See Annex 7 | Economic and Financial Analysis

Document of
The World Bank

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Report No.: 56321 - ID

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED LOAN

IN THE AMOUNT OF US$175 MILLION

AND A

PROPOSED LOAN FROM THE CLEAN TECHNOLOGY FUND

IN THE AMOUNT OF US$125 MILLION

TO THE

REPUBLIC OF INDONESIA

FOR A

GEOTHERMAL CLEAN ENERGY INVESTMENT PROJECT

(TOTAL PROJECT DEVELOPMENT IN ULUBELU UNITS 3 & 4 AND LAHENDONG UNITS 5 & 6)

June 27, 2011

Indonesia Sustainable Development Unit
Sustainable Development Department
East Asia and Pacific Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective as of June 21, 2011)

Currency Unit = Indonesian Rupiah (IDR)

IDR 1,000 = US$0.11624

US$ 1 = IDR 8,603

FISCAL YEAR

January 1 – December 31

ABBREVIATIONS AND ACRONYMS

AC	Alternating current
ADB	Asian Development Bank
AfD	Agence Française de Développement
CER	Certified emission reduction
CIF	Clean Investment Fund
CO_2	Carbon dioxide
CPS	Country Partnership Strategy
CPU	Central Procurement Unit
CQS	Selection based on the consultants' qualifications
CTF	Clean Technology Fund
EPC	Engineering, Procurement, and Construction
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FEED	Front-end engineering design
FIRR	Financial internal rate of return
FNPV	Financial net present value
GAF	Governance Action Framework
GCG	Good Corporate Governance
GDP	Gross domestic product
GHG	Greenhouse gas
GMOS	General Meeting of Shareholders
GoI	Government of Indonesia
H_2S	Hydrogen sulfide
HSE	Health, Safety and Environment
HSEMP	Health, Safety and Environment Management Plan
Hz	Hertz
IBRD	International Bank for Reconstruction and Development
IC	Selection of individual consultants
ICB	International competitive bidding
IFC	International Finance Corporation
IT	Information technology
JBIC	Japan Bank for International Cooperation
JHAA	Joint H_2S Abatement Agreement
JICA	Japanese International Cooperation Agency
JOC	Joint Operating Contract
KPK	National Corruption Eradication Commission
kscg	(unit for pressure)
kV	kilo-volt
LARPF	Land Acquisition and Resettlement Policy Framework
MEMR	Ministry of Energy and Mineral Resources
MOF	Ministry of Finance
MT	Magnetotelluric
MW	Megawatt
NOx	Nitrogen oxides
PGE	PT. Pertamina Geothermal Energy
PIP	Project implementation plan
PIU	Project Implementation Unit
PLN	PT. Perusahaan Listrik Negara
PMC	Project management consultant
PPA	Power purchase agreement
PSO	Public service obligation
QCBS	Quality and cost based selection
Rp	Indonesian Rupiah
SAGS	Steamfield Above-Ground System
SCADA	Supervisory control and data acquisition
SCMD	Supply Chain Management Department
SLA	Subsidiary Loan Agreement
SO_2	Sulfur dioxide
SOE	Statement of expenses
SS	Separator station
SSC	Steam sales contract
SSS	Single source selection
TA	Technical assistance
TSP	Total suspended particulates
VSL	Variable spread loan
WBG	World Bank Group
WBS	Whistle blower system

Regional Vice President:	James W. Adams
Country Director:	Stefan G. Koeberle
Sector Director:	John A. Roome
Sector Manager:	Franz R. Drees-Gross
Task Team Leader:	Migara Jayawardena

Table of Contents

PAD DATA SHEET

Indonesia
Geothermal Clean Energy Investment Project
(Total Project Development in Ulubelu Units 3 & 4 and Lahendong Units 5 & 6)

PROJECT APPRAISAL DOCUMENT

East Asia and Pacific Region

Indonesia Sustainable Development Unit (EASIS)

