Document of
The World Bank

FOR OFFICIAL USE ONLY

Report No: PAD1595

PROJECT APPRAISAL DOCUMENT

ON A PROPOSED

CLEAN TECHNOLOGY FUND (CTF) CONTINGENT RECOVERY GRANT

IN THE AMOUNT OF US$49 MILLION

AND

A GLOBAL ENVIRONMENT FACILITY (GEF) GRANT

IN THE AMOUNT OF US$6.25 MILLION

TO THE

REPUBLIC OF INDONESIA

FOR THE

GEOTHERMAL ENERGY UPSTREAM DEVELOPMENT PROJECT

November 2, 2016
{RVP/CD CLEARANCE DATE - SAME AS ON MOP}

Energy & Extractives Global Practice
East Asia and Pacific Region

CURRENCY EQUIVALENTS

Exchange Rate Effective as of October 15, 2016

Currency Unit	=	Indonesian Rupiah (IDR)
IDR 1,000	=	US$1
US$ 1	=	IDR

FISCAL YEAR

January 1 – December 31

ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank	ESIA	Environmental and Social Impact Assessment
AFD	Agence Française de Développement	ESMAP	Energy Sector Management Assistance Program
AMDAL	Indonesia Environmental Impact Assessment Regulations	ESMF	Environmental and Social Management Framework
ARGeo	African Rift Geothermal Development Program	ESMP	Environmental and Social Management Plan
ASTAE	Asian Sustainable Energy Program	ESMS	Environmental and Social Management System
BAPPENAS	National Development Planning Agency	FA	Financial Analysis
BAU	Business-As-Usual	FDI	Foreign Direct Investment
BPS	Statistics Indonesia	FIRR	Financial Rate of Return
CER	Certified emission reduction	FMA	Financial Management Assessment
CO2	Carbon dioxide	GCG	Good Corporate Governance
CPF	Country Partnership Framework	GDP	Gross Domestic Product
CRF	Clean Revolving Fund	GEA	Geothermal Energy Association
CTF	Clean Technology Fund	GEF	Global Environmental Facility
DA	Designated Account	GeoFund	Geothermal Energy Development Program
DPL	Development Policy Loan	GHG	Greenhouse gas
EBTKE	Directorate General of New Energy, Renewable and Conservation Energy	GIF	Geothermal Infrastructure Facility
EE	Energy Efficiency	GNZ	Government of New Zealand
EIRR	Economic Internal Rate of Return	GoI	Government of Indonesia
EMT	Exploration Management Team	GRS	Grievance Redress System
ENPV	Economic Net Present Value	GW	Gigawatt
EPM	Exploration Project Manager	IA	Implementing Agency

IADB	Inter-American Development Bank
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
IFC	International Finance Corporation
IPB	Geothermal Business Permit
IPF	Indigenous Peoples Framework
IPP	Indigenous Peoples Plan
IPPs	Independent Power Producers
IRCR	Inferred Resource Capacity Report
ISRs	Implementation Status and Results Reports
JICA	Japanese International Cooperation Agency
LARAP	Land Acquisition and Resettlement Action Plan
LCGS	Low Carbon Growth Strategy
LMAN	Indonesia's State Asset Management
MAC	Marginal Abatement Cost
MDB	Multilateral Development Bank
M&E	Monitoring and Evaluation
MIGA	Multilateral Investment Guarantee Agency
MEMR	Ministry of Energy and Mineral Resources
MFAT	Ministry of Foreign Affairs and Trade
MOF	Ministry of Finance
MRV	Monitoring, Reporting and Verification
MW	Megawatt
NAP	National Action Plan
NEC	National Energy Council
NOx	Nitrogen Oxides
NPV	Net Present Value
O&M	Operation & Maintenance
PAD	Project Appraisal Document
PDO	Project Development Objective
PIM	Project Implementation Manual
PLN	PT. Perusahaan Listrik Negara
PMK	Ministry of Financial Regulations
PMU	Project Management Unit
PPA	Power Purchasing Agreement
PPP	Public-Private Partnership
PPIAF	Public-Private Infrastructure Advisory Facility
PSOD	Private Sector Operations Department
PT SMI	PT Sarana Multi Infrastruktur
RE	Renewable Energy
RPF	Resettlement Policy Framework
RPJM	Rencana Pembangunan Jangka Menengah
RUPTL	Electricity Supply Business Plan
SAGS	Steam Field Above Ground Systems
SCD	Systematic Country Diagnostic
SOE	State-Owned Enterprise
SO2	Sulfur Dioxide
TA	Technical Assistance
TSP	Total Suspended Particulates
WACC	Weighted Average Cost of Capital
WB	World Bank
WKP	Wilayah Kerja Pertambangan
WTP	Willingness to Pay
UNDB	United Nations Development Business
WKP	Wilayah Kerja Pertambangan
WTP	Willingness to Pay
UNDB	UN Development Business

Regional Vice President:	Victoria Kwakwa
Country Director:	Rodrigo A. Chaves
Senior Global Practice Director:	Riccardo Puliti
Practice Manager:	Julia M. Fraser
Task Team Leader:	Peter Johansen

TABLE OF CONTENTS

PAD DATA SHEET

Indonesia

Indonesia: Geothermal Energy Upstream Development Project (P155047)

PROJECT APPRAISAL DOCUMENT

.

EAST ASIA AND PACIFIC

0000009259

Report No.: PAD1595

Basic Information		
Project ID P155047	EA Category A - Full Assessment	Team Leader(s) Peter Johansen
Lending Instrument Investment Project Financing	Fragile and/or Capacity Constraints [ ]	
	Financial Intermediaries [ ]	
	Series of Projects [ ]	
Project Implementation Start Date 30-Apr-2017	Project Implementation End Date 31-Dec-2022	
Expected Effectiveness Date 30-Apr-2017	Expected Closing Date 31-Dec-2022	
Joint IFC No		

Practice Manager/Manager	Senior Global Practice Director	Country Director	Regional Vice President
Julia M. Fraser	Riccardo Puliti	Rodrigo A. Chaves	Victoria Kwakwa

Borrower: Ministry of Finance, Republic of Indonesia			
Responsible Agency: PT SMI			
Contact:	Darwin Trisna Djajawinata	Title:	Director
Telephone No.:	622157854298	Email:	darwin@ptsmi.co.id

Project Financing Data(in USD Million)					
[ ]	Loan	[ ]	IDA Grant	[ ]	Guarantee
[ ]	Credit	[X]	Grant	[ ]	Other

Total Project Cost:	104.25	Total Bank Financing:	55.25
Financing Gap:	0.00		

Financing Source	Amount (USD Million)
Borrower	49.00
Clean Technology Fund (CTF)	49.00
Global Environment Facility (GEF)	6.25
Total	104.25

Expected Disbursements (in USD Million) – CTF and GEF

Fiscal Year	2017	2018	2019	2020	2021	2022				
Annual	1.25	10	10	15	10	9				
Cumulative	1.25	11.25	21.25	36.25	46.25	55.25				

Institutional Data
Practice Area (Lead)
Energy & Extractives
Contributing Practice Areas
-
Cross Cutting Topics
[X] Climate Change
[ ] Fragile, Conflict & Violence
[X] Gender
[ ] Jobs
[X] Public Private Partnership
Sectors / Climate Change
Sector (Maximum 5 and total % must equal 100)

Major Sector	Sector	%	Adaptation Co-benefits %	Mitigation Co-benefits %
Energy and mining	Other Renewable Energy	100		100
Total		100		

☐ I certify that there is no Adaptation and Mitigation Climate Change Co-benefits information applicable to this project.

Themes

Theme (Maximum 5 and total % must equal 100)

Major theme	Theme	%
Financial and private sector development	Infrastructure services for private sector development	40
Environment and natural resources management	Climate change	30
Environment and natural resources management	Other environment and natural resources management	30
Total		100

Proposed Development Objective(s)

The Project Development Objective (PDO) is to enable greenhouse gas (GHG) emission reduction and access to sustainable electricity supply through risk mitigation for geothermal investment in Indonesia

Components

Component Name	**Cost (USD Millions)**
Component 1: Risk Mitigation for Exploration Drilling	98.00
Component 2: Capacity Building on Geothermal Exploration and Environmental and Social Safeguards Management	6.25

Systematic Operations Risk- Rating Tool (SORT)

Risk Category	**Rating**
1. Political and Governance	S

2. Macroeconomic	M
3. Sector Strategies and Policies	S
4. Technical Design of Project or Program	M
5. Institutional Capacity for Implementation and Sustainability	S
6. Fiduciary	S
7. Environment and Social	S
8. Stakeholders	S
9. Other	N/A
OVERALL	S

Compliance	
Policy	
Does the project depart from the CAS in content or in other significant respects?	Yes [ ] No [X]
Does the project require any waivers of Bank policies?	Yes [ ] No [X]
Have these been approved by Bank management?	Yes [ ] No [X]
Is approval for any policy waiver sought from the Board?	Yes [ ] No [X]
Does the project meet the Regional criteria for readiness for implementation?	Yes [ ] No [ ]

Safeguard Policies Triggered by the Project	**Yes**	**No**
Environmental Assessment OP/BP 4.01	X	
Natural Habitats OP/BP 4.04	X	
Forests OP/BP 4.36	X	
Pest Management OP 4.09		X
Physical Cultural Resources OP/BP 4.11	X	
Indigenous Peoples OP/BP 4.10	X	
Involuntary Resettlement OP/BP 4.12	X	
Safety of Dams OP/BP 4.37	X	
Projects on International Waterways OP/BP 7.50		X
Projects in Disputed Areas OP/BP 7.60		X

Legal Covenants

Name	Recurrent	Due Date	Frequency
Section IA1 of Schedule 2	X		Continuous

Description of Covenant

The Recipient shall ensure that a Joint Committee is established and maintained, at all times during the implementation of the Project with functions, composition (including representatives of the Recipient, Ministry of Finance and Ministry of Energy and Mineral Resources), and resources satisfactory to the World Bank

Legal Covenants

Name	Recurrent	Due Date	Frequency
Section IB2 of Schedule 2	X		Continuous

Description of Covenant

The Recipient shall cause the Project to be implemented, in accordance with the Project Implementation Manual.

Legal Covenants

Name	Recurrent	Due Date	Frequency
Section IF1 of Schedule 2	X		Continuous

Description of Covenant

The Recipient shall apply the Environmental and Social Management Framework.

Conditions

Source Of Fund	Name	Type
CTF and GEF	PMK Regulation	Negotiations

Description of Condition: *PMK regulation issued by Ministry of Finance providing a mandate for PT SMI to use the funds transferred to the Geothermal Infrastructure Facility.*

Source Of Fund	Name	Type
CTF and GEF	Transfer of Land Rights	Negotiations

Description of Condition: *GoI (Ministry of Finance and Ministry of Mines and Energy) adopts an institutional arrangement for acquisition of land for geothermal exploration and its subsequent transfer to a private developer.*

Source Of Fund	Name	Type

CTF and GEF	CTF and GEF Grant Agreements		Negotiations	
Description of Condition: The Recipient adopts the Project Implementation Manual, acceptable to the World Bank.				
Team Composition				
Bank Staff				
Name	**Role**	**Title**	**Specialization**	**Unit**
Peter Johansen	Team Leader (ADM Responsible)	Senior Energy Specialist	Energy and Project Management	GEE09
Muchsin Chasani Abdul Qadir	Team Member	Energy Specialist	Energy	GEE02
Roberto La Rocca	Team Member	Energy Specialist	Energy and Finance	GEE09
Huong Mai Nguyen	Team Member	Energy Specialist	Energy	GEE02
Yan Li	Team Member	Energy Specialist	Energy and Finance	GEE09
Yash Gupta	Procurement Specialist	Senior Procurement Specialist	Procurement	GGODR
Budi Permana	Procurement Specialist (ADM Responsible)	Procurement Specialist	Procurement	GGODR
Novira Asra	Financial Management Specialist	Sr. Financial Management Specialist	Financial Management	GGODR
Evarist Baimu	Counsel	Senior Counsel	Legal	LEGES
Thrainn Fridriksson	Peer Reviewer	Energy Specialist	Geothermal Energy	GEEES
Alejandro J. Perez	Peer Reviewer	Senior Investment Officer	Private Sector	CNGS4
Extended Team				
Name	**Title**	**Office Phone**	**Location**	
Jens Wirth	Peer Reviewer, KfW			
Thomas Walton	Environmental Safeguards Specialist			
Pene Ferguson	Environmental Specialist			

Warren H. Waters	Social Safeguards Specialist		
Jim Randle	Geothermal Consultant		
Brian White	Geothermal Consultant		

Locations

Country	First Administrative Division	Location	Planned	Actual	Comments
Indonesia	To Be Determined (TBD)	TBD			

Consultants (Will be disclosed in the Monthly Operational Summary)

Consultants Required?	Consultants will be required for operational and advisory support to the team during project preparation and implementation.

I. STRATEGIC CONTEXT

A. Country Context

1. Indonesia is the world's largest archipelagic state, its fourth most populous nation, and the 10th largest economy in terms of purchasing power parity. It is a member of the ASEAN group of countries that have a combined population of 608.4 million and is also a member of the G-20. With more than 17,500 islands, of which 6,000 are inhabited, Indonesia has a population of over 250 million, with 300 distinct ethnic groups and over 700 languages and dialects. It has a gross national income per capita of US$3,524 (2014) and it has more than halved extreme poverty to 11.3 percent in the past fifteen years.

2. Indonesia's economic planning follows a 20-year development cycle. The current plan spans from 2005 to 2025. The five-year medium-term development plan, i.e. the third phase of the long-term plan runs from 2015 to 2019, and focuses on key development priorities including energy and infrastructure development, and on improving social assistance programs in education and health-care. Recent energy subsidy reforms have enabled shifts in public spending towards programs that directly impact the poor. However more than 28 million Indonesians currently live below the poverty line set at US$24.4 per month and approximately half of all households remain clustered around this poverty line. Employment growth has been slower than population growth, and public services remain inadequate by middle income country standards. Indonesia is also doing poorly on a number of health and infrastructure related indicators.

3. Despite rising government spending in recent years, Indonesia's core infrastructure stock, such as electricity, road networks, ports, and telecommunication facilities, has not kept pace with economic growth. The resultant "infrastructure gap" in terms of both quantity and quality of investment is due to several factors among which the most important are: a complex and non-transparent regulatory framework for implementation of infrastructure projects; an underdeveloped framework for Public-Private Partnerships (PPPs) resulting in insufficient mobilization of private funds for investment; and the inadequate participation of domestic capital markets in channeling funds to infrastructure sectors. The infrastructure gap contributes to undermine productivity, growth, competitiveness and poverty reduction efforts.

4. Going forward, reducing the infrastructure gap would support growth and prosperity through several channels. The spending effect would support short-term growth and the creation of jobs. As the investments translate into infrastructure stock, private investment will be crowded-in and productive capacity, and long-term growth will be supported. As infrastructure services are delivered firms' competitiveness would increase and so would the population's access to services.

B. Sectoral and Institutional Context

5. Indonesia's rapid economic growth has been fueled by an ever-expanding power sector. Sustained increases in electricity consumption (with average annual demand growth of 7.8% during 2009-2013) are linked with economic growth, urbanization and subsidized electricity

tariffs. Installed generation capacity was 50.9 GW as of end-2014, excluding captive generation. Nearly 78% of installed capacity is in Java and the remaining capacity is in unconnected grids in major islands, and hundreds of isolated mini-grids in rural, remote areas on Java-Bali and outer islands. PT Perusahaan Listrik Negara (PLN), the national power company, supplies consumers through its own generation and purchases from private Independent Power Producers (IPPs) and Public Private Partnership generation (PPP).

6. Keeping up with high electricity demand growth is a key development challenge. After a period of surplus in power generation caused by the impact of the Asian financial crisis, electricity supply experienced shortages as PLN faced difficulties in mobilizing sufficient power generation investments to catch up with demand growth. Private sector investment came to a halt under the combined effect of capital flight from emerging markets, and the institutional turmoil that followed the repeal of the 2002 Electricity Law by the Constitutional Court in Indonesia. In the recent past, supply barely managed to keep up with increasing demand; brownouts and load shedding have impacted economic growth and affected even ordinary consumers. This continues to be the case, even though demand has slowed down as a result of the global economic crisis.

7. Over the past decade, GoI has made great strides with the national electrification program. In 2008, data from the National Energy Council (NEC) show that the country's electrification rate was about two-thirds of the overall population. As of 2014, about 84% of the country's population was electrified. GoI now targets a 99% electrification rate by 2020 as part of its overall vision and social mission for the country's energy sector. Against this ambitious target, Indonesians enjoy a low electricity consumptions per capita at 40% of the 2012 middle income countries (MIC) average. Stark differences in the provincial electrification program exist, with the six Eastern Indonesian provinces exhibiting some of the country's lowest electricity access rates – and highest poverty rates, as shown in Annex 6.

8. In an effort to reconcile the national electrification and economic development plans, GoI has put forward the Electricity Supply Business Plan or Rencana Usaha Penyediaan Tenaga Listrik (RUPTL), 2016-2024, which *inter-alia* provides for an electrification program in the Eastern islands to close the supply gap. The Plan foresees to bring on-line over 80 GW of newly installed capacity during 2015-2024, 98% (or about 78 GW) of which has already been allocated to specific generation options. Of this allocated amount, roughly 74% (or about 58 GW) is expected to be fossil fuel-based (coal at 44% and gas at 29%), while hydro- and geothermal-power are expected to receive the lion's share of investments in clean energy (at about 12% and 8%, respectively).

9. In order to meet growing demand, Indonesia is significantly switching away from oil-fired generation in favor of accelerating the additions of new coal capacity. Indonesia is one of six Asian countries which collectively make up some 80% of the world's new coal plants under construction between now and 2020. At the rate of coal development identified through RUPTL, Indonesia alone would be adding 7% of all new coal-fired power plants globally in the next four years up to 2020. This, in turn, would have the effect of locking in new streams –several million tonnes– of greenhouse gas (GHG) emissions for the useful life of the local thermal power plants in question. It is a priority for the WB and GoI to identify alternatives to coal, one of the most important of which will be geothermal energy.

10. Geothermal development is a key development priority for GoI[1], which has set a target of 7.2GW of geothermal capacity by 2025. The Ministry of Energy and Mineral Resources (MEMR)'s "Roadmap for Accelerated Development of New and Renewable Energy 2015-2025"[2] sees geothermal contributing 7 percentage points of GoI's renewable energy (RE) target of 23% by 2025. Geothermal power is expected to contribute to the country's GHG emission reduction efforts, which target a 29% cut by 2030 compared with a Business-As-Usual (BAU) emissions projection that started in 2010[3].

11. Geothermal power is one of the best options to provide a baseload response to fast-growing energy demand and diversify the energy mix in Indonesia. It is a baseload generation technology not subject to the intermittency and variability associated with most renewable electricity sources. Indonesia's geothermal power potential is estimated at around 27 GW, roughly 40% of the world's known reserves. Many of the geothermal resources in Indonesia are also ideally located on islands with major population centers where electricity demand is high and continues to grow, though there are also resources in more remote locations such as Eastern Indonesia offering an opportunity for poverty alleviation through rural electrification, and/or displacing expensive diesel–fueled generation. Furthermore, as an indigenous and non-tradable energy source, it will also enhance the country's energy security and largely serve as a natural hedge against the volatility of fossil-fuel prices.

12. Despite the geothermal potential and the focus of GoI and development partners, only about 5% of the total resources indigenous to Indonesia are currently developed to produce power. Against a potential of approximately 27 GW, only about 1.3 GW of geothermal capacity has been developed by 2015 and estimates suggest only an additional 85 MW will be added in 2016. Most of the current installed megawatts came on-line before the 2000s from the geothermal fields of Kamojang (1983), Darajat (1994), Gunung Salak (1994) and Wayang Windu (1999), which provide over 1 GW of aggregate capacity. Only a handful of existing geothermal operations expanded production over the past decade (so-called brownfields). In terms of new (greenfield) developments that carry greater risks only one private sector project, Sarulla (320 MW), has achieved financial closure in the last decade. Other recent greenfield developments have all relied on state owned enterprises (SOEs) – They include Ulubelu 1&2 (110 MW – PGE drilled steam field and PLN established power plant) as well as the following projects being progressed by PGE alone: Ulubelu 3&4 (110 MW – with power plant financed by loan from World Bank and CTF), Lahendong 5&6/Tompaso (40 MW – with power plant financed by loan from World Bank and CTF), Lumut Balai (110 MW), Hulu Lais (55 MW) and Kerinci (55 MW). Karaha (30 MW) currently being progressed by PGE is effectively a brownfield development as the field was explored by private developers initially.

[1] The relevant national policies include: (i) Indonesia's Second National Climate Change Communication (2009); (ii) the Indonesia Green Paper (2009); (iii) the GOI National Energy Policy (2005); (iv) the Energy Blueprint 2005 – 2025; (v) Indonesia's National Long-Term Development Plan 2005-2025, and National Medium-Term Development Program for 2010 – 2014 (Rencana Pembangunan Jangka Menengah, or RPJM); (vii) the National Action Plan for Climate Change (2007); (viii) the Development Planning Response to Climate Change (2008); (ix) the Climate Change Roadmap for the National Medium-Term Development Program for 2010 – 2014 (2009); (x) Indonesia's Technology Needs Assessment on Climate Change Mitigation (2009); and (xi) other relevant sector development policies and programs.

[2] The roadmap is dated May 2015

[3] Indonesia's Intended Nationally Determined Contribution, 2015

13. Low levels of private sector participation have contributed to slower-than-desired geothermal development. This reflects high resource risk, a key barrier to geothermal development which remains unaddressed in Indonesia. Resource risk is exacerbated by exploration drilling costs, which can be up to US$8 million per well plus supporting infrastructure. With a minimum of three exploration wells needed for resource estimation in most cases, this can be prohibitive for project developers who are not guaranteed downstream returns on their pre-production investments. Exploration drilling also constitutes the biggest barrier to obtaining financing as its high associated risks increase investors' equity return requirements.

14. GoI has designed interventions specifically to address resource risk and mobilize private capital. First and foremost, it has taken important steps to resolve institutional, regulatory and tariff constraints. In June 2014**,** the geothermal tariffs were revised for a second time[4], providing some relief to developers willing to take on exploration and development risks – yet leaving issues of tariff adjustment unaddressed. In August 2014, a new Geothermal Law was issued (even though the Implementing Regulation still has not been approved). The Law allows centralizing geothermal concession tenders while securing the interest of local government in geothermal development through a production bonus – a benefit sharing mechanism – levied on top of any applicable taxes. Another important reform is the declassification of geothermal activities as "mining activities", thus allowing greater latitude for geothermal development in the country.

