach the target capacity and to sustain production over the project's life-cycle. Sponsors contingent equity provides further support in case additional works are needed to meet the required specifications. In addition, the development of a robust drilling and construction program was crucial to allow fast deployment.

During the operation phase, a mix of instruments is used to mitigate the risk that the project is not able to service both principal and interest payments over the course of the loan period:

- A 30-year FiT and a 20-year BVGL which increase the level of certainty of revenues during the loan period.
- Long-term interest rate swaps to fix the interest rates for most of the debt financing over the loan period. Fixing the interest rates means a large component of the costs during operation becomes predictable.
- Adequate level of Debt Service Reserve Account is used to reserve a portion of the revenue for principal and interest payments, which should further mitigate the risk of default.
- Political risk guarantee backed by JBIC provides additional security for the private lenders against adverse political events and non-payment by government if PLN defaults on its offtake.

4.2.4 RISK ALLOCATION TO GOVERNMENT

The government will eventually bear the costs and risks associated with guaranteeing power offtake by the state-owned electricity company according to the FiT in several ways:

- Through BVGL and ownership of PLN, government is committed to guarantee payments to the developer for the sale of electricity, in the event that PLN defaults on its financial obligations in the project.
- As the cost of generating electricity is not directly passed on to the consumers due to regulated tariff, government is therefore responsible to provide subsidies to PLN.
- PLN is exposed to substantial currency risk in this project as its offtake obligations are denominated in USD, while the revenues it collects, predominantly through electricity bills from consumers, are denominated in IDR.

Since the project uses a step-down tariff structure, the risk to the government is larger during the earlier years.

5. Effectiveness, Replication and Scale-up: Lessons from Sarulla in meeting policy goals

In this section, we analyze the effectiveness of the Sarulla GPP development and financing model in meeting Indonesia's energy policy objectives before examining barriers to scale-up of the sector in Indonesia and the replicability of the Sarulla GPP model.

5.1 Project's effectiveness in meeting the government's policy objectives

Scale-up of geothermal deployment should be consistent with the government's energy policy objectives, which are to achieve energy security and sovereignty (Government of Indonesia 2014). We have expanded this objective into several broad policy goals and sub-indicators for measuring the effectiveness of Sarulla GPP (increase private sector participation, low cost, and deployment of renewable energy). The following subsections will discuss this in more detail.

- Evidence so far suggests that there is a **strong appetite from private developers and private financiers to develop a geothermal field** when the resources have been proven.
- Drilling activities so far confirmed that **less than 10% of the geothermal potential in Indonesia is considered proven**, indicating that drilling needs to be accelerated if this energy source is to reach its potential.
- The eight-year delay between award of the Sarulla project and securing financing was largely a result of the legacy of a previous regulatory regime not the project's development and financing model.

Table 8: Effectiveness of Sarulla GPP compared to other projects in Indonesia (BNEF 2015)

BROAD POLICY GOALS	EFFECTIVENESS INDICATOR	SARULLA	ULUBELU 3 & 4	LAHENDONG 5 & 6	PATUHA	WAYANG WINDU 2
Increase private sector participation	Private finance in development	53% public debt 20% private debt 27% private equity Pre-completion revenue	57% public debt 43% public equity	45% public debt 55% public equity	63% public debt 37% public equity	All private finance*
Meet electricity demand through rapid deployment and low cost	Time to deployment from financial close (expected)	30-48 months	23-33 months	22-28 months	49 months	20 months
	Cost	USD 5.0m/MW	USD 2.9m/MW	USD 4.8m/MW	USD 2.9m/MW	USD1.8m/MW
	Technology	Combined Cycle	Single Flash	Single Flash	Dry Steam	Single Flash
Deploy renewable energy to achieve energy sovereignty	MW Installed	330 MW	110 MW	20 MW	55 MW	117 MW
	Year of Commissioning (expected)	2016-2018	2017	2017	2014	2009

*No available data to show the equity and debt mix.

The Sarulla GPP model is able to attract significant private finance, and is expected to deliver energy at competitive cost and contribute to achieving Indonesia's renewable energy targets.