Sustainable Development Department

Date: June 27, 2011 Country Director: Stefan G. Koeberle Sector Director: John A. Roome Sector Manager: Franz R. Drees-Gross Team Leader: Migara Jayawardena Project ID: P113078 Lending Instrument: Specific Investment Loan	Sector(s): Renewable energy (50%); Power (50%) Theme(s): Climate change (100%) EA Category: A – Full Assessment

Project Financing Data:

Proposed terms:

IBRD loan: commitment-linked, variable spread over LIBOR loan with a 24.5-year term, including a 9-year grace period

CTF loan: non-interest bearing loan with a Service Charge equal to one-quarter of one percent (0.25%) payable over 40 years, including a 10-year grace period

[X] Loans [ ] Credit [ ] Grant [ ] Guarantee [ ] Other:

Source	Total Amount (US$M)
Total Project (Financing) Cost:	**574.7**
IBRD Amount:	175.0
Other financing amounts by source:	
Borrower	274.7
Climate Technology Funds (CTF)	125.0

Borrower: Republic of Indonesia

Responsible Agency: PT. Pertamina Geothermal Energy (PGE)
Menara Cakrawala Lantai, 15th Floor, Jl. MH Thamrin No. 9, Jakarta, Indonesia, 10340

Contact Person: Abadi Poernomo, President Director
Telephone No.: (62-21) 3983-3222
Fax No.: (62-21) 3983-3230
Email: info@pgeindonesia.com

Estimated Disbursements (Bank FY/US$ m) – IBRD and CTF

FY	2012	2013	2014	2015
Annual	30	103	120	47
Cumulative	30	133	253	300

Project Implementation Period: August 1, 2011 – March 31, 2015
Expected effectiveness date: September 15, 2011
Expected closing date: March 31, 2015

Does the project depart from the CAS in content or other significant respects?	○ Yes ● No
Does the project require any exceptions from Bank policies? Have these been approved/endorsed (as appropriate by Bank management)? Is approval for any policy exception sought from the Board?	○ Yes ● No ○ Yes ○ No ○ Yes ● No
Does the project meet the Regional criteria for readiness for implementation?	● Yes ○ No

Project Development Objective: The development objective of the proposed project to increase power generation from renewable geothermal resources, and reduce local and global environmental impacts.

Project description:

The Project consists of the following single component:

- Investment in Geothermal Power Generation Capacity (US$574.7 million) – Investment in confirmation of geothermal resources and steam field development, as well as construction of the Steamfield Above-Ground System (SAGS) and power plants of approximately 110 MW and approximately 40 MW at the Ulubelu and Lahendong (Tompaso) geothermal fields, respectively.

Safeguard policies triggered?	
Environmental Assessment (OP/BP 4.01)	● Yes ○ No
Natural Habitats (OP/BP 4.04)	○ Yes ● No
Forests (OP/BP 4.36)	○ Yes ● No
Pest Management (OP 4.09)	○ Yes ● No
Physical Cultural Resources (OP/BP 4.11)	○ Yes ● No
Indigenous Peoples (OP/BP 4.10)	○ Yes ● No
Involuntary Resettlement (OP/BP 4.12)	● Yes ○ No
Safety of Dams (OP/BP 4.37)	○ Yes ● No
Projects on International Waters (OP/BP 7.50)	○ Yes ● No
Projects in Disputed Areas (OP/BP 7.60)	○ Yes ● No

Conditions and Legal Covenants:

Financing Agreement Reference	*Description of Condition/Covenant*	*Date Due*
Section 5.01 of the IBRD LA / Section 4.01 of the CTF LA	Additional Conditions of Effectiveness: (a) The Subsidiary Loan Agreement has been executed on behalf of the Borrower and Pertamina. (b) The IBRD / CTF Loan Agreements have been executed and delivered and all conditions precedent to its effectiveness or to right of the Borrower to make withdrawals under it (other than effectiveness of the CTF / IBRD Loan Agreement) have been fulfilled. (c) The Project Implementation Plan, including the Governance and Accountability Framework, has been adopted by PGE in accordance with the provisions of Section I.C.2 (a) of the Schedule to the Project Agreement. (d) Satisfactory legal opinions confirming due authorization of the Subsidiary Loan Agreement on behalf of the Borrower and Pertamina, respectively, have been furnished to the Bank.	For effectiveness of the Loan Agreements
Section I.C.1 of Schedule 2 to the IBRD LA / Schedule 1 to the CTF LA	The Borrower shall cause Pertamina to cause PGE and shall cause PLN to comply with the provisions of the Joint H_2S Abatement Agreement, including with respect to the necessary investments in abatement technology, particularly on the basis of the outcome of the monitoring of H_2S emissions carried out by PGE and PLN pursuant to said Agreement.	Ongoing
Section I.A.2 of the Schedule to the PA	Pertamina shall review, at least on an annual basis, the operations of PGE, and take all action necessary to ensure effective implementation of the financial plan of PGE referred to in Section II.C.4 of the Schedule to the PA	At least annually

Section I.E.12 of the Schedule to the PA	Pertamina shall: (a) cause PGE to, and PGE shall, comply with the provisions of the Joint H_2S Abatement Agreement, including with respect to the necessary investments in abatement technology, particularly on the basis of the outcome of the monitoring of H_2S emissions carried out by PGE and PLN pursuant to said Agreement; and (b) provide, promptly as needed, upon request by PGE, any funds, facilities, or other resources that may be required for such compliance.	Ongoing
Section I.E.13 of the Schedule to the PA	PGE shall take all measures necessary on its part to collect, compile, and submit to the Bank, as part of the Project Reports, information on the status of compliance with the Joint H_2S Abatement Agreement, giving details of: (a) measures taken in furtherance of said Agreement; (b) conditions, if any, which interfere or threaten to interfere with the smooth implementation of said Agreement; (c) remedial measures taken or required to be taken to address such conditions.	Quarterly
Section II.C.4 of the Schedule to the PA	PGE shall furnish for review to the Bank and Pertamina, no later than each April 30 throughout Project implementation, a five-year financial plan comprising forecast income statements, funds flow statements, and balance sheets for the ongoing fiscal year and the following four fiscal years.	Each April 30
Section II.C.5(a) of the Schedule to the PA	PGE shall produce for each of its fiscal years after its fiscal year ending on December 31, 2010, total revenues equivalent to not less than the sum of its: (i) total operating expenses; and (ii) the amount by which debt service requirements exceed the provision for depreciation.	Each December 31

I. Strategic Context

A. Country Context

1. Indonesia has made remarkable economic and political progress over the past decade. Since the Asian Financial Crisis of the late 1990's, Indonesia has demonstrated strong and sustained economic growth that has resulted in improved living standards and a marked decline in the poverty level. During the past decade, Indonesia's GDP has mostly grown approximately five to six percent annually, and even remained positive during the global economic downturn in 2008-09, when many economies contracted. This robust performance has been driven by sustained domestic consumption, increasing private and public investments, and broadly sustainable external surpluses. A sound macroeconomic foundation has underpinned the economy including stable inflation, increased tax revenues, a decline in the fiscal deficit, and manageable public debt at around thirty percent of GDP. Furthermore, a decade of relatively successful political and institutional reforms has resulted in Indonesia being a highly competitive, electoral democracy. Political power is broadly shared among the several branches of government, and is also widely dispersed through decentralized responsibilities shared with regional and local governments.

2. The future outlook for Indonesia looks bright. Economic momentum continues to build with growth forecasted around six percent over the next couple of years, and predicted to rise to seven percent on a sustained basis by mid-decade. Recognizing recent performance as well as strong future economic prospects, international ratings agencies have recently upgraded Indonesia's sovereign debt, in one case, to just below investment grade. In the period from 2010-14, budget expenditure is expected to increase by more than thirty percent over the previous five year period, given the imminent need to advance and improve a range of public services in order sustain economic growth. Infrastructure investments, which have perennially lagged behind, will be a critical component in providing improved public services that will be essential to maintain Indonesia's economic prospects. Therefore, it will be essential for Indonesia's infrastructure institutions to translate the country's resources into better and more sustainable development outcomes.