15. In 2015, GoI demonstrated continued emphasis on geothermal development. To address the issues of tariff adjustment which have in the past stalled private participation, GoI started exploring options for a new tariff regime. While the details of this new system are yet to be finalized, GoI expects it to play an enabling role for geothermal developments in the advanced markets of Java and Sumatra among those developers and holders of a geothermal license (IPB or Ijin Panas Bumi holders) willing to take on exploration and development risks.

16. GoI is cognizant that a new tariff regime may not be sufficient to mobilize private investment in geothermal power development where private sector interest is low due to inherent site-specific conditions (e.g. the geothermal fields of Eastern Indonesia). Moreover, it is yet to be seen whether such system will be sufficient to compensate for resource risk at the speed desired by GoI. GoI has taken the first step to transfer funds (about IDR 3.1 trillion or US$225 million) from what was previously known as the Geothermal Fund Facility (GFF) to a new Geothermal Infrastructure Facility (GIF) in PT Sarana Multi Infrastruktur (PT SMI) for mitigation of geothermal exploration drilling risks, particularly in areas where development prospects are not attractive for pure private sector plays. The original design of GFF was based on collateral-backed loans and failed to adequately address the high exploration risk issues since the GFF loans were to be paid back in full even in the case of unsuccessful drilling. The design of GIF will enable, among other things, government-sponsored drilling, which hinges on a more balanced approach to risk allocation in the overall geothermal development process. In order to enable PT SMI to use the funds made available through GIF, MOF is presently drafting enabling regulation (a so-called PMK) the issuance of which will be a precondition for PT SMI's involvement in government sponsored drilling. The PMK is therefore a negotiations condition for the CTF and GEF grants.

[4] The first geothermal tariff was a ceiling tariff in 2009, which was revised to be feed-in tariff in 2012. In 2014, it was revised the second time to a ceiling tariff.

17. Global experience shows that de-risking geothermal projects by using government funds for exploration has been the key to attracting risk capital and mobilizing private sector expertise towards geothermal drilling**.** Advanced development of the local geothermal markets in geothermal resource-rich countries such as USA, Japan, and New Zealand is largely attributable to cost-shared or dedicated government exploration drilling programs that increase the investment appeal for investors and developers. Government-sponsored drilling is currently the focus of much of the global push for geothermal development, and cost-shared drilling models are also being pursued in the developing geothermal markets such as Turkey, Armenia (supported by World Bank) and Mexico (supported by Inter-American Development Bank).

18. Geothermal energy is a low-pollution and low-cost alternative to expensive oil-fired generation, which Eastern Indonesia has so far been heavily reliant on and which has been holding back the electrification of this, the poorest part of the country. There are therefore huge developmental advantages of introducing geothermal baseload generation in the island grids. However, the risks involved in geothermal development in the Eastern Indonesia, i.e. the six eastern Indonesian provinces, are also higher than in the major power markets in the bigger islands. Based on international experience, the best way to attract private developers to IPB license auctions in the smaller eastern island networks and get these important resources under development is government-sponsored drilling.

19. PT SMI has been given a government mandate to finance and facilitate exploration drilling with a specific focus on the eastern islands. However, it lacks the geothermal expertise needed to implement a pre-license drilling window and can only use a limited share of the GIF funds for this purpose. Limited capacity and limited funds are thus constraining the development of government-sponsored drilling with the consequence that (i) the Eastern Indonesia market risks remaining under-developed and (ii) the feasibility and effectiveness of pre-license drilling remain untested.

20. To date, international development assistance has been focused on assisting GoI in addressing institutional and regulatory shortcomings, and providing support to downstream investment. Asian Development Bank (ADB) and several bilateral development partners such as JICA, and New Zealand Government, have been supporting GoI with institutional, regulatory and tariff reforms. The WBG has assisted GoI with the development of a pricing policy and robust regulatory provisions for geothermal development through the Global Environment Facility (GEF) and the Asia Sustainable Energy Program (ASTAE). However, issues related to pricing, environmental and social regulation, off-take guarantees, among others, still remain to be solved. The World Bank has recently approved an Indonesia Sustainable and Inclusive Energy Development Policy Loan (DPL), which includes strengthening of the regulatory environment, particularly focusing on adoption of the implementing regulation corresponding to geothermal power development for the Geothermal Law. However, to have the full effect this will need to be supplemented through well-coordinated technical assistance from multi- and bi-lateral development partners.

C. Higher Level Objectives to which the Project Contributes

21. The proposed Project supports the World Bank poverty alleviation and prosperity-sharing goals while supporting the GoI in its efforts to introduce indigenous energy resource alternatives to coal in order to limit GHG emissions. By focusing on the development of geothermal resources

in Eastern Indonesia (where electrification rates are lowest and poverty rates are highest), the Project is expected to contribute to the GoI's goals set forth in the national electrification, economic development and sustainable power sector expansion plans.

22. The Bank's current Country Partnership Framework (CPF) for Indonesia covering the period FY 2016-20 was approved in December 2015. Earlier in 2015, the Systematic Country Diagnostics (SCD) identified infrastructure bottlenecks as constraints to inclusive growth. The CPF assigned a priority role to infrastructure, including energy, for furthering the government's development goals of building a more prosperous, equal and economically independent Indonesia, eliminating extreme poverty and boosting shared prosperity.

23. Sustainable energy and universal access is identified as a key engagement area for the World Bank Group (WBG). Specifically, the CPF identifies the following four main areas for the Bank to focus on in the energy sector: (i) energy infrastructure: improving operational efficiencies, reliability of services through among others transmission and distribution and pumped storage; (ii) renewable energy and low carbon development: accelerating geothermal and other renewables complemented with sustainable development of hydropower and the gas sector; (iii) access to modern energy services: potentially through grid extensions, possible off grid solutions, modern cooking solutions; and (iv) sector governance, competitiveness and efficiency, particularly through the DPL series, and project delivery TA.

II. PROJECT DEVELOPMENT OBJECTIVES

A. PDO

24. The Project Development Objective (PDO) is to enable greenhouse gas (GHG) emission reduction and access to sustainable electricity supply through risk mitigation for geothermal investment in Indonesia.

B. Project Beneficiaries

25. The proposed Project has several beneficiaries, namely: (i) electricity consumers who will benefit from greater access to reliable electricity from geothermal resources; (ii) Indonesian citizens who will be supplied with incrementally cleaner energy mix; (iii) skilled and unskilled workers who will enjoy temporary benefits ; and (iv) counterpart institutions which will gain knowledge and experience to develop a sustainable geothermal resource risk mitigation facility. Investment in geothermal power is expected to have long-term implications for the country's sustainable development, diversification of generation portfolio and energy security. In the long-run, the lower cost of geothermal generation compared with diesel generation will reduce the total government subsidy on electricity, and therefore free up tax dollars for other public programs.

26. The Project will support electrification in Eastern Indonesia, which has the highest poverty rates in the country, thus supporting the achievement of the electrification objectives set through Energi dan Sumber Daya Mineral (ESDM)'s Program Indonesia Terang or "Brightening Indonesia" by providing direct benefits for people affected by energy poverty. This is particularly

true for women, who are disproportionately affected by it and whose access to energy resources and benefits may be further curtailed by unequal power relations within the household.

C. PDO Level Results Indicators

27. Key result indicators to monitor progress toward achievement of the PDO are:
- Estimated GHG emission reduction compared to a business-as-usual baseline (MtCO2e)
- Electric power generation capacity enabled through the issuance of geothermal development licenses (MW)
- Planned increase in the number of connected households for the associated local electricity networks (Number)

28. In addition, the following intermediate result indicators will be adopted:
- Commercial capital mobilized (US$)
- Generating capacity-equivalent of steam yields from wells drilled, total and average (MW and MW/well)
- Direct project beneficiaries (Number)
- Female beneficiaries (Number)
- Delivery of Inferred Resource Capacity Reports by Exploration Management Team (Number)
- Practice guides for safeguards implementation (Number)
- Villages located next to exploration sites with at least one public consultation held (%)
- Share of public consultations segregated by gender (%)

29. The proposed Project is designed to monitor Citizen Engagement through "Villages located next to exploration sites with at least one public consultation held". Gender is monitored through two indicators, namely: "Share of public consultations segregated by gender" and "Female Beneficiaries".

III. PROJECT DESCRIPTION

A. Project Components

30. The proposed Project (described at length in Annex 2) consists of two key components:

31. *Component 1: Risk Mitigation for Geothermal Exploration Drilling (US$98 million, of which US$49 million is from CTF and US$49 million is from GoI)* – the component will finance a program of activities designed to support geothermal exploration drilling in Indonesia, through: (a) drilling of exploration and confirmation wells; and (b) constructing access roads and other associated infrastructure to facilitate the drilling activities, at select geothermal sites. Funding for exploration drilling is expected to be made available in the amount of US$49 million from CTF with a matching contribution from MoF/PT SMI.

32. Sites for exploration drilling will be selected by the Directorate General of New Energy, Renewable and Conservation Energy (EBTKE) under MEMR. Of an initial list of five sites, pre-selected by MEMR two sites have been deemed to be promising while three were discarded. The two promising sites are (i) on the island of Flores – this possible sub-project is in an advanced stage of pre-feasibility study including comprehensive environmental and social impact assessments, making it realistic that a decision to drill could be made shortly after the Project starts implementation; and (ii) on Bacan Island in north Maluku – this possible sub-project has been screened regarding potential environmental and social issues and a pre-feasibility is planned to commence shortly. MEMR has subsequently suggested a list of additional eight sites out of which four will be selected for screening and full desk study of existing data - bringing the number of potential sub-project up to six. It is agreed with MEMR that at least half of the sites to be explored will be in the islands of Eastern Indonesia, where geothermal power can serve to increase access to sustainable energy. However, GoM may also wish to demonstrate government-sponsored drilling in sites connected to the larger power markets in Sumatra or Java which allow development of plants with larger capacity. It is therefore expected that one or two of the six sites will be in Sumatra and connected to the major power markets.

33. Based on the typical size of plants observed in Eastern Indonesia, it is estimated that 65 MW will come on-line as a result of the exploration drilling financed under this Project. This is a conservative estimate assuming that all successful site developments will be outside the major power markets. A revolving mechanism, referred to as the Geothermal Exploration Facility, will be set up through which the funds used for exploration drilling will flow back to the facility through the repayment of exploration cost plus a premium from developers that have successfully secured a license to develop the project. The reflow of funds into the Facility will ensure that funding will be available for future development, thus ensuring sustainability of the risk mitigation scheme.

34. *Component 2: Capacity Building on Geothermal Exploration and Environmental and Social Safeguards Management (US$6.25 million)* – the component will finance a program of capacity building designed to establish an efficient and effective geothermal energy exploration and tendering program including such activities as: (i) advisory support in carrying out geology, geochemistry and geophysics surveys (3G surveys) and topographic mapping for geothermal sites; (ii) advisory support for preparation of drilling, well completion and resource assessment reports (based on 3G surveys) as well as for the bidding process for exploration service companies; (iii) recruitment of an exploration management team; (iv) advisory support for environmental and social safeguard management related to exploration and exploitation of geothermal energy; and (v) just-in-time assistance to MEMR, Badan Geologi, and the Recipient in response to request for international expertise to deal with questions related to, *inter alia*, geothermal tariff setting, benefit-sharing, and data management and sharing.

35. This component will be financed by the Global Environment Facility (GEF) grant but will also benefit from a parallel grant from the Government of New Zealand (GNZ). The GNZ grant, which is equivalent to around $3.25 million, is designed to be complementary to the development objective of this Project, and will focus on supporting the GoI on: (i) establishment of an effective GIS-based database by collating and analyzing existing and new resources data, potentially to be housed within Badan Geologi (BG); (ii) methodology for robust resource and reserve estimation

and reporting protocol to an internationally acceptable standard; (iii) methodology for prioritization of potential sites for geothermal development; and (iv) capacity building for EBTKE and PT SMI for tendering and executing an exploration program.

36. The technical support and capacity building will include the building up of an Exploration Management Team (EMT) inside of PT SMI. The Team will consist of various experts coordinated by a geothermal consultancy company (more detail is provided in Annex 2). Specifically, the EMT will provide technical assistance to the government-sponsored exploration drilling program, including advisory support in carrying out geology, geochemistry and geophysics surveys (3G surveys) and topographic mapping for candidate sites. Support will also be made available for the preparation of drilling, well completion and resource assessment reports (based on 3G surveys) as well as for the bidding process for exploration drilling services. Capacity building plans will also benefit the Geothermal Directorate under the Ministry of Energy and Mineral Resources and Badan Geologi (Indonesia's Geological Agency). GNZ has already recruited a consultant to staff the EMT and the core EMT members as well as some short-term specialists will be funded by the GNZ grant during the first three years of the Project. The GEF grant will finance an in-house PT SMI Exploration Project Manager (EPM) throughout the project lifetime as well as EMT core team members for the last 2.5 years of the project and most of the short-term specialist support for the EMT.

37. Furthermore, GEF resources will fund the preparation of practice guides for the subproject-specific Environmental and Social Impact Assessment (ESIA), Environmental and Social Management Plan (ESMP), Indigenous Peoples Plan (IPP), and Land Acquisition and Resettlement Action Plan (LARAP), as well as just-in-time assistance for MEMR, Badan Geologi, and PT SMI in response to request for international expertise to deal with questions related to, *inter alia*, geothermal tariff setting, benefit-sharing, and data management and sharing.

B. Project Financing

38. Total estimated project costs are $104.25 million, of which $49 million is proposed to be financed from a cost recovery grant from CTF, $49 million from counterpart funds through PT SMI, and a GEF grant amounting to US$6.25 million (supporting 100 percent of Component 2 project expenditures). Given the revolving nature of the proposed facility, it is expected that funds will flow back in three-year cycles, therefore enabling a total of 260 MW new geothermal generating capacity and investment of about US$1.56 billion[5] over an 18-year period. Summary tables of project cost and financing (US$ million) are provided below.

[5] The contingent recovery nature of the CTF grant relates to the fact that reflows from successful licensing will be returned to CTF at the end of the Project unless already committed to financing contracts for future exploratory drilling.

CTF/GEF Support

Agency	Component 1 - Risk Mitigation for Geothermal Exploration Drilling	Component 2 - Capacity Building on Geothermal Exploration and Environmental and Social Safeguards Management	Total
MoF/PT SMI	49.00		49.00
WB/CTF	49.00		49.00
WB/GEF		6.25	6.25
Total	98.00	6.25	104.25

39. Government investment in exploration drilling has played a critical role for geothermal development worldwide. Taking full advantage of Indonesia's vast resource potential would require post-exploration, resource risk mitigation support. The post-exploration drilling phase of the geothermal development process (known as production drilling) requires significant investments, although likely at a lower financing cost due to a reduction in resource risk. To support this phase, WB may consider a tentative US$300 million IBRD loan for mid-stream development (i.e. steam-field drilling), with the aim of firming up resource levels prior to Steam-Above-Ground-System (SAGS) and power plant development – where greater private participation is likely.

Subsequent Investment

Agency	IBRD loan under consideration - Investment Support for Geothermal Exploitation	Total
WB	300.00	300.00
Total	300.00	300.00

C. Lessons Learned and Reflected in the Project Design

40. The Bank's support would build on the existing body of work and previous engagements in the global and Indonesian geothermal space. Globally, experiences such as the World Bank's Turkey Geothermal Development Project, Armenia Geothermal Exploratory Drilling Project, Geothermal Energy Development Program (GeoFund), and African Rift Geothermal Development Program (ARGeo), the IDB's Geothermal Financing and Risk Transfer Facility in Mexico, and the KfW's Geothermal Risk Mitigation Facility for East Africa all provide relevant inputs to the Project design[6].

41. Common elements and key lessons learned in the design of these engagements include: (i) the value of moving upstream in the geothermal development process in order to mitigate resource risk and catalyze private investments in the greater share of development costs; (ii) the need for the public sector to step in and mobilize exploration drilling risk capital, which the private sector struggles to raise from commercial financial institutions; and (iii) due to the complexity of

[6]This is also informed by relevant literature review, which inter-alia includes IFC-led efforts such as, "*Success of Geothermal Wells: A Global Study*" and "*Lessons from International Experience in Geothermal Development*".

geothermal exploration drilling, the provision of a technical assistance package to support engaged government entities in making informed drilling decisions. In addition, the engagements reviewed have been useful in the identification of relevant result indicators and potential risks.

42. In the Indonesian context, past World Bank activities that inform this operation are: (i) the PPIAF-funded Assessment of Geothermal Resource Risks, which took stock of the international experience with geothermal development and distilled mitigations options applicable to Indonesia; and (ii) the GEF-funded Geothermal Power Generation Development Project, which inter-alia supported the development of a pricing and compensation policy for geothermal power. Notably, the WB-ADB joint tariff methodology report on Indonesia's geothermal tariff reform informed the design of the Project.

43. In addition to the Bank's past experiences, ongoing activities that inform this operation are: (i) the CTF/IBRD, ADB Private Sector Operations Department (PSOD) and IFC downstream investment projects and related technical assistance programs; and (ii) the Climate Change Development Policy Loans, which were provided collectively by the World Bank, JICA and AFD, and which further supported the development of a pricing and compensation policy that is necessary to address the higher financial cost of geothermal electricity compared with coal-based power.

44. Several other World Bank energy sector loans have had issues with low disbursement rates related to: (i) readiness of project in terms of technical design; (ii) the inability of implementing agency to complete supporting infrastructure in a timely fashion; (iii) slow and cumbersome procurement procedures; and (iv) delays in land acquisition and implementation of the related safeguards instruments. The design of the proposed Project is informed by such experiences and the following mitigations measures have been implemented: (i) the proposed sub-projects can proceed without the need for any supporting infrastructure to be prepared by the implementing agency or any major upfront technical design effort; (ii) a procurement strategy is being prepared including measures to deal with any shortcomings in the procurement processes of the implementing agency; and (iii) land acquisition will be carried out using a willing buyer-willing seller approach that has proved efficient under the ongoing Geothermal Clean Energy Investment Project, implemented by Pertamina Geothermal Energy (PGE).

IV. IMPLEMENTATION

A. Institutional and Implementation Arrangements

45. PT SMI is the Project Implementing Agency under the strategic guidance of a Joint Committee. The Joint Committee will be made up of key stakeholders, namely MoF, MEMR, Directorate General for New Energy, Renewable and Conservation Energy (EBTKE), and Badan Geologi (BG). MoF and MEMR will exercise an overall oversight function over PT SMI and play an important role in terms of overall geothermal development coordination, respectively. EBTKE will be responsible for setting the principles for site selection and facilitating the tendering process for the geothermal area (Wilayah Kerja Pertambangan or WKP) after exploration drilling has produced sufficient evidence of the productivity of geothermal resources and viability for further

investments. Badan Geologi, the Geological Agency of Indonesia, will support project implementation through suppling geological data on the sub-project candidates.

46. The Joint Committee will make key decisions related to: (i) projects to be included for geoscience and safeguards screenings, (ii) whether to proceed with drilling and (iii) choice of well targets. PT SMI will oversee the implementation of the Project; and in doing so, it will establish a Project Management Unit fully staffed with key roles for fiduciary and safeguards supervision. More importantly, it will be supported by an Exploration Management Team (EMT) of consultants with expertise in geothermal resources and development and experience in management of drilling and civil works[7] contracts.

47. The GoI will need to direct a government entity to temporarily hold the land title. This entity is going to be either EBTKE or Lembaga Manajemen Aset Negara (LMAN), the State Assets Management Agency under the Ministry of Finance, which has been created to acquire and hold land for infrastructure projects under public-private partnership (PPP) arrangements. There will be an agreement between this entity, PT SMI and MEMR on the transfer of land title as part of the Data Package to be provided to the future developer. The process of transferring land title bundled with the Data Package is still been decided by PT SMI and MEMR. An option where land is leased to future developers is being considered since the sale of state assets is difficult in Indonesia. As a negotiations condition, GoI (Ministry of Finance and Ministry of Mines and Energy) must adopt an institutional arrangement for acquisition of land for geothermal exploration and its subsequent transfer to a private developer

48. PT SMI's role in geothermal exploration, including issues related to investing government funds, arranging drilling through properly licensed entities, will be defined in a new regulation (PMK) that is being drafted and will need to be issued by MoF. The issuance of the PMK is a negotiations condition for the CTF and GEF grants. A Project Implementation Manual (PIM) is being prepared by PT SMI and needs to be agreed with the World Bank and adopted by PT SMI before Grant negotiations. It will outline the project structure and key processes and procedures to be followed, especially those undertaken by the implementing agency. A schematic of the Project's implementation arrangements is provided in Annex 3.

B. Results Monitoring and Evaluation

49. On monitoring and evaluation (M&E) capacity, PT SMI is experienced with the implementation of the WB Indonesia Infrastructure Finance Facility (P092218), engaged with other projects (Indonesia Infrastructure Finance Facility – Additional Financing (P154779) and Regional Infrastructure Development Fund (P154947)) and well-versed with M&E procedures. As the implementing agency, PT SMI, through a PMU, will monitor the overall project implementation against the performance indicators listed in the 'PDO Level Results Indicators' section and detailed in Annex 1. They will also monitor contractors' performance supported by the EMT. Data and statistics on actual project outputs and outcomes will be gathered, analyzed, and included in the quarterly progress reports to be submitted to the Bank. These efforts on

[7] Civil works are needed to enable rig access to the sites.

monitoring progress towards the achievement of the PDO will be complemented by Implementation Status and Results Reports (ISRs).

C. Sustainability

50. GoI has long been supporting the geothermal sector by making adjustments to the institutional and regulatory environment. Through MoF/PT SMI, GoI has also committed IDR 3.1 trillion or about US$225 million for geothermal development and requested WB support to the government-sponsored exploration drilling program. Incorporating lessons learned from similar engagements, the Project design includes setting up a revolving mechanism through which the funds used for exploration drilling will flow back to the facility through repayment from developers that are successful in securing a license to develop the project. A sustainability analysis was performed for different levels of exploration success (80%, 60% and 40%) and a 25% premium charged to developers. At least 15 fields will be explored and at least 9 would be developed as long as the success rate does not drop under 60% - a reasonable assumption given that the statistical individual well success rate (wells that can be used for exploration out of total wells drilled) in Indonesia is over 60%. The full sustainability analysis of the proposed scheme is presented in Annex 7.

V. KEY RISKS

A. Overall Risk Rating and Explanation of Key Risks

51. The various risks faced by the Project have been preliminarily assessed through the Systematic Operations Risk-Rating Tool (SORT). In light of this analysis, the overall project risk is assessed to be Substantial. A number of risks of rating 'M' or higher were identified, including: (i) Political and Governance, and Fiduciary; (ii) Macroeconomic; (iii) Sector Strategy and Policies, (iv) Institutional Capacity for Implementation and Sustainability and Stakeholder Risks; (v) Technical Design of Project or Program; and (vi) Social and Environmental. Key mitigation measures have been proposed, including implementation of corporate best practices and technical assistance activities. Further details are provided in Annex 2.