5.1.1 INCREASING PRIVATE SECTOR PARTICIPATION

The project has the highest private sector participation for a geothermal power project on a previously undeveloped field since the introduction of Geothermal Law in 2003. The fact that exploration had already been concluded by the time the project was re-tendered provided a higher incentive for the private developer to take on the project since exposure to resource risk was already significantly reduced.[22] **This was demonstrated by the developer's willingness to incur significant costs** (USD 70 million) **for the access to wells and data on the proven resources** (ADB 2015). Previous exploration works also provided the developer with two ready production wells (out of 4 wells projected in Silangkitang field and 22 wells projected in both Silangkitang and Namora-I-Langit fields).

The high proportion of private debt attracted to Sarulla during the field development phase is noteworthy. Generally, private lenders do not provide financing until at least 70% of expected capacity has been drilled (Audinet 2013) but, in the case of Sarulla, only 17% of the projected capacity had been drilled prior to the financing decision.[23]

The fact that the commercial banks considered the resource in Silangkitang field to be 'proven' reduced their perceived risk. They further mitigated the risk after conducting thorough due diligence, the application of completion test system and obtaining JBIC's political risk guarantee. The sponsors' strong track record in geothermal and power business also played a key role in further assuring the lenders.

22 Private sector's role in exploration in the 1990s is excluded in the analysis due to different economic condition, business environment, regulatory framework and incentives.

23 Assuming average well capacity of 28MW in Silangkitang, the two wells drilled by UNSG represented 50% the target capacity of the Silangkitang field and 17% of the total target capacity (See Table 8 in section 4.2.1).

The Wayang Windu Unit 2 project is also known for its high private sector involvement. Sarulla and Wayang Windu 2 are similar in that the resources in both projects had been proven prior to securing debt financing. Standard Chartered, a private bank, arranged the debt financing for the Wayang Windu 2 and was later refinanced through a bonds issue after becoming fully operational.

5.1.2 MEETING ELECTRICITY DEMAND THROUGH RAPID DEPLOYMENT AND LOW COST

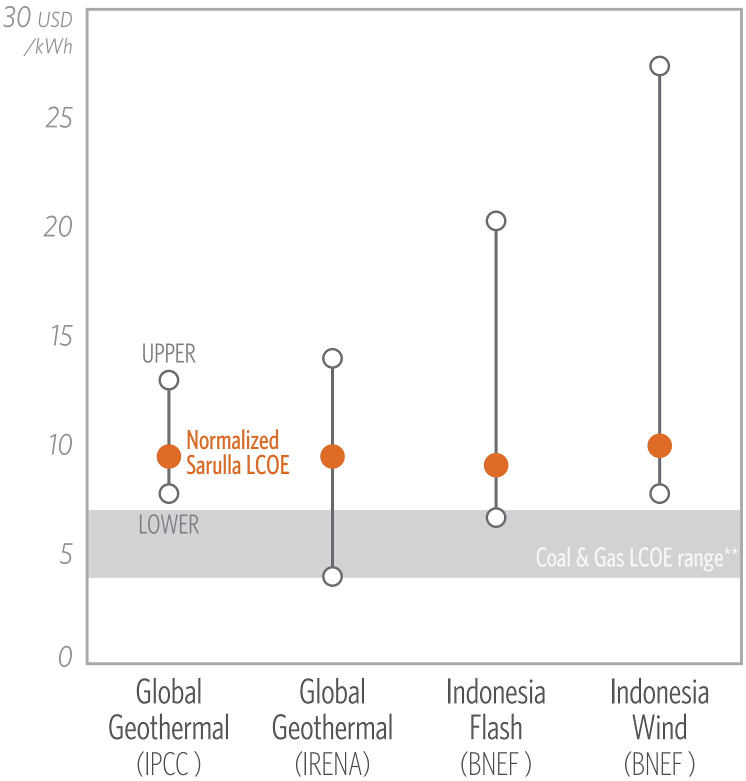
The initial investment costs of USD 5m/MW for Sarulla GPP is higher than comparable projects in Indonesia. The higher costs could partly be explained by the inclusion of upfront financing fees, interest during construction, reserve accounts and due diligence costs, as well as the application of binary ORC component in the combined-cycle technology, which typically requires higher capital costs (IEA 2010).