B. Sectoral and Institutional Context

3. Indonesia's power sector has struggled to keep up with the high electricity demand that has accompanied economic growth. An initial surplus of power generation capacity immediately following the Asian Financial Crisis eventually gave way to shortages as PT. Perusahaan Listrik Negara (PLN), the national power company, struggled to mobilize investments. PLN's financial position, which had already weakened due to the crisis, further deteriorated as a result of the dramatic increase in oil prices on the international market from 2002 to 2008. The national power company not only struggled to invest, but required growing government subsidies to keep operating a system highly dependent on petroleum products in order to meet its public service obligation. 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. Supply barely managed to keep up with increasing demand; brownouts and load shedding impacted economic growth and affected even ordinary consumers.

4. The Government of Indonesia (GoI) is responding to the capacity shortfall by assisting PLN in scaling-up its investments in power generation. In 2006, PLN, backed by government sovereign guarantees and bilateral cooperation, began to implement a *Fast-Track Program* designed to rapidly develop 10,000 MW of power generation capacity. These new power plants, located throughout the country, would utilize Indonesia's abundant, readily available, and relatively inexpensive, coal resources. It would displace high cost oil-fired generation units, increase supply at an affordable price to the economy and households, and reduce the impact of PLN's Public Service Obligation (PSO subsidy) on the state budget. This first *Fast-Track Program* is well under implementation.

5. The 10,000 MW coal-based *Fast-Track Program* also poses significant challenges. It will exacerbate local and global environmental impacts and increase Indonesia's dependence on fossil fuels for power generation. Over eighty percent of the electricity generation in Indonesia is presently based on fossil fuels, with estimated annual emissions of over 108 million tonnes of CO_2, 1.9 million tonnes of SO_2, 1.1 million tonnes of NOx, and 0.1 million tonnes of total suspended particulates (TSP). Environmental conditions will further deteriorate when the additional 10,000 MW of coal-based capacity is fully commissioned.

6. To ensure a more environmentally sustainable development of the sector, the GoI launched a second 10,000 MW *Fast-Track Program* in late 2008 that is predominantly made up of renewable energy, with geothermal making up forty percent of the target. The expected outcome is a substantial increase in renewable energy displacing alternate investments in coal-based power production. This investment in renewable energy will reduce the carbon footprint of the power sector and substantially lower local environmental impacts. However, these benefits would come at sizable incremental costs; and could undermine the affordability objective and/or add to the already high PSO subsidy.

7. Geothermal power is one of the best options to diversify Indonesia's energy mix. It is a base load generation technology not subject to the intermittency and variability associated with most renewable electricity sources. Geothermal resources in Indonesia are also ideally located on islands with major population centers where electricity demand is high and continues to grow. Furthermore, as an indigenous and non-tradable energy source, it will also enhance the country's energy security and serve as a natural hedge against the volatility of fossil-fuel prices.

8. Indonesia's geothermal power potential is estimated at around 27,000 MW, roughly 40 percent of the world's resources. Despite this potential, less than 4 percent of the total geothermal resources in Indonesia are currently developed to produce power. GoI has set a target of developing 9,500 MW by 2020, with nearly 4,000 MW of this target included in the second *Fast-Track Program* to come on-line by 2015. However, estimates suggest that only about a third of this total is likely to be developed under a business-as-usual scenario[1] despite the fact that a large number of projects have been estimated to be economically justified when local and global environmental externalities are considered.[2]