52. Key risks of rating 'M' or higher, and pertinent mitigation actions to achieving results, are:

- Political and Governance: The political will for economic reforms and good governance is relatively strong. However, the risk of corruption is pervasive throughout the country, especially among public institutions. Transparency International's 2015 Corruption Perceptions Index (CPI) ranks Indonesia 88 out of 168 countries. The country team continues to engage intensively in various initiatives for promoting good governance, transparency and oversight at the national level. At the Project level, the World Bank will be closely engaging with the relevant counterparts in order to ensure transparency throughout project preparation and implementation, for example, in setting clear principles for the decision-making mechanism and process of the Project.

- Macroeconomic: As highlighted in the "Country Context" section of this document, the Government faces fiscal pressures, amidst a potentially more challenging international

environment. However, the analysis carried out for the first Indonesia Energy Sector Reform Development Policy Loan (DPL) shows that the overall macro-policy framework is responsive to risks of imbalances, and that a range of contingency financing and crisis protocols are in place.

- Sector Strategy and Policies: There is a need to continue to strengthen the regulatory framework for geothermal development to incentivize private sector participation. GEF- and ASTAE have provided support to the Government of Indonesia on the development of a geothermal tariff methodology, and ESMAP resources have been mobilized to continue this engagement. Through the Indonesia Sustainable and Inclusive Energy Development Policy Loan (SIEDPL) program, policy assistance will also be provided to strengthen the regulatory environment, particularly to urge finalization of the regulatory framework for the full implementation of the 2014 Geothermal Law. Under the first SIEDPL, a key prior action pertinent to geothermal development is the issuance of an implementing regulation for a Production Bonus – a local benefit-sharing mechanism. This Production Bonus Regulation No. 28/2016, (enacted in July 2016), prescribes developers' obligations to pay local government an annual fee equivalent to 0.5% from revenues for PPA agreements and 0.1% from revenues for steam sales agreements.

- Institutional Capacity for Implementation and Sustainability and Stakeholder Risks: There are inherent risks in piloting a new operation, particularly related to the institutional capacity of the key entities and stakeholders involved in such an innovative mechanism. However, the Bank will build on its ongoing experience working with PT SMI. It will also build on international experience in designing geothermal exploration by: (i) providing for a coordinated TA package aimed at strengthening the capacity of the public entities involved with geothermal development generally, and with the Project specifically; and (ii) reducing investment risks for developers by tackling the riskiest part of the geothermal development process. PT SMI role in Project implementation is subject to government regulation (PMK) which is yet to be issued. Furthermore, the transfer of land tile to private sector entities will need to be clarified, either in the same PMK or in another regulation specifically addressing this subject. This risk is mitigated by making the issuance of the aforementioned PMK a finding suitable arrangements on land transfer negotiations conditions.

- Fiduciary: The fiduciary risk is assessed as Substantial. This will be further reviewed and confirmed at the appraisal stage. PT SMI's lack of experience in procurement of civil works and technology-driven drilling contracts with high uncertainties, carries risk to the project for successful and timely conclusion of procurement processes and effective project management. While PT SMI will be supported by a number of consultants it is important that it hires permanent experienced staff in relevant disciplines including procurement and contract management for managing the consulting and drilling contracts. In addition, following two sets of procurement regulations for drilling contracts under CTF and GOI's funding is expected to add to the overall complexity of the proposed Project. To mitigate fiduciary risks, PT SMI will be supported in its day-to-day operations by an EMT, as described under Component 2. A Project Implementation Manual (PIM) will also be prepared and include the applicable procurement procedures to guide PT SMI in carrying

out its functions. Furthermore, the Bank team will work closely with PT SMI in accelerating the final choice of sub-project locations including carrying out the necessary screening studies in a timely manner to facilitate start of procurement process for each sub-project locations.

- Technical Design of Project or Program: The technology is commercially proven. Yet, the high risk nature of upstream geothermal activities may lead to unsuccessful exploration, which may deplete the available funding sooner than expected. The design of the World Bank/CTF facility builds on the existing body of work and knowledge in the geothermal development space, as described in the 'Lessons Learned and Reflected in the Project Design' section. Moreover, the rolling out of such a facility would allow for mitigating geothermal-related exploration risks through cost-shared drilling – a first in the Indonesian context – with a possible demonstration/replication effect. In order to fully realize the Project benefits, technical assistance has been designed to ensure that every possible step is taken to benefit from the existing regulatory framework and the efficient use of resources set aside under PT SMI.

- Social and Environmental: The Bank's experience with geothermal projects in Indonesia indicates that land acquisition is often carried out by means of negotiated, market-based transactions rather than expropriation, and involuntary resettlement does not occur. The most significant potential risks in these remote areas are related to the induced development within or adjacent to the geothermal exploration areas. Improved access to forested areas through the provision of roads may encourage or exacerbate land clearance activities. Induced development could lead to land disputes, illegal land uses, damage or loss of natural habitats and forests, and reduced watershed protection. The second significant risk relates to the impacts from resource exploitation from downstream investments. The exploration activities are proposed to remove barriers to resource exploitation and utilization. The extent of infrastructure development is greater during the exploitation phase, leading to a wider range and large scale of potential impacts. These potential downstream impacts will need to be considered, and mitigation planned for, as part of the ESIA process for each exploration project.

VI. APPRAISAL SUMMARY

A. Economic and Financial Analysis

53. The economic analysis was carried out to assess the economic viability of a given geothermal site. The financial analysis was carried out at two levels: (i) to demonstrate how a government-sponsored exploration drilling scheme helps reduce the barrier-to-entry to the geothermal sector in Indonesia, and (ii) to test the sustainability of the proposed revolving facility. The results of the economic and financial analyses are presented below. The full analyses are available in Annex 7.

Economic Analysis

54. The exact capacity of the geothermal plants that will be developed following the exploration drilling is not yet known. For the sake of this analysis, two hypothetical sites in Eastern

Indonesia were analyzed: (i) a relatively large site with a resource potential of 55 MW; and (ii) a relatively small site with a resource potential of 10 MW. The large site is assumed to be on a bigger island with a considerable existing load and relatively high connection rate of consumers. The small site is assumed to be on one of the many small-to medium sized islands in Eastern Indonesia with a moderate existing load and low connection rate.

55. At a discount rate of 6% and a social of cost of carbon following the curve proposed by the Guidance Note on Social Value of Carbon (2014) with a weighted average of US$48.13 per tCO2 for the period 2017-52, the 55 MW geothermal development yields an economic net present value (ENPV) of US$750 million with an economic internal rate of return (EIRR) of 33.5%; and the 10 MW development yields an ENPV of US$153 million with an EIRR of 29.5%. Therefore, both developments are economically viable.

56. An estimated 0.294 million-tCO2 and 0.062 million-tCO2 emissions will be avoided through the 55 MW and 10 MW geothermal development, respectively. At the above-referenced social value of carbon, an estimated US$14.14 million and US$2.98 million worth of CO2 emissions will be avoided annually from the 55 MW and 10 MW geothermal developments, respectively.

Financial Analysis

From a Developer's Perspective

57. The financial analysis assesses the financial viability of each geothermal development, using the geothermal ceiling tariff schedule initially adopted by MEMR and which is based on avoided costs in the power system. For geothermal power plants to be commissioned in Eastern Indonesia by 2023, the ceiling tariff was US$0.263 per kWh. In the with-Project scenario, it is assumed the winning developer will pay a 25% premium on top of the cost of exploration in order to acquire a license.

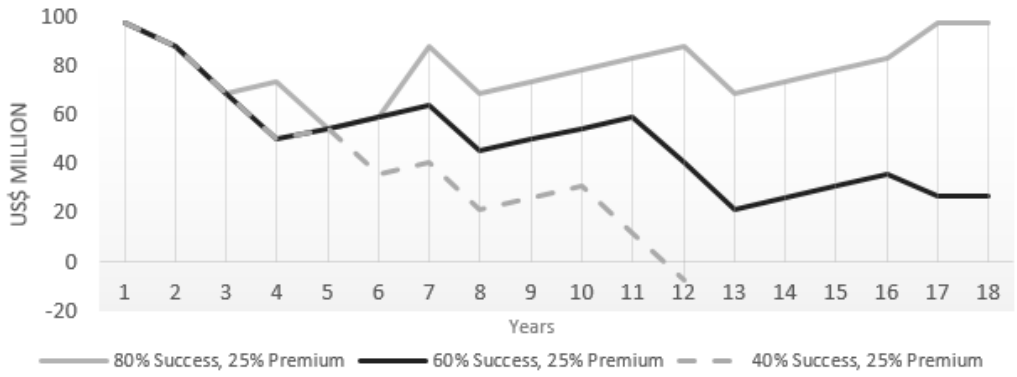
58. Without the Project intervention, the 55 MW geothermal development will yield a Financial Rate of Return (FIRR) of 20.3%, 24.7% and 27.9% under the low, medium and high enthalpy[8] scenarios, respectively, exceeding the Weighted Average Cost of Capital (WACC) requirement of both Independent Power Producer (IPP) and State-Owned Enterprise (SOE) developers, thus both IPP and SOE developers would be willing to undertake the investment. Without the Project intervention, the 10 MW geothermal development will yield an FIRR of 19.0%, 19.0% and 13.7% under the high, medium and low enthalpy scenarios, levels sufficient for an SOE developer to undertake the investment. For an IPP developer, the expected FIRR of 13.7% under the low enthalpy scenario is below its WACC of 14.3%. Due to an overall lack of knowledge on the nature of the resources, an IPP developer is thus likely to forgo such a small-scale development. With the Project, assuming the developer will have to pay a 25% exploration cost premium at tender, the FIRR of both developments will well exceed the WACC of both IPP and SOE developers under all resources enthalpy scenarios. Thus, even an IPP developer would find it financially viable to undertake the small development.

From the Implementing Agency's Perspective

[8] Enthalpy is a measurement of total energy in a thermodynamic system. In practical terms it is a measure that combines temperature and pressure in a geothermal steam resource.

59. A financial analysis was also carried out at the facility level from the perspective of the implementing agency. The analysis is testing the sustainability of the revolving facility, more specifically how the funds revolve depending on the success of exploration (80%, 60% and 40%) and the premium charged (25%). The cash flows of these scenarios are summarized in the figure below.

Cash Flows of Facility Scenarios



60. The analysis shows that a doubling of the failure rate to two out of five (corresponding to a 60% success rate) and maintaining the 25% premium would still allow for exploration of 15 fields[9] but only US$27 million would be left in the facility in year 18. As a worst case scenario, if three out of each five explorations are unsuccessful (a 40% success rate) then the facility will run out of reinvestment funds in year 12 and only up to 9 fields would be explored (and 4 developed). These results demonstrate robust financial effectiveness of the proposed scheme within a reasonable long (18 year) time horizon. At least 15 fields will be explored and at least 9 would be developed as long as the success rate does not drop under 60% - a reasonable assumption given that the statistical individual well success rate (wells that can be used for exploration out of total wells drilled) in Indonesia is over 60%.

B. Technical

61. GoI expects the private sector to bear the lion's share of investment in new geothermal capacity. To incentivize private sector participation, public interventions would need to be targeted at removing – or at least reducing – key geothermal development barriers, the largest of which is exploration drilling risk (or resource risk). The resource risk is highest at the initial stages of project development, before the first wells are drilled and decreases as more wells are drilled as each well provides further information about the nature of the reservoir, most importantly the temperature and permeability of the resources.

62. Exploration drilling risk is exacerbated by costs of up to US$8 million per well[10] plus supporting infrastructure. This can be prohibitive for project developers who are not guaranteed downstream returns on their pre-production investments. Exploration drilling also constitutes the

[9] 15 fields result from three well exploration programs over an eighteen year time horizon. Further details on this calculation are provided in Annex 7.

[10] Exploration well drilling prices are expected to be in the US$5-8 million range, depending on site-specific characteristics (e.g. remoteness, depth, etc.).

biggest barrier to obtaining financing as it increases investors' equity return requirements. Moreover, there is little appetite from the private sector to fund projects where the nature and extent of the resource are unknown.

63. Cost-shared drilling programs have proven to mitigate resource risk, thus enabling risk capital and private expertise to be mobilized towards exploration drilling in the developed geothermal markets of the USA, Japan and New Zealand. This is currently the focus of much of the global push for geothermal development and, with support from MDBs such as, WB and IADB, cost-shared drilling models are being pursued in the developing geothermal markets of Turkey, Armenia and Mexico. Turkey, the most advanced in this type of geothermal development program, has currently the fastest growing geothermal capacity in the world.

C. Financial Management

64. A Financial Management Assessment (FMA) was conducted as part of Fiduciary Assessment of the project. The FMA assesses the adequacy of the financial management system of the implementing agency, PT Sarana Multi Infrastuktur (PT SMI), in producing timely, relevant and reliable financial information on project activities. It will also assess whether the accounting systems for project expenditures and underlying internal controls are adequate to meet fiduciary objectives and allow the Bank to monitor compliance with agreed implementation procedures and appraise progress towards its objectives.

65. It was identified that the main risk of the project currently relates to the insufficient experience of PT SMI in financing exploration drilling projects and the fact that Ministry of Finance regulation (PMK) to facilitate the implementation of the project is yet to be issued. To mitigate the associated risk, PT SMI will: (i) work closely with MoF on the PMK; (ii) prepare the GEUDP Project Implementation Manual covering organization structure, verification mechanism, reporting/accountability mechanism, preparation of interim financial reports and sub-project supervision; fund flow mechanism; disbursement arrangement; and audit arrangement. All of the above are expected to be agreed before Grant negotiations.

66. The financial management risk is assessed as being Substantial before mitigation and Moderate after mitigation. This assessment concludes that with the implementation of the action plan, the risks will be substantially mitigated, and the proposed financial management arrangements will satisfy the Bank's minimum requirements under OP/BP10.02, and will be adequate to provide, with reasonable assurance, accurate and timely information on the status of the grant as required by the Bank.

D. Procurement

67. For contracts financed by CTF (US$49 million) under Component 1, the procurement shall be carried out in accordance to Guidelines: Procurement of Goods, Works, and Non-Consulting Services under IBRD Loans and IDA Credits & Grants, January 2011, revised in July 2014. For contracts financed through GoI's own financing (US$49 million) under Component 1, procurement will be carried out following the pertinent GoI/PT SMI's procurement regulations. Selection of consultants under Component 2 will be carried out as per Guidelines: Selection and Employment of Consultants under IBRD Loans & IDA Credits & Grants by World Bank Borrowers, January 2011, revised in July 2014.

68. The Bank has limited experience in financing exploration drilling. It is understood that the drilling contracts can be procured through management of a large number of separate contracts for each project or through integrated drilling contracts. The Bank has hired a consultant to advise the team on the market for geothermal exploration drilling, the appropriate types of contract, the comparative advantages for each type and the requirements for efficiently managing them. With the Bank's support, PT SMI is now preparing a Procurement Strategy for the Project. Such a strategy will include market research analysis, a list of potential consultants, contractors and suppliers in the market, and potential risks and mitigation strategy. PT SMI will also update the existing draft Procurement Plan, which shall be finalized at the latest by negotiations. It is expected that the majority of contracts will be below the prior review thresholds and hence subject to Bank's post review. The method of procurement and prior review thresholds will be reflected in Procurement Plan. After Negotiations, the Bank will arrange to publish the Procurement Plan on UNDB.

69. Procurement Capacity Assessment of PT SMI: The Bank team has carried out an assessment of procurement capacity of the implementing agency PT SMI. To date, PT SMI has procured only small value consultancies. PT SMI has no experience in drilling contracts, and procurement of civil works, goods and large consultancies. PT SMI is in the process of preparing procurement regulations that will include such contract types. While PT SMI is an SOE and not obliged to follow national procurement regulations (Perpres 54 or its amendments), PT SMI is expected to develop its procurement regulations based on Perpres 54.

70. Procurement risk is currently assessed as Substantial, and will be further reviewed and confirmed at the appraisal stage. The risks and mitigation measures are detailed in Annex 3.

E. Environment (including Safeguards)

71. The project has long-term environmental benefits due to its contribution to expanding the share of renewable and carbon-neutral energy production. Negative impacts during project implementation are associated with exploration infrastructure – access roads, drilling pads, extraction of geothermal water, and discharges of water and drilling muds. The exact number of wells and the location of the infrastructure will not be decided until project implementation, when feasibility studies for each site have been completed by the EMT – financed under Component 2 from GEF resources. At that stage, there will be an approximate plan, but the final location and number of wells will be determined during the exploration process. The impacts from exploration are generally site-specific and readily managed using standard industry measures.

72. There is potential for significant risks in remote, forested areas related to induced development. Improved access to forested areas through the provision of roads may encourage or exacerbate land clearance activities. Induced development could lead to land disputes, illegal land uses, damage or loss of natural habitats and forests, and reduced watershed protection.

73. Significant risks are also related to the potential impacts from resource exploitation from downstream investments. The exploration activities funded by this Project are proposed to remove barriers to resource exploitation and utilization, and the feasible sites are likely to be developed for energy generation.

74. The ESMF, which has been publicly disclosed by the WB and PT SMI on July 31 and August 15, 2016 respectively, prescribes processes to screen and categorize sub-projects for their

environmental and social risks to: (a) eliminate high-risk projects / infrastructure with unacceptable levels of environmental and social impacts; (b) provide clear guidance on the safeguards instrument to be prepared and cleared by the Bank; (c) determine mitigation and management approaches, methodologies and instruments to reduce impacts to acceptable residual levels; and (d) ensure compliance with World Bank environmental and social safeguards policies and standards. Subproject-specific ESIA and ESMP will be prepared by suitably qualified consultants prior to the exploration process to ensure that the risks have been identified and suitable mitigation measures are developed. The ESMF has also detailed that the ESIA will address the indirect impacts such as induced development, and the potential risks from downstream geothermal developments to ensure that the impacts of exploitation and utilization phases are consistent with World Bank safeguards policies.

75. Since the Project will also influence downstream investment, national guidelines will be prepared under Component 2 that will address both donor safeguards and Indonesian regulations for the geothermal sector.

76. PT SMI has a corporate Environmental and Social Management System (ESMS), which provides an in-house framework for assessing and managing investment risks in its operations, and has a team of safeguards specialists. PT SMI has experience with the Indonesian Environmental Impact Assessment regulations ('AMDAL'), the World Bank safeguards policies and the IFC Performance Standards. The ESMS is fully compliant with Indonesian regulations, and is being revised to meet the standard of international donors. Human resource capacity is also being bolstered with additional in-house safeguards staff and consultants to prepare adequate safeguards instruments for drilling programs under this Project, such as ESIA, ESMP and Land Acquisition and Resettlement Action Plans.

F. Social (including Safeguards)

77. The abovementioned ESMF also includes an Indigenous Peoples Planning Framework (IPPF) and a Resettlement Policy Framework (RPF). In addition to the significant social impacts identified in the Environmental section above, in remote areas there may be groups of indigenous people who may be disproportionately vulnerable to direct and indirect impacts of geothermal exploration. An IPPF has therefore been prepared. The IPPF defines the procedure to be followed in determining whether indigenous peoples may be affected, and guidelines for preparing Indigenous People Plans (IPPs) and documenting free, prior and informed consultation with them on the IPPs developed.

78. An RPF has also been prepared, for cases in which land may be acquired by expropriation rather than commercial transaction. The Bank's experience with geothermal projects in Indonesia indicates that land acquisition is often carried out by willing buyer-willing seller mechanism, and involuntary resettlement does not occur. However, the RPF has been prepared to establish the principles and procedures for negotiated transactions and, if required, involuntary land acquisition and resettlement under Indonesian laws and safeguard policy OP4.12. The RPF provides guidance for preparation of Land Acquisition and Resettlement Action Plans (LARAPs). LARAP will be prepared when there will be involuntary acquisition of land and/or resettlement and/or restriction of access to resources.

79. It is expected that the Project will also have both widespread and localized social benefits. The stakeholders are primarily the local communities, government agencies and local businesses. Local stakeholders will benefit from increased electricity supply, and / or more reliable supply from future geothermal investment in these remote areas. They may also benefit from any upgrades to roads and supporting infrastructure. In the short term, there may be temporary benefits from the drilling phase (e.g., for the service industry, contractors, etc). More broadly, the citizens of Indonesia would benefit from a more effective and efficient geothermal energy industry greater proportion of national energy production from renewable sources, replacing generation from fossil-fuel plants.

G. World Bank Grievance Redress

80. Communities and individuals who believe that they are adversely affected by a World Bank (WB) supported project may submit complaints to existing project-level grievance redress mechanisms or the WB's Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed in order to address project-related concerns. Project affected communities and individuals may submit their complaint to the WB's independent Inspection Panel which determines whether harm occurred, or could occur, as a result of WB non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the World Bank's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate Grievance Redress Service (GRS), please visit http://www.worldbank.org/GRS. For information on how to submit complaints to the World Bank Inspection Panel, please visit www.inspectionpanel.org.