When looking at the costs throughout the project life cycle, Sarulla GPP compares well with geothermal projects in Indonesia and globally, even in the absence of public supports (See Figure 5). For baseload power, although direct comparison is not available, Figure 5 indicates that Sarulla's LCOE is still 40-60% more expensive than coal. However, geothermal provides an advantage over coal by being able to provide baseload power with lower greenhouse gas emissions and pollution.

Sarulla has not delivered fast geothermal deployment because it took around eight years for the project to reach financial close after the award of the tender in 2006. Financing delays were due to a renegotiation of the tariff with PLN and PGE's ownership of the project concession – the legacy of a previous regulatory regime – complicating stakeholders' attempts to attract finance. The Indonesian government addressed this in its 2003 Geothermal Law by allowing private developers to obtain the geothermal concession rights directly through government auction. Only fifteen Pertamina-owned concessions remain and most have already been developed by the state-owned oil and natural gas corporation.

Upon securing financing, expected deployment time of the project is generally comparable to other geothermal projects in Indonesia considering the greater number of drillholes and power capacity.

Figure 5: Competitiveness of Sarulla GPP LCOE (IRENA 2015, BNEF 2014a, BNEF 2014b, WEC 2013)*



*The Normalized Sarulla LCOE depicted in the graph shows the LCOE of the project when using discount factor provided by the benchmark, thereby removing the impact of financing arrangement and tax which had a significant impact in the calculation of the discount factor and, eventually, the LCOE.
**Direct comparison not possible due to unknown discount rate

5.1.3 INCREASING ENERGY SOVEREIGNTY THROUGH RENEWABLE ENERGY DEVELOPMENT

Indonesia has set an ambitious target for renewable energy which is expected to contribute up to 23% of total energy mix (GR 79/2014) in 2025. If successful, Sarulla GPP will increase geothermal capacity by 20%, increase renewable capacity by 5% (MEMR 2014) and meet 10% of projected geothermal capacity additions between 2013 and 2020. It is projected to produce an annual output of 2.6 TWh from 2018 onwards, equivalent to 18% of estimated electricity production in North Sumatra in 2018 (PLN 2015).

5.2 Potential for scaling up geothermal in Indonesia

Indonesia has the largest geothermal resource in the world, with potential capacity reaching 29GW (Table 9), of which less than 5% has been utilized (EBTKE 2015).

Under the national energy policy, the government plans to increase geothermal deployment to 7.6 GW by 2025 and 15.9 GW by 2050, representing, respectively, 5.2% and 3.5% of total installed capacity (DEN 2014). However, the ability of geothermal to provide a large capacity factor allows it to contribute a larger share in meeting electricity demand. In terms of production, geothermal is projected to meet 6.1% and 5.4% of the total electricity demand by 2025 and 2050 (DEN 2014).

5.3 Barriers to scale-up and replication

Meeting Indonesia's ambitious geothermal target of 7.6 GW in capacity by 2025 requires the sector to grow more than fivefold in the space of 12 years (DEN 2014). The Indonesian government has gradually introduced policies to address key barriers to scaling up geothermal in Indonesia. Through a long-term USD denominated FiT, a BVGL and mandatory offtake by PLN, government has significantly lowered the risks associated with currency fluctuation and offtake for private developers. In 2014, the government's new geothermal law addressed licensing issues and increased the FiT. The introduction of these policies has demonstrated the government's intention to accelerate the development of the sector by encouraging more private sector participation.

The full impact of these recent changes remains to be seen and key barriers to scale up geothermal deployment still remain.