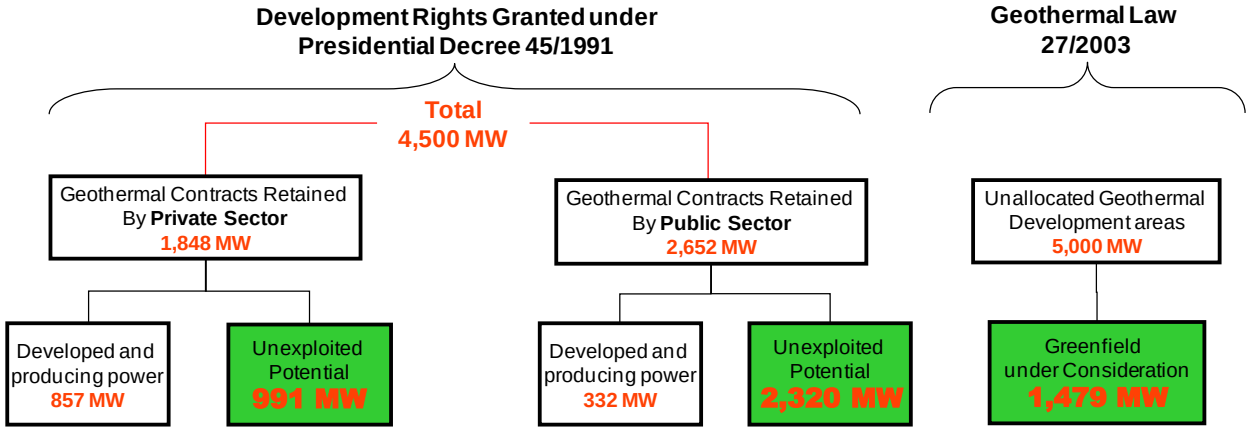
9. The GoI has long recognized the potential for geothermal to serve as a significant power generation source. A major effort began in the 1990's to target the development of 4,500 MW of

[1] World Bank, May 2008, Indonesia Geothermal Power Generation Development Project – Project Appraisal Document.

[2] It is important to distinguish that although avoidance of local pollution directly benefits Indonesians, the benefits of avoided GHG emissions extend beyond a single country and positively impact the entire world.

power generation capacity. As a part of this effort, GoI issued a Presidential Decree in 1991[3] allocating development rights in 18 geothermal working areas to public and private developers. However, beginning in 1997, the Asian Financial Crisis effectively stalled expansion of the program with the country having only reached 807 MW of installed capacity. Very little new geothermal capacity has been added since. At present, installed capacity is 1,189 MW. Of this amount, 857 MW of geothermal capacity is privately operated with about another 1,000 MW of unexploited potential under the control of existing private developers. Several state-owned enterprises operate another 332 MW of generation capacity, although the fields they control could support substantially more – approximately 2,300 MW of additional generation capacity. In consideration of these conditions, the public sector is expected to play a key role in catalyzing the second *Fast-Track Program*; and immediately scale-up the majority of the considerable geothermal resources under its control. The remaining geothermal fields are to be competitively tendered for development. Figure 1 below illustrates the allocation of existing geothermal concessions and the prospects for tendering new development opportunities.

Figure 1 - Allocation of Geothermal Resources Prospects in Indonesia



10. In 2003, the GoI resumed efforts to revive the sector, and issued a geothermal law (Law 27/2003), making geothermal the only renewable energy governed by its own law. The Law, among other things, shifted regulatory authority of the sector from what was previously delegated to the national oil company back to the GoI (Ministry of Energy and Mineral Resources - MEMR); mandated that geothermal fields that are not allocated under Presidential Decree No. 45/1991 be transparently and competitively tendered for development; and, to be consistent with the decentralization law, enhanced the role of local governments in developing the geothermal resources within their respective jurisdictions. In order to better handle its increased oversight responsibilities for sector development, MEMR established a dedicated directorate for geothermal.[4] The directorate has led the way in revising the sector *Master Plan*, establishing the geothermal development targets and selecting the projects to be included in the second *Fast-Track Program*. If the 4,000 MW target in the second *Fast-Track Program* is achieved, then the avoided annual emission from displaced coal-fired power plants would amount to an estimated 29 million tonnes of CO_2, 144,000 tonnes of SO_2, 80,000 tonnes of NOx, and 68,000 tonnes of TSP.