Annex 1: Results Framework and Monitoring

Results Framework

Project Development Objectives

PDO Statement

The Project Development Objective (PDO) is to enable greenhouse gas (GHG) emission reduction and access to sustainable electricity supply through risk mitigation for geothermal investment in Indonesia

These results are at	Project Level

Project Development Objective Indicators

Indicator Name	Baseline	Cumulative Target Values						
		YR1	YR2	YR3	YR4	YR5	YR6	End Target
Electric power generation capacity enabled through the issuance of geothermal development licenses (Megawatt)	0.00	0.00	0.00	0.00	16.25	32.50	65.00	65.00
Estimated GHG emission reduction compared to a business-as-usual baseline (Metric tons)	0.00	0.00	0.00	0.00	0.08	0.16	0.33	0.33
Planned increase in the number of connected households for the associated local electricity networks (Number)	0.00	0.00	0.00	0.00	29,102	58,205	116,411	116,411[11]

[11] The underlying assumptions are: 1 MW plant capacity, with 92% capacity factor, produces 8,059 MWh/year, 20% of which serving electrification needs, with an average consumption level of 900 kWh/y/residential consumer (intended as HH)

Intermediate Results Indicators

Indicator Name	Baseline	Cumulative Target Values						
		YR1	YR2	YR3	YR4	YR5	YR6	End Target
Commercial capital mobilized (USD millions)	0.00	0.00	0.00	0.00	0.00	0.00	390.00	390.00
Generating capacity-equivalent of steam yields from wells drilled (total) (MW) (Megawatt)	0.00	0.00	0.00	12.00	24.00	36.00	48.00	48.00
Generating capacity-equivalent of steam yields from wells drilled (average) (MW/well) (Megawatt)	0.00	0.00	0.00	6.00	6.00	6.00	6.00	6.00
Direct project beneficiaries (Number)[12]	0.00	0.00	0.00	0.00	145,510	291,025	582,055	582,055
Female beneficiaries (Number)	0.00	0.00	0.00	0.00	72,755	145,512	291,027	291,027
Delivery of Inferred Resource Capacity Reports by Exploration Management Team (Number)	0.00	0.00	1	2	3	4	4	4
Practice guides for safeguards implementation (Number)	0.00	0.00	1	2	2	2	2	2
Villages located next to exploration sites with at least one public consultation held (Percentage)	0.00	0.00	20.00	40.00	60.00	80.00	100.00	100.00
Share of public consultations segregated by gender (Percentage)	0.00	0.00	50.00	50.00	50.00	50.00	50.00	50.00

[12] It assumes five people per household that can be electrified

Indicator Description

Project Development Objective Indicators

Indicator Name	Description (indicator definition etc.)	Frequency	Data Source / Methodology	Responsibility for Data Collection
Electric power generation capacity enabled through the issuance of geothermal development licenses	This indicator reflects the new generation capacity enabled under the Project and is expressed in MW.	Yearly	PT SMI	PT SMI
Estimated GHG emission reduction compared to a business-as-usual baseline	This indicator reflects the outcome of the GHG accounting exercise based on 65 MW of new generation capacity enabled under the Project.	Yearly	PT SMI	PT SMI
Planned increase in the number of connected households for the associated local electricity networks	This indicator measures the planned increase in access enabled through the Project.	Yearly	PT SMI	PT SMI

Intermediate Results Indicators

Indicator Name	Description (indicator definition etc.)	Frequency	Data Source / Methodology	Responsibility for Data Collection
Commercial capital mobilized	This indicator looks at the private capital mobilized as a result of the project interventions.	Yearly	PT SMI	PT SMI
Generating capacity-equivalent of steam yields from wells drilled (total)	This indicators tracks the generating capacity-equivalent of steam yields expected.	Yearly	PT SMI	PT SMI
Generating capacity-equivalent of steam yields from wells drilled (average)	This indicators tracks the average generating capacity-equivalent of steam yields expected from each well.	Yearly	PT SMI	PT SMI

Direct project beneficiaries	This indicator tracks the number of direct beneficiaries electrified as a result of the project interventions.	Yearly	PT SMI	PT SMI
Female beneficiaries	This indicator tracks the number of female beneficiaries electrified as a result of the project interventions.	Yearly	PT SMI	PT SMI
Delivery of Inferred Resource Capacity Reports by Exploration Management Team	This indicator tracks the number of reports delivered by the EMT.	Yearly	PT SMI	PT SMI
Practice guides for safeguards implementation	This indicator tracks the number of practice guides that will inform safeguards implementation under the Project.	Yearly	PT SMI	PT SMI
Villages located next to exploration sites with at least one public consultation held	This indicator supports tracking of Citizen Engagement.	Yearly	PT SMI	PT SMI
Share of public consultations segregated by gender	This indicator supports tracking of gender action.	Yearly	PT SMI	PT SMI

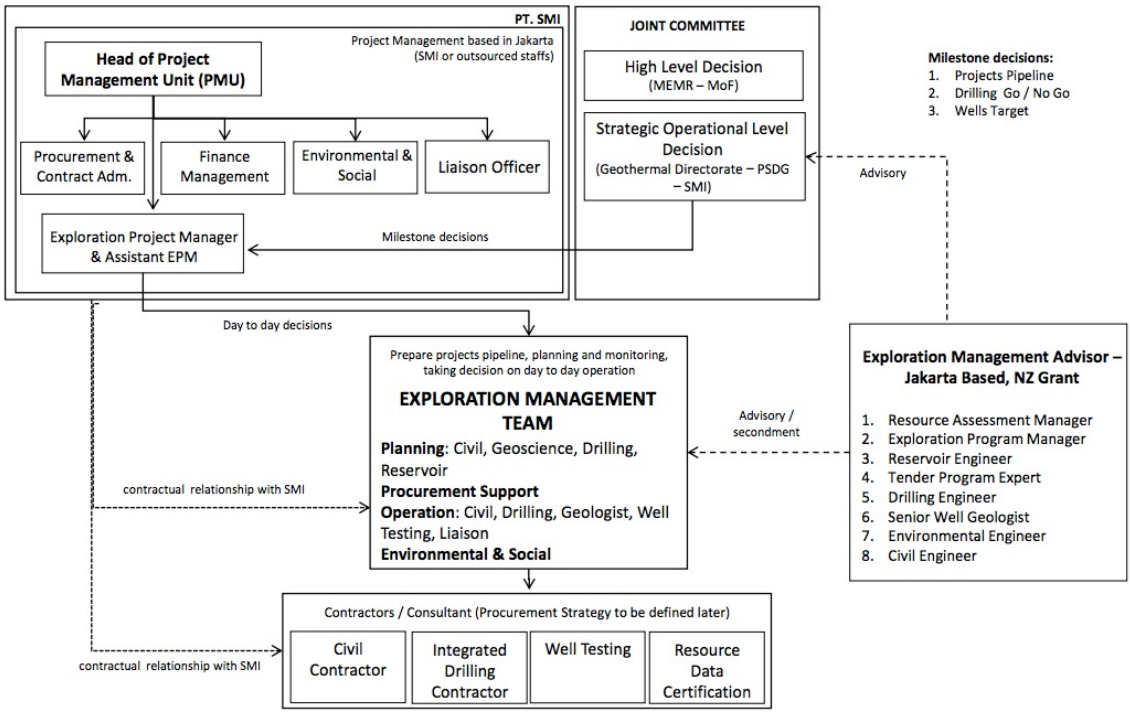
Annex 2: Detailed Project Description

Indonesia: Geothermal Energy Upstream Development Project

81. The Project Development Objective (PDO) is to enable greenhouse gas (GHG) emission reduction and access to sustainable electricity supply through risk mitigation for geothermal investment in Indonesia.

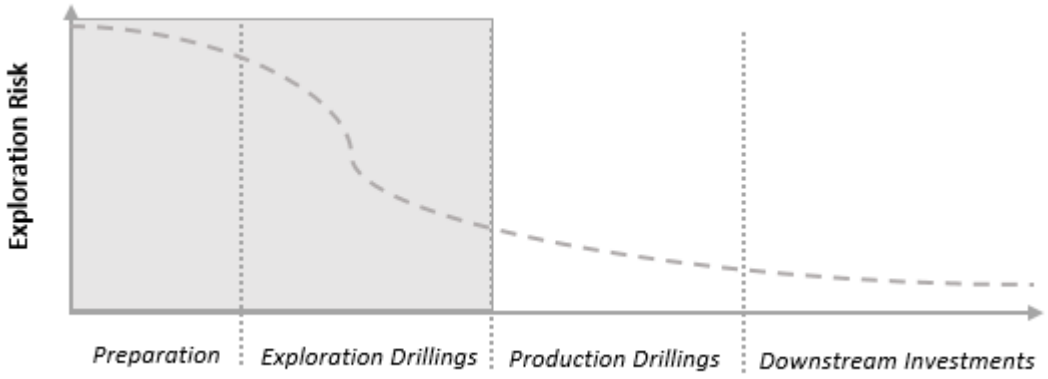
82. The Project has two components: *Component 1: Risk Mitigation for Geothermal Exploration Drilling (US$98 million);* and *Component 2: Capacity Building on Geothermal Exploration and Environmental and Social Safeguards Management (US$6.25 million).*

83. The Project organization is envisaged as follows:



84. *Component 1: Risk Mitigation for Geothermal Exploration Drilling (US$98 million)*

a. Design Background: *Component 1* focuses on supporting government-sponsored exploration drilling (the riskiest part of the geothermal development process as shown in the shaded area in the schematic below) for prospective license holders. This approach has been used in several countries. The most recent parallel is Turkey, where MTA (Geological Survey) explores and drills in selected areas and auctions off sites shown to be feasible for power production to private developers. Results are promising: Turkey has the fastest growing geothermal sector in the world; and most of that growth is based on development of fields where MTA has carried out exploration drilling, thus greatly reducing resource risk. Other countries that have taken this approach with successful results are the US, New Zealand and Japan.



b. Financing and Risk Sharing: Funding for exploration drilling will be made available in the amount of US$49 million from WB/CTF with a matching contribution from PT SMI. WB/CTF and PT SMI will assume the same risk position going into exploration drilling. After the projects have been mostly de-risked and verified to have attractive inferred resource capacity, they will be moved to a pipeline for tendering.

c. Business Model and Fund Management: Each exploration drilling sub-project will be financed from either the CTF, or the Geothermal Infrastructure Fund (GIF) at PT SMI, alternating in sequence. The first sub-project is financed by CTF; the second by GIF, and so on. Sub-projects fully financed by CTF will follow WB's fiduciary guidelines; those by GIF will follow government's fiduciary guidelines. However, sub-projects financed by the government are also required to comply with WB's safeguards requirements as per WB policies.

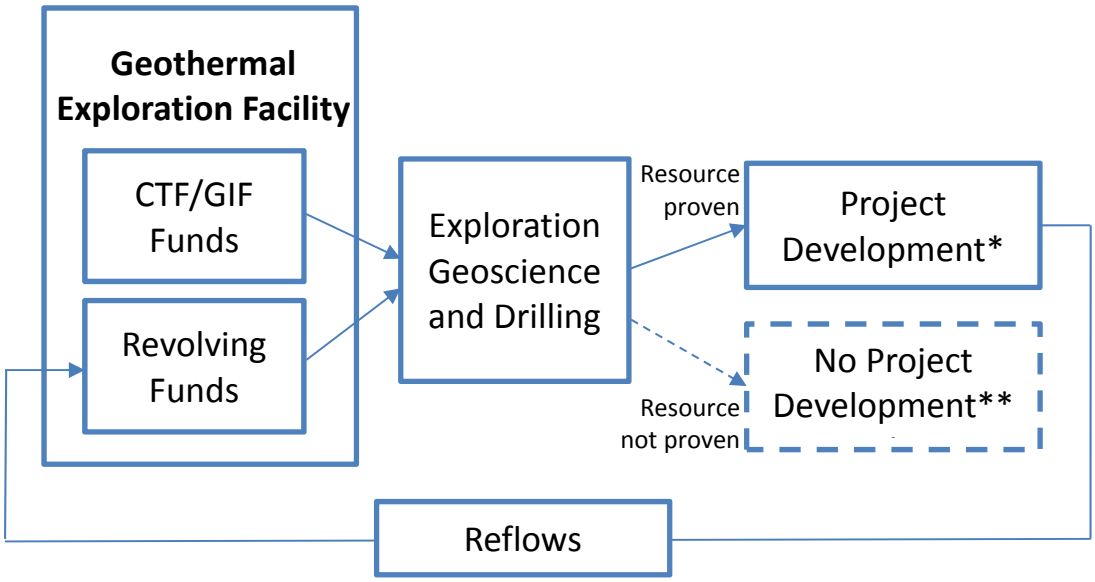
   i. After exploration drilling is completed and the Inferred Resource Capacity Report (IRCR) has been independently verified, a *Geothermal Data Package* will be prepared. It will include the full resource data on the site as well as land rights for future development. Based on the IRCR it will be determined whether commercial development is viable and whether the sub-project should be tendered out.

   ii. The GoI will need to direct a government entity to temporarily hold the land title. This entity is going to be either EBTKE or Lembaga Manajemen Aset Negara (LMAN), the State Assets Management Agency under the Ministry of Finance, which has been created to acquire and hold land for infrastructure projects under public-private partnership (PPP) arrangements. There will be an agreement between this entity, PT SMI and MEMR on the transfer of land title as part of the Data Package to be provided to the future developer. The process of transferring land title bundled with the Data Package is still been decided by PT SMI and MEMR. An option where land is leased to future developers is being considered since the sale of state assets is difficult in Indonesia.

iii. In case of *successful exploration*, the Geothermal Data Package will be tendered out to prospective developers. The winning bidder will receive the Geothermal Data Package. In return, he will pay for the full drilling cost plus a 25% premium[13]. The premium is designed to cover the cost of unsuccessful exploration and ensure sustainability of the program. For sub-projects financed by CTF, all reflow funds will go into a separate Revolving Fund account (different from the original CTF account) to finance future exploration drilling. For sub-projects financed by GIF funds will flow back to MOF, who will be obliged to top up the GIF - working like a virtual revolving fund.

iv. In case of *unsuccessful exploration*, or in case tendering is unsuccessful (i.e., no buyer is found for the Geothermal Data Package), the sub-project may be assigned to a state-owned enterprise (SOE) developer[14]. However, if no development will take place, the Data Package will be transferred to EBTKE. The resource data for the site will be included in the geothermal resource database that is currently under development. In this case, there will be no reflow of funds in to the Revolving Fund account.

d. A schematic of the component design is presented below[15]:



**Successful bidder pays for the Geothermal Data Package*
*** Geothermal Data Package transferred to EBTKE*

e. <u>Geographic Focus and Scope of Drilling Activities:</u> Sites will be selected in line with the country's geothermal development objectives by the Directorate General of New Energy, Renewable and Conservation Energy (EBTKE) under MEMR. Of an initial

[13] An 80% success rate translates into a 25% premium if the facility is to be fully re-capitalized by the end of the last exploration drilling cycle. The full analysis is presented in Annex 7.
[14] There are presently three SOE geothermal developers: PGE, Geo Dipa and PLN.
[15] Smaller sub-projects may not need a production drilling phase. In case of successful exploration drilling and no need for production drilling, smaller sub-projects may be in a position to securing financing and move forward.

list of five sites, pre-selected by MEMR two sites have been deemed to be promising while three were discarded. The two promising sites are (i) on the island of Flores – this possible sub-project is in an advanced stage of pre-feasibility study including comprehensive environmental and social impact assessments, making it realistic that a decision to drill could be made shortly after the Project starts implementation; and (ii) on Bacan Island in north Maluku – this possible sub-project has been screened regarding potential environmental and social issues and a pre-feasibility is planned to commence shortly.

MEMR has subsequently suggested a list of additional eight sites out of which four will be selected for screening and full desk study of existing data - bringing the number of potential sub-project up to six. It is agreed with MEMR that at least half of the sites to be explored will be in the islands of Eastern Indonesia, where geothermal power can serve to increase access to sustainable energy. However, GoM may also wish to demonstrate government-sponsored drilling in sites connected to the larger power markets in Sumatra or Java which allow development of plants with larger capacity. It is therefore expected that one or two of the six sites will be in Sumatra and connected to the major power markets.

Site screenings are expected to be conducted on a rolling-basis based on the suggestions made by MEMR/BG and it is expected that four sites will be developed as a result of the project interventions. For each site, EMT will prepare a report on the basis of the following information: (i) general details, including location, prior surveys and plans, map of location; (ii) land denomination (e.g. conservation forest, protection forest, etc.); (iii) field concept and summary of resource estimation; (iv) summaries of geology, geophysics, geochemistry surveys; (v) summary of temperature gradient wells; (vi) social and environmental issues; (vii) existing electricity infrastructure in the area, including projected demand and power supply, transmission and distribution lines; and (viii) probable type of development (e.g. flash, binary). The share of early stage exploration to be executed by a service company on behalf of GoI (or how many exploration/reinjection wells will be drilled before a field is auctioned off) will be dependent on these reports. Feasibility reports will be updated with the results from exploration drilling. If the defined work area is considered feasible, these reports will form part of the package for tendering the work area for exploitation.

f. Expected Impact: Component 1 will deliver drilled wells, which provide data that serve as inputs to investment decisions. Assuming a portfolio of several smaller sub-projects in Eastern Indonesia, the Project is expected to directly enable 65 MW of new geothermal power capacity, which, based on development costs of about $6 million per MW[16], would imply commercial investments of about US$390 million. The proposed concept involves setting up a revolving mechanism through which the funds used for exploration drilling will flow back to the facility through repayment from developers who are successful in securing a license to develop the sub-project. Given the revolving nature of the facility, it is expected that funds will flow back over three-year cycles for 18

[16] ESMAP "Geothermal Handbook: Planning and Financing Power Generation"

years and that their use may enable 260 MW and about US$1.56 billion of new capacity and investment. For the full analysis, please see Annex 5.

85. *Component 2: Capacity Building on Geothermal Exploration and Environmental and Social Safeguards Management (US$6.25 million)*

a. This component will finance a program of capacity building designed to establish an efficient and effective geothermal energy exploration and tendering program including such activities as: (i) advisory support in carrying out geology, geochemistry and geophysics surveys (3G surveys) and topographic mapping for geothermal sites; (ii) advisory support for preparation of drilling, well completion and resource assessment reports (based on 3G surveys) as well as for the bidding process for exploration service companies; (iii) recruitment of an exploration management team; (iv) advisory support for environmental and social safeguard management related to exploration and exploitation of geothermal energy; and (v) just-in-time assistance to MEMR, Badan Geologi, and the Recipient in response to request for international expertise to deal with questions related to, inter alia, geothermal tariff setting, benefit-sharing, and data management and sharing.

b. This component will be financed by the Global Environment Facility (GEF) grant but will also benefit from a parallel grant from the Government of New Zealand (GNZ). The GNZ grant, which is equivalent to around US$3.25 million, is designed to be complementary to the development objective of this Project, and will focus on supporting the GoI on: (i) establishment of an effective GIS-based database by collating and analyzing existing and new resources data, potentially to be housed within Badan Geologi (BG); (ii) methodology for robust resource and reserve estimation and reporting protocol to an internationally acceptable standard; (iii) methodology for prioritization of potential sites for geothermal development; and (iv) capacity building for EBTKE and PT SMI for tendering and executing an exploration program.

c. The technical support and capacity building will include the building up of an Exploration Management Team (EMT) inside of PT SMI. The Team will consist of various experts coordinated by a geothermal consultancy company. Specifically, the EMT will provide technical assistance to the government-sponsored exploration drilling program, including advisory support in carrying out geology, geochemistry and geophysics surveys (3G surveys) and topographic mapping for candidate sites. Support will also be made available for the preparation of drilling, well completion and resource assessment reports (based on 3G surveys) as well as for the bidding process for exploration drilling services. Capacity building plans will also benefit the Geothermal Directorate under the Ministry of Energy and Mineral Resources and Badan Geologi (Indonesia's Geological Agency). GNZ has already recruited a consultant to staff the EMT and the core EMT members as well as some short-term specialists will be funded by the GNZ grant during the first three years of the Project. The GEF grant will finance an in-house PT SMI Exploration Project Manager (EPM) throughout the project lifetime as well as EMT core team members for the last 2.5 years of the project and most of the short-term specialist support for the EMT.

d. Furthermore, GEF resources will fund the preparation of practice guides for the subproject-specific Environmental and Social Impact Assessment (ESIA), Environmental and Social Management Plan (ESMP), Indigenous Peoples Plan (IPP), and Land Acquisition and Resettlement Action Plan (LARAP), as well as just-in-time assistance for MEMR, Badan Geologi, and PT SMI in response to request for international expertise to deal with questions related to, inter alia, geothermal tariff setting, benefit-sharing, and data management and sharing. The following table provides a detailed breakdown of the GEF-financed activities and related estimated budget:

Activity	**Estimated Budget**
Exploration Management Team to manage: (1) geological, geochemical and geophysical surveys (3G surveys), topographic mapping for candidate sites and drilling preparation; (2) well completion and resource assessment reports; (3) drilling management; and (4) support bidding process for exploration service companies	5,450,000
Support with preparation of practice guides for sub-project-specific ESIA, ESMP, IPP, and LARAP, and just-in-time assistance in request for international expertise for relevant regulatory issues such as tariff-setting, benefit-sharing, and data sharing and management	200,000
Implementing agency administrative costs, including incremental costs for the PMU	600,000
Total	6,250,000

86. Government investment in exploration drilling has played a critical role for geothermal development worldwide. Taking full advantage of Indonesia's vast resource potential would require post-exploration, resource risk mitigation support. The post-exploration drilling phase of the geothermal development process (known as production drilling) requires significant investments, although likely at a lower financing cost due to a reduction in resource risk. To support this phase, WB may consider a tentative US$300 million IBRD loan for mid-stream development (i.e. steam-field drilling), with the aim of firming up resource levels prior to Steam-Above-Ground-System (SAGS) and power plant development – where greater private participation is likely.

Annex 3: Implementation Arrangements

Indonesia: Geothermal Energy Upstream Development Project

Project Institutional and Implementation Arrangements

Project administration mechanisms

87. The key government agencies engaged with the Project's CTF/GEF support (*Component 1: Risk Mitigation for Geothermal Exploration Drilling* and *Component 2: Capacity Building on Geothermal Exploration and Environmental and Social Safeguards Management)* are:

a. *Ministry of Finance (MOF),* which will exercise an overall oversight function over PT Sarana Multi Infrastruktur (PT SMI);

b. *PT SMI,* a company that supports the implementation of the GoI's infrastructure development agenda through partnerships with private and multilateral financial institutions, has been identified as the implementing agency for the proposed Project.

   With 100% ownership by MoF, PT SMI is expected to transform into an Indonesian development bank and is seen as the GoI's key effort in creating a more open and transparent investment regime and better institutions for infrastructure finance. Under a set of enabling regulatory mandates, PT SMI has plans to strengthen corporate governance, partnership schemes and investor base to become the facilitator and financier for infrastructure crucial for Indonesia's continued growth.

   Within this context, PT SMI is the recipient of about IDR 3.1 trillion or US$225 million, which will be used to support geothermal exploration through government-sponsored, pre-license drilling. WB will provide PT SMI with investment and TA support for government-sponsored drilling.