5.3.1 INCREASING INVESTMENT IN EXPLORATION

Drilling activity so far has confirmed that 2 GW or less than 10% of the potential is suitable for geothermal development (see table 9), indicating that drilling needs to be accelerated if this energy source is to reach its potential. However, engaging the private sector in exploration may prove challenging. Despite the new policies introduced, a fully private-led geothermal development in Indonesia still may not be achievable in the foreseeable future. As experienced in many other countries, the ability of the private sector to take on the high risks associated with exploration remains a significant barrier. The significant amount of up-front capital required to carry out exploration, global success rates of 59% (IFCa 2013), and the reluctance of public and private financiers to fund exploration require private project developers to have large enough balance sheets to bear the risk. Even financing from Development Financial Institutions (DFIs) will have limited impact unless the resource has been largely proven (ADB 2015).

Table 9: Summary of geothermal potential in Indonesia (EBTKE 2015)

GEOTHERMAL POTENTIAL (MWE)						
RESOURCES		RESERVES			TOTAL	INSTALLED
SPECULATIVE	HYPOTHETICAL	PROBABLE	POSSIBLE	PROVEN		
7.377	5,009	13,413	823	2,288	**28,910**	**1,344**
TOTAL RESOURCES: **12,386**		TOTAL RESERVES: **16,524**				

The government should recognize that risk should be allocated to those who are best suited to bear them. In fields where there is little interest for private exploration or where risk is considered too high for private developers to bear, government intervention may be necessary. If private exploration is required, the government can extend soft loans, grants, insurance and guarantees to private developers to carry out exploration.

Another option could be for the government itself to take on the exploration, tendering out proven concessions to the private sector. Choosing this approach would require the government to incur significant up-front costs. However, it also means that private developers would require a lower return and subsequently a lower tariff from the government because of the substantial reduction in risk. This potential reduction in tariff could reach USD 1-3 ¢/kWh (ADB 2015). In addition, tendering out proven fields could also increase the private sector's appetite as demonstrated by Sarulla GPP.

The Government's Geothermal Fund, established in 2011 and managed by the Indonesia Investment Agency, Pusat Investasi Pemerintah (PIP), is well positioned to take on these responsibilities once key barriers to the scale up of the fund are addressed. The fund has yet to function effectively with zero disbursement to date. PIP's legal obligation to make low-risk, prudential investments does not match with funding geothermal exploration, a higher risk investment, making the fund unable to operate effectively. Strengthening the governance system of the fund or moving its management to another institution better suited to perform the role could be viable solutions.

5.3.2 INCREASING ACCESS TO LONG TERM DEBT

Sarulla GPP has shown that long-term debt is crucial to develop large scale geothermal projects. The Sarulla GPP model may not be easily replicated as the availability of long term debt instruments is rather limited. In Indonesia, commercial banks typically only provide corporate loans with tenor of less than 10 years (ADB 2015), while corporate bonds are mostly issued with a 5-year tenor (ADB 2012).

The government's long-term Business Viability Guarantee Letter (BVGL) and long-term USD-denominated FiT unlocked long-term debt from DFIs and commercial banks by addressing concerns about state-owned utility PLN's creditworthiness as the main offtaker for most power plants in Indonesia and providing high certainty on the project's revenue stream and removing the project's exposure to currency risk.

However, scaling up these instruments would require that the government bear the costs associated with providing the off-taker guarantee and the risk of local currency depreciation as the regulated electricity price means the cost of generating electricity is not passed through to end consumers. The government may not always be willing or able to provide such instruments for all geothermal projects.

If the BVGL can only be extended for a shorter period, the higher FiT introduced in 2014 can help developers to pay off loans more quickly, making longer-term loans less essential to project development. The use of a FiT that is initially higher and then decreases over time could also be a viable option to allow faster loan repayment.

5.3.3 SHIFTING ROLE OF PUBLIC FINANCE

The involvement of commercial lenders in field development may not always be replicable in other projects. Sarulla attracted commercial finance in part because significant exploration had already been done and the extent of the resource in one of the fields is considered to be more proven. In general, at least 70% of expected capacity must be drilled before commercial financing becomes available (Audinet 2013).

In Sarulla, commercial lenders have signaled their willingness to fund the construction phase of a geothermal project when key bankability concerns have been resolved – BVGL appears to be effective in addressing this concern. Once commercial finance is able to support the construction stage, public finance can focus on the exploration and field development stages where debt financing is scarce.