   In its role as IA, PT SMI is expected to be supported by an Exploration Management Team (EMT), which is intended to carry out the role of overseeing that all the geoscience investigations are carried out, interpreting those investigations, deciding on the most appropriate exploration strategy, preparing targets and well prognoses, preparing specifications for the drilling activities (whether integrated or separate), assisting in establishing service contracts for drilling, supervising the drilling activities by the service contractors including the implementation of the Environmental and Social Management Plan (ESMP), testing the wells and preparing code-compliant reservoir capacity reports for use when tendering or otherwise awarding the concessions;

c. *Ministry of Energy and Mineral Resources (MEMR),* which will play an important role in terms of overall geothermal development coordination;

d. *Badan Geologi (BG),* the Geological Agency of Indonesia, which is expected to facilitate project implementation by providing input to the Inferred Resource Capacity Report, which will be based on data sourced from 3G surveys and topographic mapping carried out in-house or by third-party service companies;

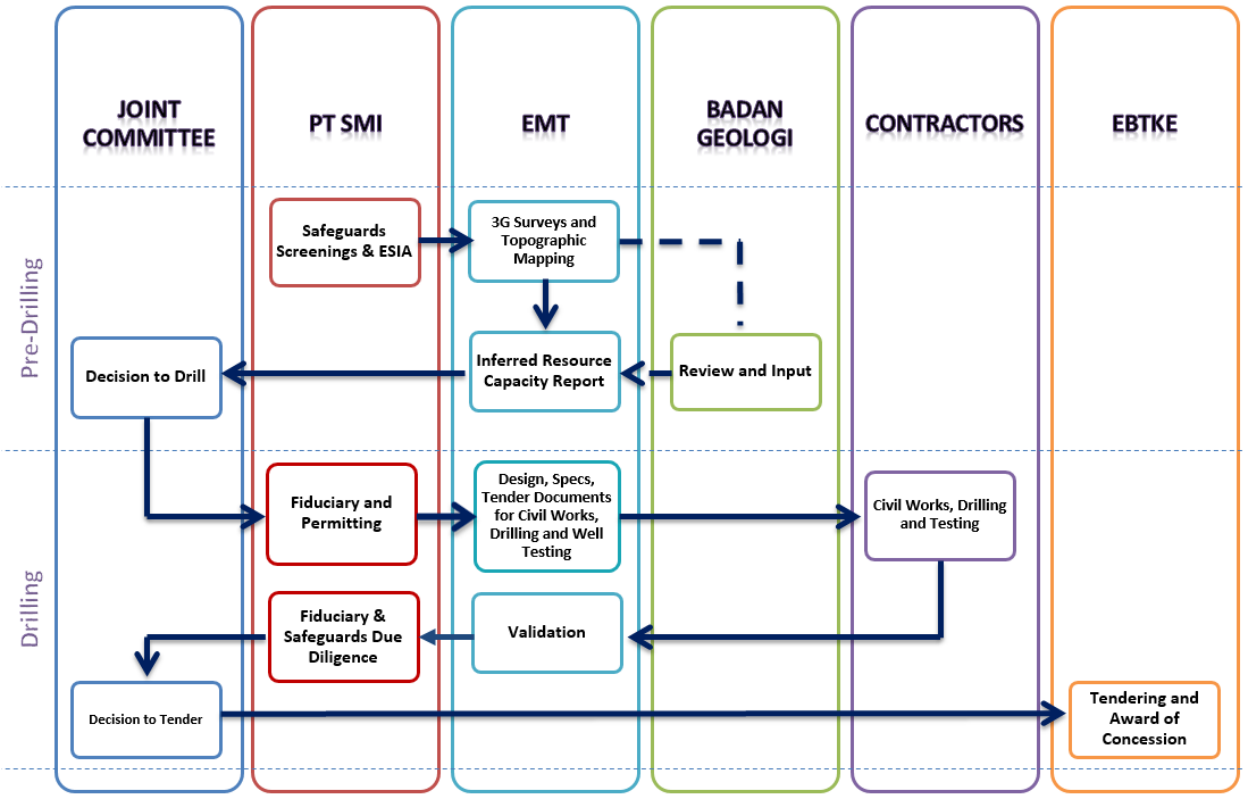
e. *Directorate General of New Energy, Renewable and Conservation Energy (EBTKE),* which, under MEMR, will be responsible for setting principles for site selection to be

included in the scheme as well as tendering and award of the concessions to the winning bidders;

f. *LMAN*, the State Asset Management Agency under the Ministry of Finance and the government agency established to undertake land acquisition for PPP projects; and

g. *PLN*, the state power company which has the monopoly on electricity distribution in Indonesia and is expected to provide Power Purchase Agreements (PPAs) to the winning bidders as long as winning bids are below a preset ceiling price.

88. A visual representation of the sequencing of key actions under the proposed Project's CTF/GEF support *(Component 1: Risk Mitigation for Geothermal Exploration Drilling* and *Component 2: Capacity Building on Geothermal Exploration and Environmental and Social Safeguards Management)* is provided below.



Financial Management, Disbursements and Procurement

1. *Financial Management*

89. The financial management risk is assessed as being Substantial before mitigation and Moderate after mitigation. It was identified that the main risk of the project currently relates to the insufficient experience of PT SMI in financing exploration drilling sub-projects and the fact that Ministry of Finance regulation (PMK) to facilitate the implementation of the project is yet to be issued. To mitigate the associated risk, PT SMI will: (i) work closely with MoF on the PMK; (ii) prepare the GEUDP Project Implementation Manual covering organization structure, verification

mechanism, reporting/accountability mechanism, preparation of interim financial reports and sub-project supervision; fund flow mechanism; disbursement arrangement; and audit arrangement. All of the above are expected to be agreed before Grant negotiations.

2. *Disbursements and Flow of Funds*

90. The applicable disbursement methods are Advance and Reimbursement. Two Designated Accounts (DAs) denominated in US dollars (one for CTF and one for GEF) will be opened in government-owned or commercial bank acceptable to the Bank under the name of PT SMI. These DAs will be a segregated account with fluctuated ceiling. These DAs will be used for financing eligible expenditures of the project. Disbursement arrangement for the Project will be reflected in the Project Implementation Manual and agreed with the Bank. Applications for the replenishment of the DA advance may be submitted through quarterly IFR, which consist of: (i) DAs Activity Statement; (ii) Statement of Expenditures under Bank's prior review and non-prior review; (iii) Project Cash Forecast for 6 months period; and (iv) Project Sources and Uses of Funds.

91. When PT SMI receives a payment request from the exploration contractors, payment will be made from CTF account. When payment request received from consultant, payment will be made from GEF account. Two options are available for PT SMI:

i. PT SMI may use the advance method, the flow of funds is as follows:
   a) Designated Accounts (DAs) will be open under the name of PT SMI
   b) PT SMI submits a request for an advance to the Bank
   c) The Bank will transfer initial deposit (advance) to DA based on request (using IFR format which include projection of project needs for the 6 months period).
   d) PT SMI make payment to contractor and consultant.
   e) Additional transfer can be made based on request (using IFR format which include projection of project needs for the 6 months period).

ii. PT SMI may opt for the pre-financing method, where instead of transferring the funds to the DA, the Bank transfers the funds to PT SMI's account as reimbursement for the pre-financing amount.

92. The flow of funds arrangement will be describe more detail in the Project Implementation Manual.

3. *Procurement*

93. Component 1 - *Risk Mitigation for Geothermal Exploration Drilling (US$98 million)* - envisages procurement of drilling contracts, associated infrastructure and goods for each of the exploration project site. Each sub-project will be financed from either the CTF, or the Geothermal Infrastructure Fund (GIF) at PT SMI, alternating in sequence. The business model envisages the first sub-project to be wholly financed by CTF; the second to be wholly financed by GIF, and so on.

94. Component 2 - *Capacity Building on Geothermal Exploration and Environmental and Social Safeguards Management (US$6.25 million)* – is largely focused on the selection of a firm

to provide EMT services for management of (1) geological, geochemical and geophysical surveys (3G surveys), topographic mapping for candidate sites and drilling preparation (2) well completion and resource assessment reports; (3) drilling management; and (4) support the bidding process for exploration service companies. It is expected that the EMT services will be procured through a consulting firm to avoid complexity in managing several small consultancies. This will be further discussed and confirmed during appraisal and appropriately reflected in Procurement Plan.

95. For contracts financed by CTF (US$49 million) under Component 1, the procurement shall be carried out in accordance to Guidelines: Procurement of Goods, Works, and Non-Consulting Services under IBRD Loans and IDA Credits & Grants, January 2011, revised in July 2014. For contracts financed through GoI's own financing (US$49 million) under Component 1, procurement will be carried out following the pertinent GoI/PT SMI's procurement regulations. Selection of consultants under Component 2 will be carried out as per Guidelines: Selection and Employment of Consultants under IBRD Loans & IDA Credits & Grants by World Bank Borrowers, January 2011, revised in July 2014.

96. The Bank has limited experience in financing exploration drilling. It is understood that the drilling contracts can be procured through management of a large number of separate contracts for each project or through integrated drilling contracts. The Bank has hired a consultant to advise the team on the market for geothermal exploration drilling, the appropriate types of contract, the comparative advantages for each type and the requirements for efficiently managing them. With the Bank's support, PT SMI is now preparing a Procurement Strategy for the Project. Such a strategy will include market research analysis, a list of potential consultants, contractors and suppliers in the market, and potential risks and mitigation strategy. PT SMI will also update the existing draft Procurement Plan, which shall be finalized at the latest by negotiations. It is expected that the majority of contracts will be below the prior review thresholds and hence subject to Bank's post review. The method of procurement and prior review thresholds will be reflected in Procurement Plan. After Negotiations, the Bank will arrange to publish the Procurement Plan on UNDB.

97. *Procurement Capacity Assessment of PT SMI*: The Bank team has carried out an assessment of procurement capacity of the implementing agency PT SMI. To date, PT SMI has procured only small value consultancies. PT SMI has no experience in drilling contracts, and procurement of civil works, goods and large consultancies. PT SMI is in the process of preparing procurement regulations that will include such contract types. While PT SMI is an SOE and not obliged to follow national procurement regulations (Perpres 54 or its amendments), PT SMI is expected to develop its procurement regulations based on Perpres 54.

98. The team is in discussions with PT SMI for the technical support the Bank can provide in developing its procurement regulations so as to incorporate best practices suited to meet PT SMI's particular needs and achieve value for money through efficient and transparent procurement processes, thereby also enabling consistency and harmonization of procurement procedures under the different components of the project regardless of source of financing. The following are the Procurement Risks & Mitigation measures:

a) PT SMI lacks experience in the procurement of civil works and technology-driven drilling contracts. This carries risk to the project for successful and timely conclusion of procurement processes and effective project management. While PT SMI will be supported by number of consultants, it is important that PT SMI hires permanent

experienced staff in relevant discipline including procurement and contract management for managing the consulting and drilling contracts. This will be further discussed and confirmed with PT SMI during appraisal.

b) Following two sets of procurement regulations for drilling contracts under CTF and GOI's funding is expected to add to the overall complexity of the proposed Project. A Project Implementation Manual (PIM) will be prepared and include the applicable procurement procedures to guide PT SMI in carrying out its functions. In order to provide clarity and avoid different interpretations during project implementation, the PIM will also specify that Bank's Procurement and Consultants Guidelines will take precedence over Perpres 54 (and its amendments) and/or with PT SMI regulations for the procurement under CTF and GEF financing.

c) The Bank team will work closely with PT SMI in accelerating the selection of sub-project locations including carrying out the relevant studies in a timely manner to facilitate start of the procurement process for each sub-project location.

Procurement risk is currently assessed "Substantial," which will be further reviewed and confirmed at appraisal stage. The Bank procurement staff has provided hands-on support to PT SMI staff for selection of consultant for an ESIA during project preparation and will provide need based training and hands on implementation support to facilitate PT SMI carry out the procurement efficiently complying with the Procurement guidelines

99. Retroactive Financing: PT SMI has completed the selection of Environmental and Social Impact Assessment (ESIA) consultant and the contract has been signed in October 2016 for an estimated contract price of approx. US$ 100,000. The selection process followed Bank's Consultants Guidelines and was prior reviewed by the Bank. This contract may qualify for retroactive financing. In addition some small value consultancies may also be procured for retroactive financing. These details will be confirmed during appraisal.

4. *Environmental and Social*

100. PT SMI, as the implementing agency, is responsible for the implementation of safeguards. They will be supported by the EMT, safeguards consultants and the World Bank safeguards specialists. PT SMI's Environmental Social Safeguard and Business Continuity Management (ESS&BCM) Division will provide the in-house safeguards expertise and will have specific tasks: 1) coordinate with the EMT project managers to ensure that the safeguards aspects are integrated into the sub-project cycle and the feasibility, design and drilling phases; 2) screen land requirements and the environmental and social risks and issues during site selection and pre-feasibility (with the help of safeguards consultants where necessary); 3) recruit safeguards consultants to prepare sub-projects' LARAP, IPP, ESIA and ESMP; 4) review and provide comment on the safeguards instruments before World Bank clearances; 5) review and commenting on draft bidding documents and contract agreements with drilling contractors to ensure the ESMP is included; 6) lead the stakeholder engagement and community consultations in partnership with the safeguards consultants and the local government; 7) implement the IPP; 8) manage the Grievance Redress Mechanism on behalf of the project; and 8) receive regular reports from the EMT and prepare reports to the World Bank.

101. The EMT will be responsible for: 1) the overall coordination of stakeholder engagement and safeguards tasks in the sub-project cycle and ensuring there is complete integration at each phase; 2) supervision of the implementation of the ESMP by the drilling contractor and following up on non-conformances, incidents and other issues; and 3) reporting to PT SMI ESS&BCM Division and Management regarding safeguards implementation.

102. Drilling contractors will be required to comply with the ESMP by preparing and implementing a Contractor's ESMP, which details the specific methods, processes and resources that will be used to meet the requirements of the ESMP.

5. *Monitoring & Evaluation*

103. On monitoring and evaluation (M&E) capacity, PT SMI is experienced with the implementation of the WB Indonesia Infrastructure Finance Facility (P092218), engaged with other projects (Indonesia Infrastructure Finance Facility – Additional Financing (P154779) and Regional Infrastructure Development Fund (P154947)) and well-versed with M&E procedures. Through a PMU, PT SMI as the implementing agency will monitor the overall project implementation against the performance indicators listed in the 'PDO Level Results Indicators' section and detailed in Annex 1. They will also monitor contractors' performance with the support from the EMT. Data and statistics on actual project outputs and outcomes will be gathered, analyzed, and included in the quarterly progress reports to be submitted to the Bank. These efforts on monitoring progress towards the achievement of the PDO will be complemented by Implementation Status and Results Reports (ISRs).

6. Role of Partners (if applicable)

104. WB's partners in this initiative will be the Government of New Zealand and the Japan International Cooperation Agency (JICA). The support from the Government of New Zealand is cast within their broader geothermal development-focused technical assistance program to MEMR and Badan Geologi, and will include co-funding alongside GEF for an EMT to support PT SMI in managing exploration drilling contracts. JICA provides parallel TA support to MoF/PT SMI on business models for utilizing public funds dedicated to geothermal development at PT SMI. WB and JICA are closely collaborating on this, and the proposed Project is fully aligned with JICA's recommendations.

Annex 4: Implementation Support Plan

Indonesia: Geothermal Energy Upstream Development Project

Strategy and Approach for Implementation Support

105. Implementation is expected to begin in Q4 FY17, following Board approval and signing of grant agreements. Implementation support will begin as early as possible to prepare the Government and the implementing agency ahead of the first disbursement.

Implementation Support Plan

106. Bank team members for procurement, financial management, and safeguards will be based in Jakarta and the region to ensure timely support to the client. Formal supervision and field visits will be carried out at least twice a year.

Financial Management

107. **Internal Audit Arrangements.** PT SMI has its own internal audit unit which is responsible for conducting internal audits within PT SMI. The use of project funds will be subject to internal auditing by the PT SMI's internal audit unit GEUDP Project Implementation Manual will include arrangements for the internal auditing of the Project.

108. **External Audit Arrangements.** The Grant will be subject to external audit. Each audit will cover a period of one fiscal year of the recipient. The Bank will accept PT SMI corporate audit with disclosure on the use of the Bank's funds. Audit reports and audited financial statements will be furnished to the Bank not later than six months after the end of the fiscal year concerned and shall be made available to the public. The audit will be conducted in accordance with audit terms of reference acceptable to the Bank and agreed by negotiation. PT SMI will make the annual project audit reports available on its website.

109. **Supervision Plan.** Risk-based supervision of project financial management will be conducted. This will involve desk supervision, including review of IFRs and audit reports and field visit. Financial management supervision plan to be conducted every six months together with the task team as part of the project implementation support.

Procurement Support

110. The Bank is expected to support procurement implementation through two missions per year during the first two years of operation. Later on, the frequency of implementation support for procurement will depend on the progress of capacity building in the implementing agency. Procurement post-reviews will be conducted at least annually by the Bank or by its consultants or audit agencies acceptable by the Bank.

Main focus in terms of support during project implementation:

Time	*Focus*	*Skills Needed*	*Resource Estimate*
First twelve months	• Build capacity for project management • Build capacity for procurement, financial management, and safeguards	• Project management • Energy expert (local and international) • Procurement • Financial management • Social and environment Safeguards	$100,000, including $25,000 of travels
12-48 months	• Build capacity for project management • Build capacity for procurement, financial management, and safeguards	• Project management • Energy expert (local and international) • Procurement • Financial management • Social and environment safeguards	$270,000, including $60,000 of travels

Skill Mix Required:

Skills Needed	*Number of Staff Weeks*	*Number of Trips*
Overall Supervision	4	2
TTL	4	2
Co-TTL	4	2
Energy Specialist	4	2
Geothermal Energy Expert	8	2
Financial Management	4	2
Procurement	4	2
Environmental Safeguards	4	2
Social Safeguards	4	2

Partners

Institution	*Role*
Government of New Zealand, Ministry of Foreign Affairs and Trade (NZ MFAT)	TA support linked to the Project, as detailed in the pertinent sections in the PAD main text, Annex 2 and Annex 3.
Japan International Cooperation Agency (JICA)	Direct TA support to MoF/PT SMI. JICA's advisory on business models for utilizing public funds dedicated to geothermal resources at PT SMI, in line with the proposed WB scheme.

Annex 5: Clean Technology Fund

Indonesia: Geothermal Energy Upstream Development Project (P155047)

Results Framework

Indicator	**CTF/GEF World Bank Project** (5-yr implementation)	**CTF/GEF World Bank Project, including revolving flows and subsequent investment support** (18-yr time horizon)[17]
Geothermal Electricity Generation capacity enabled [MW electrical]	65	260
Potential for GHG emissions reduced or avoided[18] -Tons per year [MtCO2e /year] -Tons over lifetime of the project[19] [MtCO2e]	0.33 6.54	1.31 26.15
Financing leveraged through CTF funding [$ million]	US$445.25 million, including: - US$6.25 million GEF - US$49 million Government - US$390 million Private/Public of which US$150 million IBRD[20]	~US$1.56 billion (Private/Public)[21], of which US$150 million IBRD
CTF leverage ratio [1:X]	1 : 9.1	1 : 32
CTF cost effectiveness - CTF cost effectiveness [$CTF/tCO2eq avoided over lifetime of the Project] - Total project cost effectiveness [$Total Project/tCO2eq avoided over lifetime of the Project]	7.5 75.6	1.9 60.0
Other Co-benefits	• Improved Energy Security • Environmental Co-benefits • Improved Energy Access • Employment Opportunities	

[17] The Government of Indonesia has put forward the Electricity Supply Business Plan or Rencana Usaha Penyediaan Tenaga Listrik (RUPTL), 2016-2024.

[18]This potential for emissions reductions will be fulfilled if all the geothermal resources confirmed through the successful exploration drilling projects supported under Component 1 are developed into power plants and direct applications, which would generate the actual emission reductions. The majority of those projects will be commissioned after the Project has closed.

[19] Assumes a 20 year useful life

[20] Assumes 65 MW times $6 million/MW to reflect the cost of geothermal power development in the smaller fields of Eastern Indonesia. Share of co-financing from Private and Public sector to be determined on a project-by-project basis.

[21] Assumes 260 MW times $6 million/MW to reflect the cost of geothermal power development in the smaller fields of Eastern Indonesia. Share of co-financing from Private and Public sector to be determined on a project-by-project basis.

A. Introduction

Country and Sector Context

111. Indonesia's economic planning follows a 20-year development cycle. The current plan spans from 2005 to 2025. The five-year medium-term development plan, i.e. the third phase of the long-term plan runs from 2015 to 2019, and focuses on key development priorities including energy and infrastructure development, and on improving social assistance programs in education and health-care. Recent energy subsidy reforms have enabled shifts in public spending towards programs that directly impact the poor. However more than 28 million Indonesians currently live below the poverty line set at US$24.4 per month and approximately half of all households remain clustered around this poverty line. Employment growth has been slower than population growth, and public services remain inadequate by middle income country standards. Indonesia is also doing poorly on a number of health and infrastructure related indicators.

112. In addition despite rising government spending in recent years, Indonesia's core infrastructure stock, such as electricity, road networks, ports, and telecommunication facilities, has not kept pace with economic growth. The resultant "infrastructure gap" in terms of both quantity and quality of investment is due to several factors among which the most important are: a complex and non-transparent regulatory framework for implementation of infrastructure projects; an underdeveloped framework for PPPs resulting in insufficient mobilization of private funds for investment; and the inadequate participation of domestic capital markets in channeling funds to infrastructure sectors. The infrastructure gap contributes to undermine productivity, growth, competitiveness and poverty reduction efforts. Going forward, reducing the infrastructure gap would support growth and prosperity through several channels. The spending effect would support short-term growth and the creation of jobs. As the investments translate into infrastructure stock, private investment will be crowded-in and productive capacity, and long-term growth will be supported. As infrastructure services are delivered firms' competitiveness would increase and so would the population's access to services.

113. Indonesia's rapid economic growth has been fueled by an ever-expanding power sector. Sustained increases in electricity consumption (with average annual demand growth of 7.8% during 2009-2013) are linked with economic growth, urbanization and subsidized electricity tariffs. Within this context, keeping up with high electricity demand is a key development challenge. In an effort to reconcile the national electrification and economic development plans, GoI has put forward the Electricity Supply Business Plan or Rencana Usaha Penyediaan Tenaga Listrik (RUPTL), 2016-2024, which *inter-alia* provides for an electrification program in the Eastern islands to close the supply gap. The Plan foresees to bring on-line over 80 GW of newly installed capacity during 2016-2024, 98% (or about 78 GW) of which has already been allocated to specific generation options. Of this allocated amount, roughly 74% (or about 58 GW) is expected to be fossil fuel-based (coal at 44% and gas at 29%), while hydro- and geothermal-power are expected to receive the lion's share of investments in clean energy (at about 12% and 8%, respectively).

114. Indonesia's geothermal power potential is estimated at around 27 GW, roughly 40% of the world's known reserves. Only about 5% of the total resources indigenous to Indonesia are currently developed to produce power. Historically, low levels of private sector participation have contributed to slower-than-desired geothermal development. To spur development, GoI has

designed interventions specifically to address resource risk and mobilize private capital, including exploring a new tariff regime. Nonetheless, GoI is cognizant that these efforts may not be sufficient to mobilize private investment in geothermal power development where private sector interest is low due to inherent site-specific conditions (e.g. the geothermal fields of Eastern Indonesia).

115. De-risking geothermal projects by using government funds for exploration has been key to attracting risk capital and mobilizing private sector expertise towards geothermal drilling. Advanced development of the local geothermal markets in geothermal resource-rich countries such as USA, Japan, and New Zealand suggests that cost-shared or dedicated government exploration drilling programs increase the investment appeal for investors and developers. Government-sponsored drilling is currently the focus of much of the global push for geothermal development and cost-shared drilling models are being pursued in the developing geothermal markets such as Turkey, Armenia (supported by World Bank) and Mexico (supported by Inter-American Development Bank).

Indonesia's CTF Investment Plan

116. The CTF Investment Plan for Indonesia was originally approved in March 2010 and then revised in February 2013 and May 2015. The overall rationale for CTF intervention remains unchanged from the 2013 revision and reflects the evolution of Indonesia's policies and priorities. In order to make a decisive contribution to low-carbon economic and social development through furthering the country's geothermal sector, the GoI is looking to: (i) remove barriers for increased private sector participation; (ii) mobilize the resources committed to geothermal development; and (iii) implement the provisions mandated by the Geothermal Law.

117. In addition to geothermal development support, funds under the Energy Efficiency (EE)/Renewable Energy (RE) private sector programs implemented by IFC will continue targeting market barriers across the spectrum of technologies relevant to the Indonesian context, by utilizing various financing modalities, including direct investments and investments through financial intermediaries. A summary of the revised CTF financing plan is provide below.

Table 1: Revised CTF Financing Plan (2015) - (US$ Million)[22]

MDB & Program/Project Title	Total	CTF	MDB	Other Co-financing
WB Geothermal Energy Upstream Development Project	2,860.5	50	0	2,810.5
WB Geothermal Clean Energy Project	575	125	175	275
ADB Private Sector Geothermal Program	2,625	150	375	2,100
IFC Geothermal Electricity Finance Program	1,770	50	120	1,600
IFC Energy Efficiency and Renewable Energy	225	25	75	125
Total	**8,055.5**	**400**	**745**	**6,910.5**

[22] The higher leverage in the approved CIP was based on a different set of assumptions, including developing geothermal prospects in the main markets of Java and Sumatra with higher geothermal development-dedicated resources made available to PT SMI, a higher contribution from GEF and a direct contribution from AfD.

Brief Project Description

118. The Project has two components: *Component 1: Risk Mitigation for Geothermal Exploration Drilling (US$98 million); and Component 2: Capacity Building on Geothermal Exploration and Environmental and Social Safeguards Management (US$6.25 million).*

119. *Component 1: Risk Mitigation for Geothermal Exploration Drilling (US$98 million)* – The component focuses on supporting government-sponsored exploration drilling. The proposed concept involves setting up a revolving mechanism through which the funds used for exploration drilling will flow back to the facility through repayment of exploration costs plus a premium from developers that have been awarded a license. Funding for exploration drilling is expected to be made available in the measure of US$49 million (CTF contribution net of management fee) from CTF with a matching contribution from MOF/PT SMI for priority sites selected by the Directorate General of New Energy, Renewable and Conservation Energy (EBTKE) under MEMR. The reflow of funds into the Facility will ensure that funding will be available for future development, thus ensuring sustainability of the risk mitigation scheme. Based on the typical size of plants observed in Eastern Indonesia, it is estimated that 65 MW are to come on-line as a result of the exploration drilling financed under this Project.

120. *Component 2: Capacity Building on Geothermal Exploration and Environmental and Social Safeguards Management (US$6.25 million)* – This component will be financed by the Global Environment Facility (GEF). Building on the previous GEF support to the Indonesian geothermal sector, GEF funding will focus on building the local capacity for geothermal development by providing the resources needed to establish an efficient and effective exploration and tendering program. Specifically, this Component will provide technical assistance to the government-sponsored exploration drilling program, including advisory support in carrying out geology, geochemistry and geophysics surveys (3G surveys) and topographic mapping for candidate sites.

121. Support will be also made available for the preparation of drilling, well completion and resource assessment reports (based on 3G surveys) as well as for the bidding process for exploration service companies. It is envisioned that such support will be carried out by specialist service providers coordinated within an Exploration Management Team (EMT). In addition, technical assistance will cover the services of a geothermal consultant to provide support for MEMR's Geothermal Directorate's capacity building efforts.

122. The EMT and geothermal consultant activities will be financed by the GEF grant combined with grant support planned by the Government of New Zealand (GNZ). The planned grant from GNZ will be designed to be complementary to the CTF and GEF-financed support. The GNZ grant is expected to support GoI on: (i) establishment of an effective GIS-based database by collating and analyzing existing and new resources data, potentially to be housed within Badan Geologi (BG); (ii) methodology for robust resource and reserve estimation and reporting protocol to an internationally acceptable standard; (iii) methodology for prioritization of potential sites for geothermal development; and (iv) capacity building for EBTKE and PT SMI for tendering and executing an exploration program.

123. Furthermore, the GEF-funded TA will produce 'good practice' guides for preparing safeguards documentation, e.g. related to Environmental and Social Impact Assessments, Environmental Management Plans, and plans for indigenous people and resettlement that would be needed for exploration and exploitation of geothermal energy. Finally, it will cover just-in-time support for overall management, and donor coordination and ensure that adequate administrative functions are in place.

124. Government investment in exploration drilling has played a critical role for geothermal development worldwide. Taking full advantage of Indonesia's vast resource potential would require post-exploration, resource risk mitigation support. The post-exploration drilling phase of the geothermal development process (known as production drilling) requires significant investments, although likely at a lower financing cost due to a reduction in resource risk. To support this phase, WB may consider a tentative US$300 million IBRD loan for mid-stream development (i.e. steam-field drilling), with the aim of firming up resource levels prior to Steam-Above-Ground-System (SAGS) and power plant development – where greater private participation is likely.

B. Assessment of Proposed Project with CTF Investment Criteria

Potential for GHG emissions savings

125. It is expected that the proposed Project enables 260 MW of new geothermal capacity. Based on unlocking 65 MW of geothermal capacity per cycle, and given the revolving nature of the proposed facility, it is expected that funds will flow back every three years over an 18 year cycle, therefore enabling the aforementioned capacity of 260 MW over the lifetime of the facility. The operation of 260 MW of geothermal capacity will displace higher polluting alternatives for power generation. Therefore, the proposed Project is expected to avoid about 1.31 MtCO2e per year or 26.15 MtCO2e over the lifetime of the investment.

126. **Assumptions.** The CO2 emissions reduction potential was estimated by subtracting projected lifetime emissions from the Project (Project scenario) from the projected lifetime emissions in the business-as-usual scenario (Baseline). In the Project scenario, CO2 emissions were estimated using an average emission factor for geothermal energy facilities of 122 tCO2e/GWh[23]. In the Baseline scenario, CO2 emissions were estimated based on the combined margin grid emission factor of 746 tCO2e/GWh[24]. The net emission factor was therefore calculated as 746 tCO2e/GWh minus 122 tCO2e/GWh, which gives 624 tCO2e/GWh. The capacity factor was assumed as 92%, therefore 260 MW of geothermal capacity was assumed to produce about 2,095 GWh per year.

127. ***CTF Leverage Ratio.*** The CTF leverage ratio is estimated at 1:9.1 upon the completion of 5-year Project implementation period. This is based on the assumption that US$49 million in CTF financing would leverage another US$6.25 million in GEF financing, US$49 million from GoI, and US$390 million from the Private/Public sector. The CTF leverage ratio increases to 1:32 after

[23] *Bertani, Ruggero; Thain, Ian (2002), "Geothermal Power Generating Plant CO_2 Emission Survey", IGA News (International Geothermal Association)*

[24] Source: CO2 Emissions from Fuel Combustion (2011 Edition), IEA, Paris

considering the financing leveraged from enabling 260 MW geothermal capacity over an 18-year period.

CTF Cost Effectiveness

128. The cost-effectiveness is 7.5 US$/tCO2 for CTF funding and 75.6 US$/tCO2 considering total funding for the Project.

129. **Marginal abatement cost.** In October 2013, the CTF Trust Fund Committee suggested providing information on the estimated marginal abatement cost (MAC) for projects for which the marginal abatement cost is likely to exceed US$100 per ton of CO2. This decision draws from the CTF criteria which specifies that CTF co-financing will not be available for investments in which the marginal cost of reducing a ton of CO2 exceeds US$200, which reflects the lower-end estimate of the incentive needed to achieve the objectives of the BLUE Map Scenario as indicated in the International Energy Agency's Energy Technology Perspectives 2008 Report.

130. Preliminary calculations confirm that the MAC for the Project will not exceed the aforementioned US$200 threshold value per ton of CO2. In fact, the MAC for the Project should be lower than US$75.8 per ton of CO2. This is an overestimation of the MAC, as several economic benefits were not included to estimate Net Present Value (NPV). These include indirect benefits from induced investment in spas, greenhouses, and other secondary uses of geothermal heat, and new temporary and permanent jobs created in the communities where geothermal resources are developed.

> $MAC=NPV/LCO2$, where NPV stands for Net Present Value and LCO2 stands for Lifetime CO2 emissions savings.

Demonstration Potential at Scale

131. **Scope for avoided annual GHG emissions through replication.** The Project is expected to enable the installation of about 65 MW of new capacity over a 5-year implementation period and lead to the development of 260 MW of new geothermal power when fund reflows are considered over an 18-year period. Demonstrating the viability of government-sponsored drilling may unlock further investment in the sector, particularly by private developers who find the costs associated with exploration drilling prohibitive for the sustainability of their operations. Geothermal power is expected to contribute to the country's Greenhouse Gas (GHG) emission reduction efforts, which target a 29% cut by 2030 compared with a Business-As-Usual (BAU) emissions projection that starts in 2010.

132. **Transformation Potential.** The proposed CTF-funded Project will pave the way for the further development of the geothermal sector in Indonesia by establishing a mechanism for mitigating the major barrier hindering geothermal growth, namely the exploration drilling risk. The successful implementation of this Project can enable replication of similar interventions in the future seizing on additional resources from Government, private sector, and development partners, including JICA, AFD, and the Government of New Zealand, as well as from potential partners being attracted to the geothermal sector, including the United States and Islamic Development

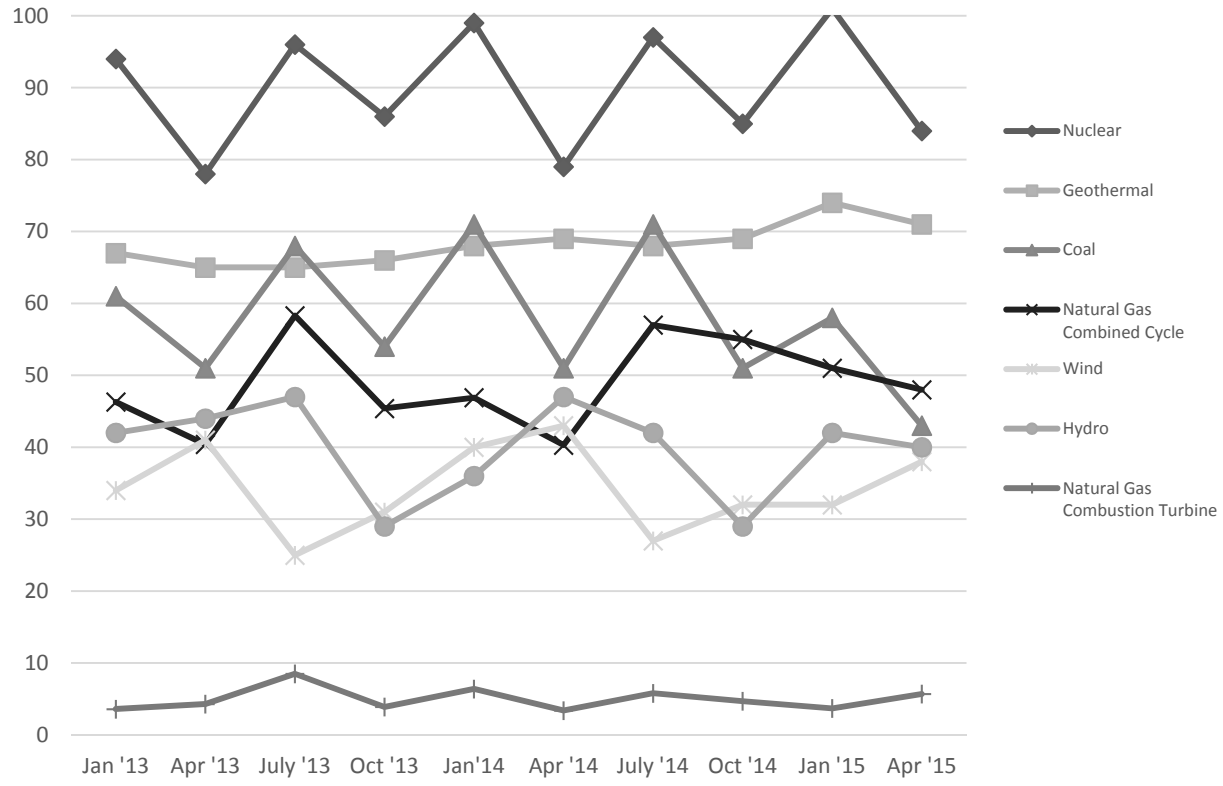
Bank. The further replication of similar mechanisms can help unlock the potential for geothermal in the country, which is estimated at 27 GW. In the short-term, the proposed CTF-funded Project will help enable 260 MW of geothermal capacity, while in the medium-term, the replication of similar investments can contribute to achieving the Government objective of installing 4.8 GW of geothermal power by 2024 as set forth in the Electricity Supply Business Plan or Rencana Usaha Penyediaan Tenaga Listrik (RUPTL), 2016-2024. Additionally, lessons learned from the institutional and operational set up of this facility can benefit the development of the geothermal energy sector in Indonesia and other countries.

Development Impact

133. **Improved energy security**. Geothermal energy is a renewable, baseload source of power. Harnessing geothermal power can have great implications in terms of greening, diversifying the energy mix and increasing energy security of resource-rich countries. Geothermal energy is not affected by price fluctuations and delivery of fuel, as is the case of higher polluting alternatives – such as the diesel fuel that would be substituted on the smaller islands of Easter Indonesia. The replenishment of heat from natural processes and modern reservoir management techniques enable the sustainable use of geothermal energy - the same cannot be said about fossil fuels. With appropriate resource management, the tapped heat from an active reservoir is continuously restored by natural heat production, conduction and convection from surrounding hotter regions, and the extracted geothermal fluids are replenished by natural recharge and by injection of the depleted (cooled) fluids. In addition, geothermal power plants operate fairly steadily with the global average capacity factor[25] close to 75% and newer installations reaching 90% and above (IPCC, 2011). A visual representation of how the capacity factor of geothermal plants stacks up vis-à-vis other technologies/fuels is given in Figure 1.

[25]Capacity factor is the ratio of the actual output of a generating unit over a period of time (typically a year) to the theoretical output that would be produced if the unit were operating uninterruptedly at its nameplate capacity during the same period of time.

Figure 1. US-observed Capacity Factors for Geothermal and other Technologies/Fuels, 2013 - 2015



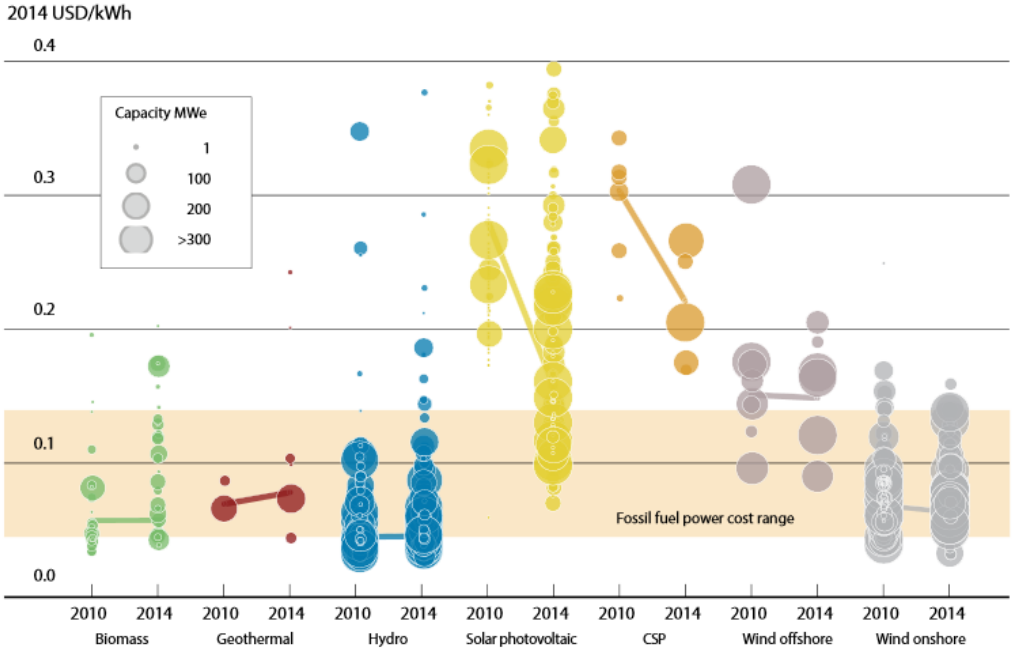
Source: Adapted from U.S. Energy Information Administration (EIA): http://www.eia.gov/todayinenergy/detail.cfm?id=14611#

134. **Environmental co-benefits**. Geothermal power's environmental benefits far outweigh potentially adverse impacts. First and foremost, there is no combustion in the geothermal development process, which technically means no technology-driven carbon dioxide (CO2) emissions. Practically, however, direct emissions do exist and are linked to the geology of the underground reservoir and fluids. Nonetheless, these are dwarfed by the emissions of thermal-power plants. At the local pollution level, geothermal power has also negligible emissions of sulfur dioxide (SO_2), nitrogen oxide (NO_x), and total suspended particulates (TSP). Secondly, Geothermal has minimal land and freshwater requirements. For example, geothermal plants use 5 gallons of freshwater per megawatt hour, while binary air-cooled plants use no fresh water. By contrast, coal and gas facilities' freshwater use is in the hundreds. Adverse impacts commonly refer to manageable site- and technology-specific issues (e.g. securing a project's land or right-of-way, disturbance of protected/sacred sites), which call for thorough feasibility studies and impact assessments to inform project planning and design. Old issues such as subsidence and risk of hydrothermal eruption are now addressed through the normal practice of fluid reinjection.

135. **Improved energy access**. Geothermal power can be an economically attractive generation option, which could contribute to increased energy access in Indonesia. The focus of the Project will be on the geothermal power development market in Eastern Indonesia in order to increase

access to electricity in areas with high poverty rates and expensive diesel-fired power generation. In these areas, reliable and affordable access to electricity is expected to contribute to sustained and sustainable economic growth for about 4 million poor people. The levelized cost of geothermal generation is typically between four and 10 US cents per kWh (Figure 2) in the best geothermal areas. The observed cost range makes geothermal power competitive against higher polluting energy sources. This a particularly important point given that reconciling the electrification and renewable energy expansion plans of many developing country governments puts great pressure on pursuing least-cost renewable generation options.

Figure 2. Levelized Cost of Electricity for Utility-Scale Renewable Technologies, 2010 and 2014



Source: IRENA (2014)

136. **Employment opportunities**. The Project will increase drilling activity, contributing to the direct creation of jobs as part of the drilling crews and associated services. In addition, jobs in construction and maintenance of power plants and other geothermal facilities will be created, both directly investments under the Loan Facility and indirectly through the full development of sub-projects for which resources are confirmed with support from the RSM or developed through capacity drilling financed by the Loan Facility. For reference, the Geothermal Energy Association (GEA) estimated that approximately 860 different people with a wide range of skills are employed over the development cycle in a typical 50MW geothermal project. Approximately 2 people per MW are involved during the drilling phase.[26]

Implementation Potential

[26] Geothermal Energy Association (GEA), "Green Jobs Through Geothermal Energy", October 2010.

137. Geothermal development is a pillar of the country's Low Carbon Growth Strategy and a key development priority for GoI[27]. The Ministry of Energy and Mineral Resources (MEMR)'s "Roadmap for Accelerated Development of New and Renewable Energy 2015-2025"28 sees geothermal contributing 7 percentage points of GoI's renewable energy (RE) target of 23% by 2025 – today's overall RE installed capacity stands at 6%. Geothermal power is expected to contribute to the country's Greenhouse Gas (GHG) emission reduction efforts, which target a 29% cut by 2030 compared with a Business-As-Usual (BAU) emissions projection that starts in 2010. With GOI's commitment and international aid support as well as considering Indonesia's geothermal resources, the implementation potential is assessed as high.

138. **Leveraged co-financing.** The proposed Project's financing plan amounts to US$104.25 million. Out of this, it is envisioned that the Project's investment component would be co-financed through PT SMI's dedicated resources for geothermal development in the amount of US$49 million and a contingent recovery grant of US$49 million from CTF (CTF contribution net of management fee) to be used for risk mitigation in geothermal exploration drilling. This would be combined with a non-reimbursable grant of US$6.25 million from the Global Environment Facility (GEF) for technical assistance and capacity building. The Project is expected to directly enable 65 MW of new geothermal power capacity, which would imply commercial investments of about US$390 million.

139. The proposed concept involves setting up a revolving mechanism through which the funds used for exploration drilling will flow back to the facility through repayment from developers who are successful in securing a license to develop the sub-project. Given the revolving nature of the facility, it is expected that funds will flow back over three-year cycles and that their use may enable 260 MW and about US$1.56 billion of new capacity and investment, respectively.

140. Taking full advantage of Indonesia's vast resource potential would require post-exploration, resource risk mitigation support. This phase, known as production drilling, requires significant investments, although likely at a lower financing cost due to a reduction in resource risk. To support this phase, WB may consider a tentative US$300 million IBRD loan for mid-stream development (i.e. steam-field drilling), with the aim of firming up resource levels prior to SAGS and power plant development – where greater private participation is likely.

C. CTF Additionality

141. Geothermal-based electricity production development has a very unique risk profile. Exploration and development of the geothermal resource itself is high risk and requires a long phase of technically complex and capital intensive investment before constructing the power plant. This is a major barrier to scaling-up geothermal-based electricity generation, which is exacerbated by the fact that no commercial equity financing or other long-term financing is available for

[27]The relevant national policies include: (i) Indonesia's Second National Climate Change Communication (2009); (ii) the Indonesia Green Paper (2009); (iii) the GOI National Energy Policy (2005); (iv) the Energy Blueprint 2005 – 2025; (v) Indonesia's National Long-Term Development Plan 2005-2025, and National Medium-Term Development Program for 2010 – 2014 (Rencana Pembangunan Jangka Menengah, or RPJM); (vii) the National Action Plan for Climate Change (2007); (viii) the Development Planning Response to Climate Change (2008); (ix) the Climate Change Roadmap for the National Medium-Term Development Program for 2010 – 2014 (2009); (x) Indonesia's Technology Needs Assessment on Climate Change Mitigation (2009); and (xi) other relevant sector development policies and programs.
[28]The roadmap is dated May 2015

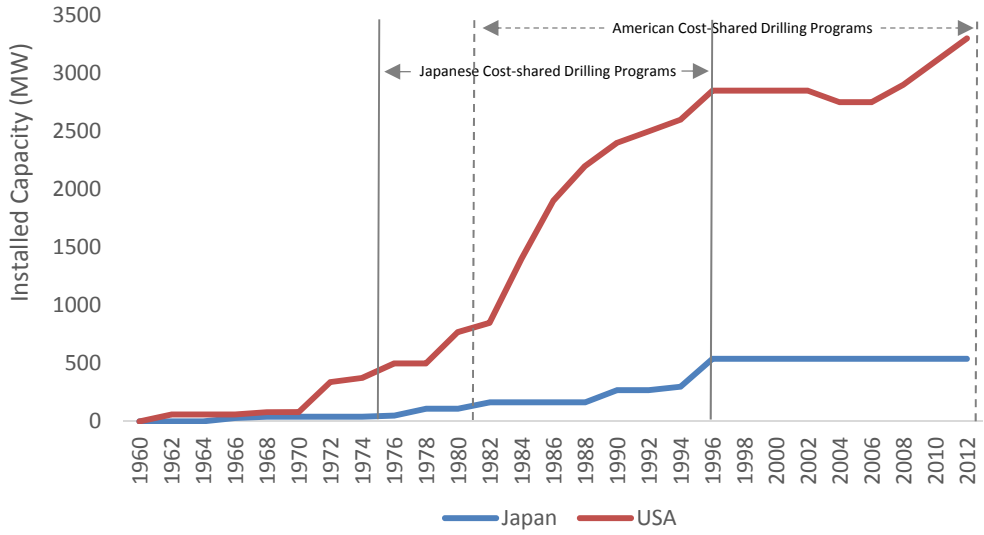
geothermal exploration and resource development phases. Indonesia is no exception to this. Despite the geothermal potential (approximately 27 GW) and the focus of GoI and development partners, only about 5% of the total resources indigenous to Indonesia are currently developed to produce power. Most of the current installed megawatts came on-line before the 2000s and, in terms of new (greenfield) developments that carry greater risks only one private sector project, Sarulla (320 MW), has achieved financial closure in the last decade.