6. Conclusion

Indonesia has the largest geothermal resource in the world, with potential capacity reaching 29GW, of which less than 5% has been exploited (EBTKE 2015). However, the development of the sector has been characterized by low involvement of the private actors.

Sarulla GPP is distinguished by the high involvement of the private sector in a project exploiting a previously undeveloped geothermal resource in Indonesia. Sarulla GPP produces power at a similar cost to other geothermal projects globally and in Indonesia. The project demonstrates that with appropriate policy measures and risk mitigation tools, private project developers and financiers can be mobilized in developing geothermal energy in Indonesia.

6.3.1 KEY LESSONS

Several key factors enabled Sarulla GPP to be built:

- Geothermal resources that were already confirmed as suitable for power production when the developer won the tender, proved to be crucial in providing stakeholders with the incentive to undertake the project
- Government policies, public guarantees, and contingent equity from the project developer, facilitated the project in the following ways:
    - » A long-term USD-denominated feed-in-tariff (FiT) ensured revenue certainty over the project's life-cycle and removed the developer's and the lenders' exposure to currency fluctuation risk
    - » A Business Viability Guarantee Letter (BVGL) addressed concerns about the project's bankability by ensuring the state-owned offtaker's creditworthiness
    - » Japan Bank For International Cooperation's (JBIC) political risk guarantee reduced the cost of the commercial loans it covers
    - » Contingent equity support provided by the project developer to ensure the project meets targeted specifications, reassured financiers
- Availability of concessional and senior loans from the Clean Technology Fund (CTF), Canadian Climate Fund (CCF), Asian Development Bank (ADB) and JBIC. In particular, the CTF and CCF loans enabled the project to reach financial close

The combination of these measures enabled the project developer to secure the long-term loans at competitive rates necessary to make the project viable. Without them, expected equity returns would have dropped 4% to a level that is likely lower than the developer's expected returns.

Sarulla GPP also demonstrates that, when knowledge gap are reduced and risk mitigation measures are effectively applied, debt financiers could be more involved during the field development stage where risks are still considered high. Prior to financial close, project lenders spent considerable time conducting due diligence to be comfortable with the technical aspects of the project. In addition, the development of a detailed drilling and construction program were crucial for lenders to finalize the financing decision.

6.3.2 CONSIDERATIONS FOR SCALE UP

In meeting its ambitious geothermal deployment target, the government has gradually introduced a number of policies, intended to address the key challenges of geothermal development and scale up private investment in the sector. Recently, the government issued a new Geothermal Law which aimed to address the licensing issue, increase the level of FiT and expand the scope of the BVGL.

Despite these policies, key barriers remain – specifically related to exploration and long-term funding:

- The risks associated with exploration, including funding and the financial capacity of developer, could potentially be a significant barrier in scaling up geothermal deployment. Addressing this risk may require the government to take a larger role in dealing with exploration risks, by either conducting exploration itself before tendering out to private developers or by providing financial support in the form of concessional loans, grants, insurance or guarantees. Sarulla GPP indicates that private developers are prepared to incur significant costs to gain access to proven fields.
- Long-term debt in Indonesia is still relatively scarce, as most corporate loans and bonds have tenors below 10 years. Given the significant initial capital outlay incurred in geothermal projects, long-term debt financing is essential. A long-term BVGL may be required to mobilize such debt financing. When a long-term BVGL

is unavailable, structuring a tariff with a step-down approach could be a viable solution to allow for faster loan repayment, while the recent tariff increase could also help in reducing the need for longer debt tenor.

In addition to increasing the government's role, scaling up private finance in geothermal development also requires effective allocation of public and private capital. Sarulla GPP shows that private financiers have signaled their willingness to fund the construction stage when key bankability issues have been resolved. Public finance, including that from Development Financial Institutions (DFIs), would therefore be more useful if it focuses on exploration and field development activities for which access to finance is still limited. Imposing a requirement on independent assessment of reserves and of the feasibility of the project once exploration has been concluded can help mitigate the risks exposed to DFIs during field development.

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