142. The CTF funds are critical to address a market failure that is specific to the geothermal sector. In the absence of the CTF funds, the development and engagement of the private sector in the geothermal market would take considerable time or not even materialize given the significant levels of risks associated with early stage resource confirmation. Currently, there are no schemes in Indonesia mitigating resource risk to attract private capital for geothermal development – a model which has proved its strength in developed markets such as, the USA and Japan, and that is being pursued in the developing geothermal markets of Turkey, Armenia and Mexico. CTF funds would be used to introduce such model in Indonesia. The proposed CTF-funded Project will pave the way for the further expansion of the geothermal market in Indonesia by attracting private sector investments, allowing for future complementary commercial and multilateral lending, as well as sponsor equity.

143. Cost-sharing as a means to mitigate resource risk is currently the focus of much of the global push for geothermal development, as it has proven to enable risk capital and private expertise to be mobilized towards geothermal drilling. For example, Japan and the United States experienced a major period of geothermal development thanks to cost-shared drilling programs. After two decades of cost-shared development which allowed installing some 500 MW of geothermal capacity (about 90% of the country's total), the Japanese program came to a halt in 1995 and no new significant developments have been undertaken since. After 2011's earthquake and Fukushima disaster, the central government has been taking important steps towards reviving geothermal power development, including reintroducing cost-sharing for resource estimation.

144. The United States has had various forms of government cost-sharing, but has kept the majority of development and capital investment directly with the private sector. The rollout of the Geothermal Grant and Loan Program has brought to bear over 2.5 GW of new geothermal installed capacity, thus more than tripling the 750 MW installed by the early 1980s. Figure 3 shows the evolution of the installed geothermal power capacity in USA and Japan in light of their respective cost-sharing programs. Cost sharing is a win-win situation in that it reduces the burden on public finances while catalyzing geothermal development by the private sector. At the exploration stage, cost-sharing creates additional liquidity in risk capital that is often scarce, unduly costly, or both.

Figure 3 – Evolution of the Installed Geothermal Power Capacity in USA and Japan



Source: ESMAP (2015)

D. Implementation Readiness

145. The underlying national policies that are relevant for the development of the country's geothermal sector include: (i) Indonesia's Second National Climate Change Communication (2009); (ii) the Indonesia Green Paper (2009); (iii) the GOI National Energy Policy (2005); (iv) the Energy Blueprint 2005 – 2025; (v) Indonesia's National Long-Term Development Plan 2005-2025, and National Medium-Term Development Program for 2010 – 2014 (Rencana Pembangunan Jangka Menengah, or RPJM); (vii) the National Action Plan for Climate Change (2007); (viii) the Development Planning Response to Climate Change (2008); (ix) the Climate Change Roadmap for the National Medium-Term Development Program for 2010 – 2014 (2009); (x) Indonesia's Technology Needs Assessment on Climate Change Mitigation (2009); and (xi) other relevant sector development policies and programs.

146. The proposed Project will be carried out by MoF's PT SMI, an Infrastructure Financing Company which is experienced with World Bank projects. MEMR's Badan Geologi, the custodian of geothermal exploration data in Indonesia, is expected to facilitate project implementation. In carrying out its function, PT SMI would be supported by an Exploration Management Team (EMT) on the management of drilling contractors, general site topographic surveys and any additional scientific surveys needed to develop field models to be tested by drilling. The EMT will also coordinate civil works to enable rig access to the sites prepared by the civil contractor. Badan Geologi under the guidance of MEMR will vet the geological data sourced from the exploration drilling activities. BG will also support the interface with local government counterparts to secure geothermal development-related clearances as needed. To ensure close coordination, a joint committee comprising of representatives from MoF/PT SMI and MEMR/BG will be established to be used as a sounding board by the parties on the decision to drill and tender, and ultimately provide guidance to the Project. Finally, PT SMI is set to change status from Infrastructure Financing Company to Development Bank in the medium-term. With the new status, PT SMI will receive a mandate to scale-up development of the country's renewable energy

resources. In order to fulfil its mandate, PT SMI is looking at different models for climate investing, including co-financing arrangements, fund management functions, financial intermediary roles and advisory services. PT SMI has confirmed interest in exploring options for WB financing, particularly for geothermal steam-field development.

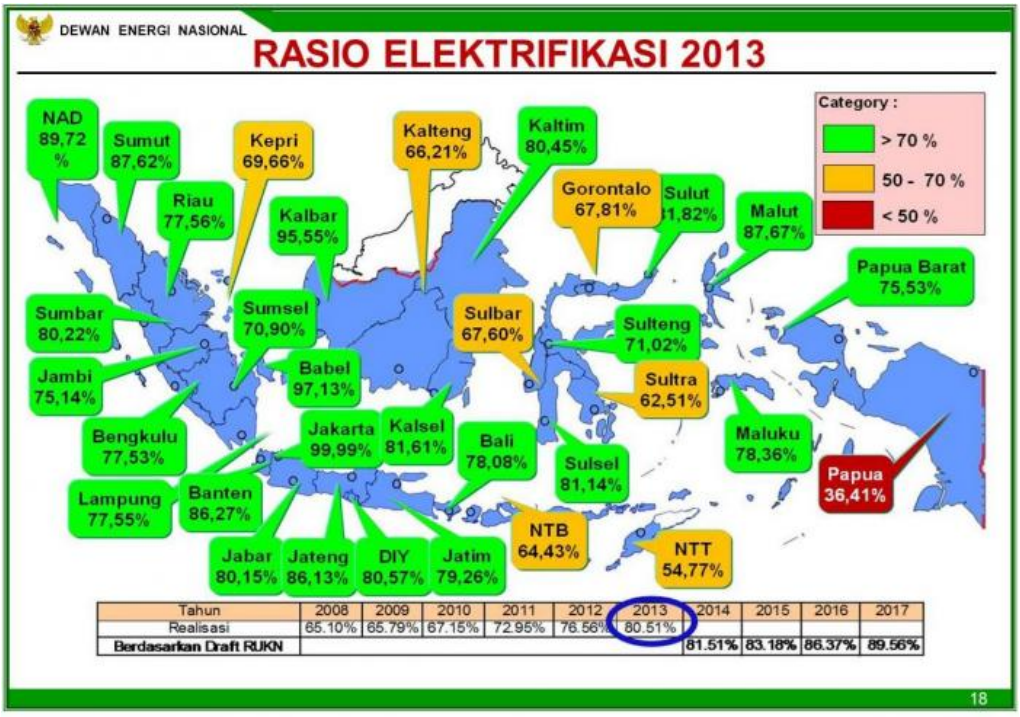
147. The Bank's support would build on the existing body of work and previous engagements in the global and Indonesia geothermal space. Globally, experiences such as, the Turkey's Geothermal Development Project and Armenia's Geothermal Exploration Drilling Project provide relevant input to the Project design. In the Indonesian context, past World Bank activities which inform this operation are: (i) the PPIAF-funded Assessment of Geothermal Resource Risks, which took stock of the international experience with geothermal development and distilled mitigations options applicable to Indonesia; and (ii) the GEF-funded Geothermal Power Generation Development Project, which inter-alia supported the development of a pricing and compensation policy for geothermal power. In addition to the Bank's past experience, ongoing activities which inform this operation are: (i) the CTF/IBRD, ADB-PSOD and IFC downstream investment projects and related technical assistance programs; and (ii) the Climate Change Development Policy Loans, which, provided collectively by the World Bank, JICA and AFD, further support the development of a pricing and compensation policy that is necessary to address the higher financial cost of geothermal electricity compared with coal-based power.

Annex 6: Supplemental Research and Analysis

INDONESIA: Geothermal Energy Upstream Development Project (P155047)

148. Indonesia Electrification Program: Over the past decade, the Government of Indonesia (GoI) has made great strides with the national electrification program. In 2008, data from the National Energy Council (NEC) show that the country's electrification rate was about two-thirds of the overall population (Figure 1). As of 2014, about 84% of the country's population was electrified. GoI now targets a 99% electrification rate by 2020 as part of its overall vision and social mission for the country's energy sector. Against this ambitious target, Indonesians enjoy a low electricity consumptions per capita at 40% of the 2012 middle income countries (MIC) average. Stark differences in the provincial electrification program exist, with the six Eastern Indonesian provinces exhibiting some of the country's lowest electricity access rates – and highest poverty rates.

Figure 1 - Electrification Rates by Province, 2013



Source: National Energy Council, 2014

149. Poverty Rates in Indonesia: According to Statistics Indonesia (BPS), Indonesia's Eastern provinces – shaded in Table 1 below – also exhibit some of the country's highest poverty rates. In these areas (which include both urban and rural centers), reliable and affordable access to electricity is expected to contribute to sustained and sustainable economic growth for about 4 million poor people.

Table 1 - Poverty Rates by Region and Province, 2014

Province	Number of Poor People (000)			Percentage of Poor People		
	Urban	Rural	Urban+Rural	Urban	Rural	Urban+Rural
Aceh	161.94	719.31	881.26	11.76	20.52	18.05
Sumatera Utara	632.20	654.47	1286.67	9.35	9.40	9.38
Sumatera Barat	108.08	271.12	379.20	5.43	8.68	7.41
Riau	166.36	333.52	499.89	6.90	8.92	8.12
Kepulauan Riau	97.38	30.42	127.80	6.09	9.86	6.70
Jambi	100.12	163.68	263.80	9.85	7.07	7.92
Sumatera Selatan	367.12	733.71	1100.83	12.93	14.46	13.91
Bangka Belitung	22.33	49.31	71.64	3.39	7.27	5.36
Bengkulu	104.54	216.41	320.95	18.22	17.14	17.48
Lampung	230.63	912.28	1142.92	11.08	15.41	14.28
DKI Jakarta	393.98	-	393.98	3.92	-	3.92
Jawa Barat	2578.36	1748.71	4327.07	8.47	11.35	9.44
Banten	375.69	247.14	622.84	4.73	6.67	5.35
Jawa Tengah	1945.29	2891.17	4836.45	12.68	15.96	14.46
DI Yogyakarta	333.03	211.84	544.87	13.81	17.36	15.00
Jawa Timur	1535.81	3250.98	4786.79	8.35	16.13	12.42
Bali	99.90	85.30	185.20	4.01	5.34	4.53
Nusa Tenggara Barat	370.18	450.64	820.82	18.54	16.31	17.25
Nusa Tenggara Timur	100.34	894.33	994.68	10.23	22.15	19.82
Kalimantan Barat	82.05	319.46	401.51	5.76	9.76	8.54
Kalimantan Tengah	40.78	105.55	146.32	4.98	6.57	6.03
Kalimantan Selatan	62.51	120.37	182.88	3.79	5.33	4.68
Kalimantan Timur	97.89	155.71	253.60	4.01	10.33	6.42
Sulawesi Utara	59.18	149.05	208.23	5.51	11.41	8.75
Gorontalo	25.21	168.96	194.17	6.60	23.10	17.44
Sulawesi Tengah	67.08	325.57	392.65	9.77	15.27	13.93
Sulawesi Selatan	162.49	701.81	864.30	5.22	13.25	10.28
Sulawesi Barat	26.31	127.58	153.89	9.16	13.19	12.27
Sulawesi Tenggara	48.25	294.01	342.26	7.06	16.78	14.05

Maluku	49.83	266.28	316.11	7.80	26.28	19.13
Maluku Utara	12.19	70.45	82.64	3.95	8.56	7.30
Papua	35.37	889.04	924.41	4.47	38.92	30.05
Papua Barat	14.78	214.65	229.43	5.86	36.16	27.13
Indonesia	**10507.20**	**17772.81**	**28280.01**	**8.34**	**14.17**	**11.25**

Source: Badan Pusat Statistik (BPS), 2014

150. Geothermal Development: Indonesia's geothermal power potential is estimated at around 27,000 MW (Table 3), roughly 40 percent of the world's endowment. Tapping this abundant, indigenous, clean and baseload source of power would contribute to the country's sustainable development, generation portfolio diversification and energy security enhancements efforts.

Table 3 - Indonesia's Geothermal Prospects (MW)[29]

	Speculative	Hypothetical	Probable	Possible	Proven	Total
Sumatra	5,530	2,353	5,491	15	389	13,778
Kalimantan	50	-	-	-	-	50
Sulawesi	900	125	761	110	65	1,961
Maluku	275	117	142	-	-	534
Java	2,363	1,521	2,980	603	1,837	9,304
Papua	50	-	-	-	-	50
Bali-Nusa Tenggara	365	359	943	-	14	1,681
Total						**27,358**

Source: Authors based on data from MEMR

[29] Source: ESMAP - http://www.esmap.org/sites/esmap.org/files/DocumentLibrary/ESMAP_Scaling-up%20Geothermal%20in%20Indonesia_KS15-13_Optimized.pdf

Annex 7: Economic and Financial Analysis

Indonesia: Geothermal Energy Upstream Development Project (P155047)

151. This annex comprises two parts, an economic analysis to assess the economic viability of a given geothermal site; and a financial analysis to (i) demonstrate how a government-sponsored exploration drilling scheme helps reduce the barrier-to-entry to the geothermal sector in Indonesia, and (ii) test the sustainability of the proposed revolving facility.

Economic Analysis

152. The exact capacity of the geothermal plants that will be developed following the exploration drilling is not yet known. For the sake of this analysis, two hypothetical sites in Eastern Indonesia were analyzed: (i) a relatively large site with a resource potential of 55 MW; and (ii) a relatively small site with a resource potential of 10 MW. The varied size of the hypothetical plants will help assess the impact of site scale on the economic and financial viability of geothermal development and the government-sponsored exploration drilling scheme. The large site is assumed to be on a bigger island with a considerable existing load and relatively high connection rate of consumers. The small site is assumed to be on one of the many small-to medium sized islands in Eastern Indonesia with a moderate existing load and low connection rate.

153. A benefit-cost analysis was carried out, on a site-by-site basis, to assess the economic viability of each geothermal development selected for government-sponsored exploration drilling under the Project scheme, taking into account the global environmental benefit of avoided greenhouse gas (GHG) emissions from geothermal-based generation vis-à-vis a comparable thermal power development. The analysis was carried out over a 30-year lifetime of a geothermal development, exclusive of the construction period, at an economic opportunity cost of 6.0%.[30] The social cost of carbon is assumed to follow a curve proposed by The Guidance Note on Social Value of Carbon (2014)[31] increasing from US$32 per ton of CO2 in 2017 to US$82 ton of CO2 in 2052, or a weighted average of US$48.13 per ton of CO2 in the period of 2017-52 at the social discount rate of 6.0%.

Cost-benefit analysis

154. The economic cost estimates were derived based on known or inferred relationships between costs and technical characteristics of geothermal projects, excluding taxes and duties. Investment costs of geothermal development are determined by the following factors: (i) size of the development (MW) determined by both resources availability and demand; (ii) the enthalpy and depth of the resources; (iii) difficulty of access to the concession area; and (iv) cost and efficiency of project management.

155. In terms of composition, geothermal development comprises four types of costs: (i) drilling costs, a function of the number wells and the cost of each well; (ii) infrastructure costs for construction roads, well pads and other infrastructure facilities; (iii) equipment costs, including power plant and steam field above ground systems (SAGS); and (iv) project management costs.

[30] Source: Discounting Costs and Benefits in Economic Analysis of World Bank Projects, OPSPQ, 2016
[31] Source: *The Guidance Note on Social Value of Carbon* (2014)

156. Drilling cost is a function of the following factors: (i) well productivity; (ii) success rate of drilling; (iii) well depth, and (iv) prevailing services and material cost. Well productivity, in turn, depends largely on the enthalpy of the resources.

157. Three enthalpy scenarios were assumed in the analysis: (i) low enthalpy, i.e., low temperature between 180°C and 230°C; (ii) medium enthalpy with temperature above 230°C but relatively low pressure[32]; and (iii) high enthalpy with both high temperature and high pressure. Resource enthalpy is also a key determinant of the reinjection-to-production well ratio. Lower enthalpy resources generally require a higher reinjection-to-production well ratio. Estimates of resource temperature and other parameters were made based on interpretations of previous geothermal developments in Indonesia. Below is a summary of the well productivity and reinjection-to-production well ratio assumptions under each enthalpy scenario.

Table 1 - Well Assumptions

Enthalpy	Well Productivity (MW/well)	Reinjection-to-Production Well Ratio
High	10.0	15%
Medium	7.0	33%
Low	5.0	90%

158. Drilling cost per well was assumed at $6.0 million for a 7" x 2,500 meter deep production well and $5.5 million for a 7" x 2,000 meter reinjection well. Success rate[33] of drilling improves along the phases of the geothermal development from around 60% in the exploration phase to 75% for delineation and production drilling.

159. The base case scenario assumes medium enthalpy for both fields. It was further assumed three wells will be drilled at the exploration phase. Thus, the total number of wells to be drilled based on the above assumptions are estimated and summarized below.

Table 2 – Number of Wells to be Drilled

	Development 1 - 55 MW			**Development 2 - 10 MW**		
Enthalpy	*Low*	*Base case Medium*	*High*	*Low*	*Base case Medium*	*High*
Productivity (MW per well)	5.0	7.0	10.0	5.0	7.0	10.0
Number of wells						
Exploration wells	3	3	3	3	3	3
Delineation and production	9	7	5	1	-	-
Reinjection	9	3	1	1	-	-
Total	**21**	**13**	**9**	**5**	**3**	**3**

160. Fuel cost for drilling was assumed at $50 per bbl until 2020 and $85 per bbl thereafter.

[32] Defined as less than 10% excess enthalpy compared to reservoir temperature when measured in a discharging well with at least 5 barg WHP, a definition agreed with MEMR albeit minor insistencies with the international conventions.
[33] Defined as the likelihood the well productivity exceeds a preset threshold

161. Infrastructure Costs are driven primarily by the difficulty in site access. The analysis laid out three scenarios: (i) easy access with initial access road length ranging between 0 and 7.5 km from existing public access road; (ii) medium with initial access road between 7.5 km and 20 km; and (iii) difficult with initial access road longer than 20 km. All well pads are assumed to require 2 km additional road. Initial access road cost was assumed at $0.5 million per km for easy and medium access scenarios, $0.75 million per km for difficult access scenario. It is further assumed an average length of 0.75 km of access road to additional well pads. The additional access road was assumed to cost $0.38 million per km for easy and medium access scenarios, and $0.56 million for difficult access scenario. The base case scenario assumes easy access for both fields.

162. Power Plant Costs assumed at $1,500 per kW for a standard single-unit 55 MW plant, and $2,000 per kW for the 10 MW plant. For any other sizes, the plant costs were estimated using an experiential formula derived from actual plant cost data.[34]

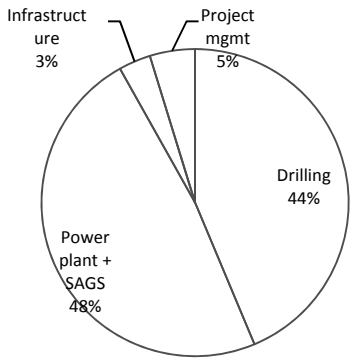
163. Assuming medium enthalpy and easy access, the total cost of geothermal development under the base case scenario was thus estimated at US$211.5 million for the 55 MW site, and US$45.3 million for the 10 MW site.

Table 3 – Total Investment Cost

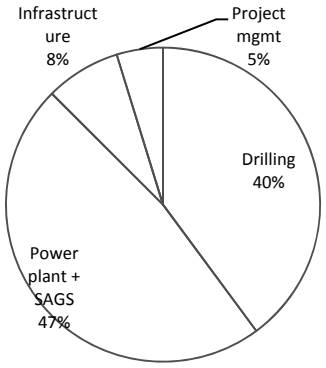
	Development 1 (US$ million)	**Development 2** (US$ million)
Drilling	92.3	18.0
Infrastructure	7.1	3.5
Power plant and SAGS	101.8	21.5
Project management	10.3	2.3
total	**211.5**	**45.3**

Figure 1 – Investment Cost Breakdown

a. Development 1 – 55 MW



b. Development 2 – 10 MW



164. O&M costs include (i) ongoing expenses assumed at 2.0 US¢/kWh and 2.3 US¢/kWh for the 55MW and 10 MW unit respectively, (ii) occasional costs for plant shutdown and overhaul assumed to occur every 5 years, at a cost of 500,000 USD per event, and (iii) costs of make-up

[34] Single unit plant cost = 1.6051 * $(MW)^{-0.316}$

wells assuming a 3% linear reservoir drawdown, with 3 production size wells being drilled at each make-up well drilling campaign for the 55 MW site; and 1 at the 10 MW site.

Benefits

165. The economic benefits of each development comprise two parts: (i) the economic value of the power supply from the plant; and (ii) the avoided cost in CO2 emissions vis-à-vis thermal powered generation.

166. Plant Factor. A plant factor of 92% was assumed based on experience from operations of existing geothermal power plants in Indonesia.

167. Power supply. The annual power output amounts to 443.3 GWh from the 55 MW plant, and 80.6 GWh from the 10 MW plant.

168. The economic value of the power supply from each geothermal development is estimated as the weighted average of the cost of diesel-based power supply it substitutes and the willingness-to-pay for the additional power supply it enabled to provide access to un-electrified households.

169. The substituted cost of supply. In Eastern Indonesia where indigenous coal resources are generally rare, and low quality coal is costly to transport, the least-financial-cost power supply usually comes from diesel generators burning expensive fuel transported from afar. The supply substituted by the geothermal development is thus assumed at marginal cost of diesel-based generation at a diesel costs of US$0.70 per liter.[35] At a thermal efficiency of 34% for a larger more efficient unit and 30% for a smaller unit, the marginal cost of diesel generation is estimated at $0.20 per kWh for the larger plant and $0.21 per kWh for the smaller plant.

170. Expanded supply to increase access to electricity. In Eastern Indonesia, access to electricity is far from being universal, in part, due to shortage of power supply. The need for electrification is assumed to be bigger on the smaller islands. Thus, for the 55 MW plant it is assumed that 80% of the geothermal-based generation will be substituting diesel-based supply while 20% will be serving the need for electrification; whereas for the 10 MW plant 60% diesel substitution and 40% electrification is assumed. The WTP for power supply made available through electrification is conservatively assumed at US$0.40 per kWh.[36] Assuming total system losses at around 30%, the WTP for power generation for electrification was thus estimated at US$0.28 per kWh.

171. Willingness to pay (WTP) based on the above-mentioned assumptions, is thus estimated at around US$0.22 per kWh for power generated from the large site and US$0.25 per kWh for that from the small site.

[35] The Government of Indonesia provides subsidies on automotive diesel to keep its retail price around IDR 5,500 (US$0.42) per liter. However, the subsidy is not available for diesel used in electricity generation. Table 68, PLN Statistics 2014 indicated the cost of generation of PLN's diesel fleet averaged from US$ 0.23 to US$0.25 per kWh in the period of 2012-14, translating to a marginal cost of diesel generation between US$0.21 to US$0.24 per kWh, or a cost of fuel between $0.70-0.85 per liter, assuming 34% efficiency. Here, to be conservative cost of US$0.70 per liter is assumed. IEA Statistics, July 2016 https://www.iea.org/media/statistics/surveys/prices/mps.pdf recorded an automotive diesel price range of US$0.686 – US$1.369 per liter in OECD countries in the month of July, 2016.

[36] The Welfare Impact of Rural Electrification: A Reassessment of the Costs and Benefits and IEG Impact Evaluation (2008) indicated the estimated WTP for lighting at US$0.71 per kWh in Indonesia.

172. Avoided cost vis-a-via thermal power. Modern closed-loop geothermal power plants emit no greenhouse gasses; lifecycle GHG emissions are around 122 gCO2/kWh.[37] With an efficiency of 34% and 30%, the emission factor of diesel generation is estimated at 784 gCO2/kWh and 889 gCO2/kWh, respectively. Assuming the global social cost of CO2 following the curve proposed by the Guidance Note on Social Value of Carbon (2014) with a weighted average of US$48.13 per tCO2 for the period 2017-52, geothermal generation will thus avoid an estimated US$0.032 per kWh in CO2 emissions from the 55 MW plant, and an estimated US$0.037 per kWh from the 10 MW plant.

Table 4 – Avoided Cost of CO2 Emission

	Development 1 (55 MW)	Development 2 (10 MW)
Substituted technology	Large diesel	Medium diesel
Substituted diesel efficiency	34%	30%
CO_2 conversion factor of diesel (Kg/GJ)	74.1	
Heat content of diesel used for generation (kJ/kWh)	10,588	12,857
Diesel generation emissions (kg/kWh)	0.784	0.889
Geothermal generation emissions (kg/kWh)	0.122	0.122
Avoided CO2 emission (*$kgCO_2/kWh$*)	0.663	0.767
Avoided cost of CO2 emission (*$/kWh*)	0.032	0.037

173. The total economic value of the geothermal development is thus estimated at $0.25 per kWh from the 55 MW development, and $0.29 per kWh from the 10 MW development. The table below provides a summary of the economic benefits from each geothermal development.

Table 5 - Summary of Economic Benefits

	Development 1	**Development 2**
Power supply		
Capacity (MW)	55.0	10.0
Capacity factor	92%	92%
Annual output (GWh)	443.3	80.6
Substituted power generation		
Type	Large diesel	Small diesel
Cost of fuel ($/liter)	0.70	0.70
Efficiency	*34%*	*30%*
Economic value of the power generated		
Substituted existing supply	*80%*	*60%*
Marginal cost of substituted diesel generation ($/kWh)	0.20	0.23
Electrification	*20%*	*40%*
WTP for electrification ($/kWh)	0.40	0.40
Average WTP ($/kWh)	0.22	0.25

[37] Source: Thráinn Fridriksson, Gases in Geothermal Fluids and Gas Emissions from Geothermal Power Plants, April 2016, ESMAP

	Development 1	Development 2
Avoided cost of CO_2 emissions vis-a-via thermal ($kWh)	0.03	0.04
Total economic value of geothermal power supply ($kWh)	**0.25**	**0.29**

174. Global environmental benefit. Based on the above-mentioned assumptions, an estimated 0.294 million-tCO2 and 0.062 million-tCO2 emissions will be avoided through the 55 MW and 10 MW geothermal development respectively. With a global social cost of CO2 following the curve proposed by The Guidance Note on Social Value of Carbon (2014) with a weighted average of US$48.13 per tCO2 for the period 2017-52, an estimated $14.14 million and $2.98 million worth of CO2 emissions will be avoided annually from the 55 MW and 10 MW geothermal development respectively.

175. Outcome of the economic analysis. At a discount rate of 6% and a social of cost of carbon following the curve proposed by The Guidance Note on Social Value of Carbon (2014) with a weighted average of US$48.13 per tCO2 for the period 2017-52, the 55 MW geothermal development yields an economic net present value (ENPV) of US$750 million with an economic internal rate of return (EIRR) of 33.5%; and the 10 MW development yields an ENPV of US$153 million with an EIRR of 29.5%. Therefore, both developments are economically viable.

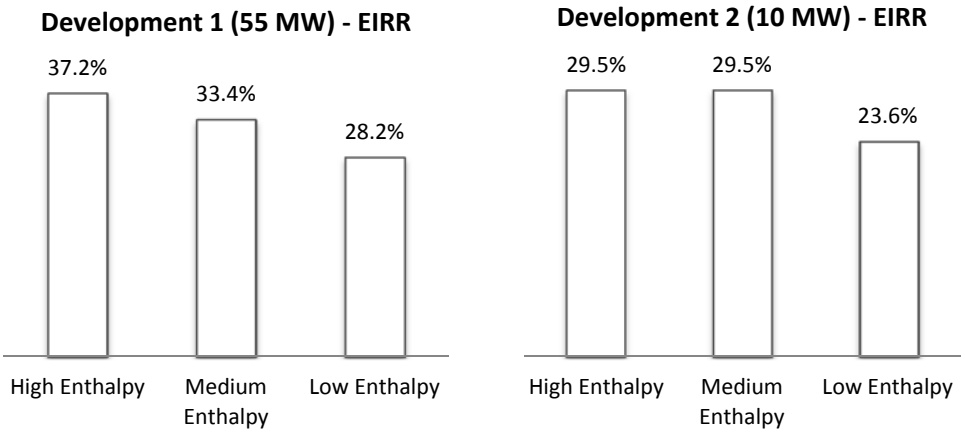
Table 6 – Economics Analysis, ENPV and EIRR Results

	Development 1 55 MW	Development 2 10 MW
ENPV @ 6% discount rate	US$750 million	US$153 million
EIRR	33.5%	29.5%

Sensitivity analysis

176. A sensitivity analysis was carried out to assess the impact of resource enthalpy on the EIRR. The results are summarized in the figure below.

Figure 2 – Sensitivities of Enthalpy



177. Moreover, the sensitivity analysis also examines the impact of global externality, i.e., the value of the avoided CO2 emissions, on the EIRR. The results are summarized in the table below.

Table 7 – Sensitivities of Global Externalities

	55 MW	**10 MW**
EIRR – including global externality	33.5%	29.5%
EIRR – excluding global externality	29.6%	26.2%

Financial Analysis

178. The Financial Analysis (FA) was carried out from two different perspectives: (i) one from a developer's perspective, assessing the financial viability of a given geothermal site on a with- and without project basis; (ii) the other from the implementing agency's perspective, assessing its cash in- and out-flows related to the investments in geothermal exploration drilling over a period of 18 years.

From a Developer's Perspective

179. The financial analysis assesses the financial viability of each geothermal development, using the geothermal ceiling tariff schedule initially adopted by MEMR and which is based on avoided costs in the power system.[38] For geothermal power plants to be commissioned in Eastern Indonesia in or before 2023, the ceiling tariff was US$0.263 per kWh. All project related costs are calculated on nominal basis, assuming a 3% price escalation annually, inclusive of taxes, duties and financial charges. In the with-Project scenario, it has been assumed the winning developer will pay a 25% premium on top of the cost of exploration in order to acquire a license.

180. Financing mix. In Indonesia, the costs of geothermal exploration have been born by the developer through full equity financing because debt financing is usually not available at this stage of the development due to the high levels of resource uncertainties. Once resources risks are greatly reduced, developers can access debt financing more easily. Thus, in the without-Project scenario the financing mix is assumed to vary from full equity financing at the exploration stage, to a 70/30 debt-to-equity thereafter.

181. Financing cost. Each stage of geothermal development is associated with a certain amount of risks and capital requirements. Although the capital requirements are higher in later stages, the resource risks at early exploration stages are often deemed insurmountable from a financial perspective, stalling the sector's development. Developers would demand a considerable risk premium commensurate with the high resource uncertainty associated with the exploration stage of the geothermal development. For the later stages of the development, developers required risk premium is much lower due to the much reduced resources risks. The table below provides a summary of the required risk premiums of IPP and SOE (with lower hurdle rates) developers and their corresponding weighted average cost of capital (WACC).

Table 1 - Risk premium

	Exploration	**Post-Exploration**
IPP	25%	14%
SOE	16%	11%

[38] Source: Unlocking Indonesia's Geothermal Potential (2015) and Indonesia Geothermal Tariff Reform – Tariff Methodology Report (2015)

182. Weighted average cost of capital. With the cost of debt at 8.0% and corporate tax at 25%, the WACC with- and without- the Project intervention, under high, medium and low enthalpy scenarios are summarized in the table below.

Table 2 - Project WACC

	Without Project (Greenfield)						**With Project (Brownfield)**	
	Development 1			Development 2			Development 1	Development 2
Enthalpy	*high*	*medium*	*low*	*high*	*medium*	*Low*		
IPP	10.4%	10.1%	9.7%	16.4%	16.4%	14.3%	10.2%	10.2%
SOE	8.5%	8.4%	8.2%	11.6%	11.6%	10.5%	8.4%	11.6%

183. Outcome of the financial analysis. At the recommended ceiling tariff of 26.3 US cent per kWh[39]:

- *Without the Project intervention, the 55 MW* geothermal development will yield an FIRR of 20.3%, 24.7% and 27.9% under the low, medium and high enthalpy scenarios, respectively, exceeding the WACC requirement of both IPP and SOE developers, thus both IPP and SOE developers would be willing to undertake the investment.

- *Without the Project intervention, the 10 MW geothermal* development will yield an FIRR of 19.0%, 19.0% and 13.7% under the high, medium and low enthalpy scenarios, levels sufficient for an SOE developer to undertake the investment. For an IPP developer, the expected FIRR of 13.7% under the low enthalpy scenario is below its WACC of 14.3%. Due to an overall lack of knowledge on the nature of the resources, an IPP developer is thus likely to forgo such a small-scale development.

Table 3 – Financial Analysis Results, without Project Intervention

	Development 1 (55 MW)			Development 2 (10 MW)		
Enthalpy	*high*	*medium*	*low*	*high*	*medium*	*Low*
FIRR without Project	27.9%	24.7%	20.3%	19.0%	19.0%	13.7%
IPP WACC	10.4%	10.1%	9.7%	16.4%	16.4%	14.3%
SOE WACC	8.5%	8.4%	8.2%	11.6%	11.6%	10.5%

- *With the Project*, assuming the developer will have to pay a 25% exploration cost premium at financial closure, the FIRR of both developments will well exceed the WACC of both IPP and SOE developers under all resources enthalpy scenarios. Thus, even an IPP developer would find it financially viable to undertake the small development.

Table 4 – Financial Analysis Results, with Project Intervention

	Development 1 (55 MW)			Development 2 (10 MW)		
Enthalpy	*high*	*medium*	*low*	*high*	*medium*	*Low*

[39] Ibid.

FIRR with Project	29.5%	25.6%	20.7%	18.9%	18.9%	13.3%
IPP WACC	10.2%			10.2%		
SOE WACC	8.4%			11.6%		

From the Implementing Agency's Perspective

184. A financial analysis is also carried out at the facility level from the perspective of the implementing agency. The analysis is testing the sustainability of the revolving facility, more specifically how the funds revolve depending on the success of exploration and the premium charged.

185. The exploration of a specific site is only considered successful if the site is subsequently developed into a geothermal generation facility and the exploration costs paid into the facility. Through the initial allocation (of US$49 million form CTF and a matching US$49 million from MoI via the Geothermal Infrastructure Facility or GIF) it is assumed that five sites can be explored. As a basic assumption, four of these are expected to be successfully developed, i.e. an 80% success rate. This number is considered realistic given the historical drilling success rates in Indonesia and given the careful investigations and vetting of options that will precede the exploration.

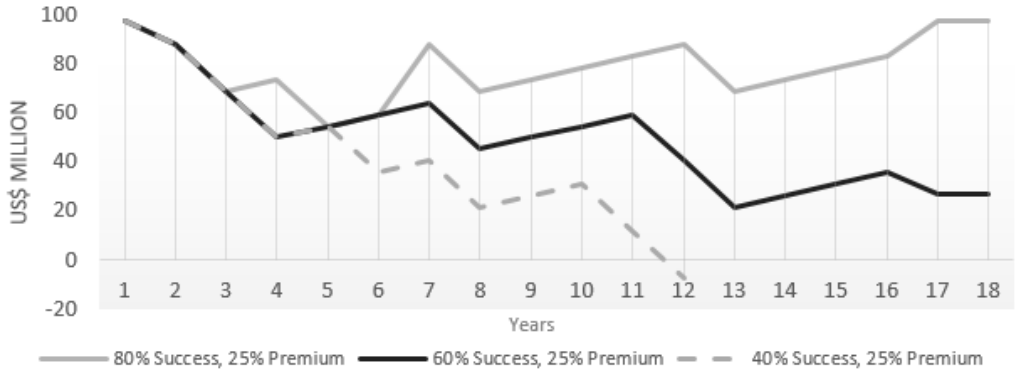
186. Successful developers will be required to pay for the full cost of exploration as well as a premium to compensate for the unsuccessful sub-projects so as to keep the facility revolving. Per definition the 80% success rate translates into a 25% premium if the facility is to be fully re-capitalized by the end of the last drilling cycle with the possibility of continuing serving exploration drilling purposes beyond the assumed period of analysis.

187. It is assumed that as a minimum the facility should revolve twice following exploration of an initial five fields, i.e. that a minimum of 15 fields can be explored over a period of 18 years assuming that the exploration-to-license period is three years.

188. The analysis shows that a doubling of the failure rate to two out of five (corresponding to a 60% success rate) and maintaining the 25% premium would still allow for exploration of 15 fields but only US$27 million would be left in the facility in year 18. As a worst case scenario, if three out of each five explorations are unsuccessful (a 40% success rate) then the facility will run out of reinvestment funds in year 12 and only up to 9 fields would be explored (and 4 developed). The cash flows of the three scenarios are shown in Figure 1.

189. These results demonstrate robust financial effectiveness of the proposed scheme within a reasonable long (18 year) time horizon. At least 15 fields will be explored and at least 9 would be developed as long as the success rate does not drop under 60% - a reasonable assumption given that the statistical individual well success rate (wells that can be used for exploration out of total wells drilled) in Indonesia is over 60%.

Figure 1 – Cash Flows of Facility Scenarios



Assumptions

190. The financial analysis of the proposed revolving facility is based on three different success rate scenarios, namely: (i) 80%; (ii) 60%; and (iii) 40%. It is also based on five drilling cycles, which are expected to accommodate the completion of three-well exploration programs in each of the prospective geothermal fields. Exploration drilling is expected to commence in Year 2 and be carried out in parallel in up to three separate fields, as indicated by "Exploration Drilling 1, 2 and 3" in Figure 2 below.

Figure 2 – Facility Revolving Framework

Completed Cycle	0	0	0	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Exploration Drilling 1	*Field 1*			*Field 4*			*Field 7*			*Field 10*			*Field 13*					
Exploration Drilling 2		*Field 2*			*Field 5*			*Field 8*			*Field 11*			*Field 14*				
Exploration Drilling 3			*Field 3*			*Field 6*			*Field 9*			*Field 12*			*Field 15*			

191. The facility benefits from the contributions of CTF and the Indonesian GIF, which at US$49 million each result in an aggregate capitalization of US$98 million. Yearly cash outflows include the cost of exploration drilling assumed to be US$6 million per well, and expenditures related to PT SMI's management fees and preliminary surveys, which are estimated at US$1 million per year. An exception to this way of treating management- and survey-related expenditures is for the first five years of operations where GEF funding would cover pertinent dues.

192. In funding exploration drilling, the capital from the CTF and GIF contributions is expected to be drawn upon and exhausted first (or prior to tapping the facility reflows), as shown in Figure 3 below. As the initial capital contributions are depleted, the facility is expected to start drawing from the reflows generated by the exploration cost paybacks of and premiums charged to successful developers.

Figure 3 – CTF and GIF Balance, Net of Reflows

Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Initial CTF Balance	49	39	30	20	11	1	
Initial GIF Balance	49	49	39	30	20	11	1

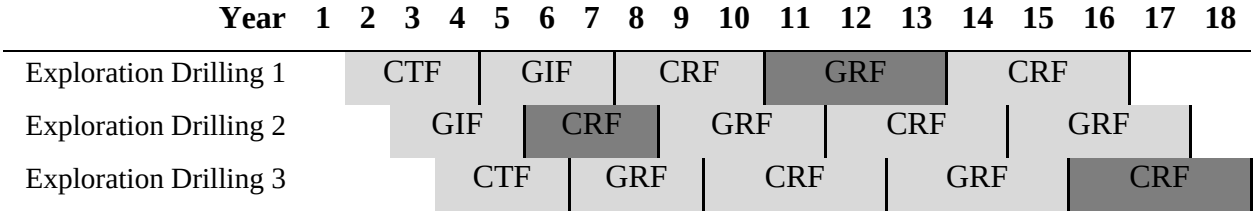
Total Initial Balance 98 88 69 50 31 12 1

Analysis and Results

- Scenario (i): 80% Success Rate

193. In the 80% success scenario, it is expected that drilling would lead to productive fields in four out of five exploration programs, as per the light gray areas highlighted in Figure 4 below. As the initial CTF and GIF contribution is exhausted, reflows committed to exploration drilling are indicated with the abbreviations of Clean Revolving Funds (CRF) and Geothermal Revolving Funds (GRF), respectively.

Figure 4 – Investment Schedule at an 80% Success Rate of Productive Fields



194. In the case successful developers were to repay only the cost of exploration (0% premium), the facility would be expected to end the drilling activities with a positive balance, while falling short of recapitalizing the original contributions made by CTF and GIF. With a 25% premium charged to successful developers, reflows are expected to re-capitalize the facility in full by year 18 as shown in Figure 5.

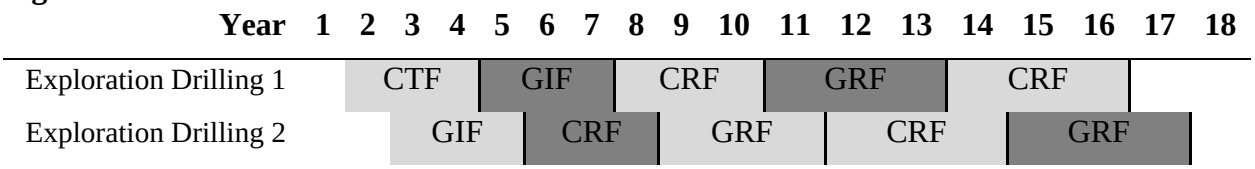
Figure 5 – Facility Cash Flows with an 80% Success Rate

Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
CTF/CRF Flows	49	39	30	44	11	49	40	30	21	34	25	39	30	44	35	49	40	40
GIF/GRF Flows	49	49	39	30	44	11	49	40	53	44	58	49	39	30	44	35	59	59
Net Total	**98**	**88**	**69**	**74**	**55**	**60**	**88**	**69**	**74**	**79**	**83**	**88**	**69**	**74**	**79**	**83**	**98**	**98**

- Scenario (ii): 60% Success Rate

195. Over the same 18-year period, a 60% success rate is expected to lead to positive outcomes in three out of five exploration programs, as per the light gray areas in Figure 6 below. Within this scenario, it is expected that the facility's full re-capitalization would no longer be within reach at a 25% premium charged to successful developers and that only US$27 million would be left in the facility in year 18, as illustrated in Figure 7.

Figure 6 – Investment Schedule at a 60% Success Rate



Exploration Drilling 3	CTF	GRF	CRF	GRF	CRF

Figure 7 – Facility Cash Flows with a 60% Success Rate

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
CTF/CRF Flows	49	39	30	20	11	49	40	30	21	34	25	15	6	20	11	25	16	16
GIF/GRF Flows	49	49	39	30	44	11	25	16	30	21	34	25	15	6	20	11	11	11
Net Total	**98**	**88**	**69**	**50**	**55**	**60**	**64**	**45**	**50**	**55**	**60**	**41**	**22**	**26**	**31**	**36**	**27**	**27**

- Scenario (iii): 40% Success Rate

196. In the 40% success rate scenario only two out of five exploration programs are expected to be brought forward for downstream development. As a result, the facility cash flows would only allow for the exploration of up to 9 fields and the further development of 4. Moreover, no new exploration programs are envisaged from year 12 onwards due to lack of funding resources. The investment schedule and the facility cash flows at a 40% success rate are illustrated in Figure 8 and Figure 9, respectively.

Figure 8 – Investment Schedule at a 40% Success Rate

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Exploration Drilling 1	CTF			GIF			CRF				*Field 10*			*Field 13*				
Exploration Drilling 2		GIF			CRF			GRF				*Field 11*			*Field 14*			
Exploration Drilling 3			CTF			GRF			CRF				*Field 12*			*Field 15*		

Figure 9 – Facility Cash Flows with a 40% Success Rate

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
CTF/CRF Flows	49	39	30	20	11	25	16	6	-3	11	2	-9	-18	-4	-13	-23	-32	-32
GIF/GRF Flows	49	49	39	30	44	11	25	16	30	21	11	2	-9	-18	-4	-13	-13	-13
Net Total	**98**	**88**	**69**	**50**	**55**	**36**	**41**	**22**	**26**	**31**	**12**	**-7**	**-26**	**-21**	**-17**	**-36**	**-45**	**-45**