[3] Presidential Decree No. 45/1991.
[4] As of 2010, the Geothermal Directorate is under a dedicated Directorate General for Renewable Energy.

11. Despite the GoI's ambitious geothermal development program and recent reform initiatives, the present capacity of 1,189 MW is significantly below the 2,700 MW target established for the end of 2010 in MEMR's *Geothermal Road Map*. In general, Indonesia has had difficulty in mobilizing financing even for conventional power generation options such as coal, given the challenging investment climate both globally and within the country. Despite being regarded as a commercially viable renewable energy technology, geothermal power development in Indonesia faces a number of significant sector specific issues that are deterring investments. These barriers include: (a) momentous investment needs that are estimated to be as much as US$10-US$12 billion for the second *Fast-Track Program* alone, (b) insufficient policy and regulatory support for implementation of the Geothermal Law, (c) inadequate incentives and pricing mechanisms that fail to both reflect the environmental benefits of the technology and enable investors to secure a return commensurate with the higher risks they face especially when developing unexplored (green) geothermal fields, (d) limited institutional capability to properly plan geothermal development and sufficiently engage suitable developers, and (e) weak domestic capacity in the areas of resource assessment, equipment manufacturing, construction, and operation and maintenance of geothermal energy facilities. Consequently, only a handful of existing geothermal operations (brownfields) in Indonesia have expanded production over the past decade while no new greenfield projects that carry greater risks have been developed.

12. Despite these challenges, geothermal development remains a key development priority for the GoI, and is a vital part of its *Low Carbon Growth Strategy* for Indonesia. In order to move forward with sector reforms and mobilize investments, the GoI has requested assistance from international and bilateral organizations, including the World Bank Group (WBG). The WBG has responded by developing a strategy, as summarized in Table 1, under which both the International Bank for Reconstruction and Development (IBRD) and the International Finance Corporation (IFC) would coordinate efforts to bring their respective comparative advantages to support geothermal development in Indonesia. The WBG strategy calls for a two-pronged approach. First and foremost, the WBG is assisting the GoI with the major reforms that are being undertaken to progressively enhance the investment climate in the sector. At the same time, the WBG is also helping to immediately stimulate investments that are at an advanced stage of preparation by directly supporting both public and private developers.

Table 1 – WBG joint strategy for geothermal development in Indonesia

Policy Reforms to enhance investment climate for geothermal development
• Supporting the GoI effort to create policies and incentives to mobilize investments in geothermal development
• Helping GoI better prepare and manage the process of offering (tendering) geothermal concessions to developers, in line with the Geothermal Law
• Improving domestic capabilities to manage sector development and to undertake investments
• Extending long-term carbon funds towards geothermal development in order to enhance financial viability of investments
Direct support to immediately stimulate investment and scale-up development
• Assisting public and private developers with existing concessions to expand development
• Helping reduce the cost of geothermal development and filling financing gaps by extending attractive financing terms as well as mobilizing grant support
• Cost sharing of exploration risks associated with geothermal power development especially with undeveloped fields (greenfields)
• Improving the capabilities of developers to immediately undertake the development of their geothermal fields

13. The GoI is in the process of developing a set of policy and institutional reforms to address critical barriers and mobilize investments in the geothermal sector. The World Bank's *Geothermal Power Generation Development Project*[5] is assisting MEMR design, develop consensus among GoI stakeholders, and implement several key reform measures. More specifically, the project is helping MEMR develop a pricing and compensation policy, mitigate geothermal resource risks, and strengthen domestic capabilities in the sector, in particular to competitively tender new transactions. Key among these activities is the pricing and compensation policy that is necessary to address the higher financial cost of geothermal electricity compared with coal-based power when environmental and other benefits are not internalized; so that developers can secure a return commensurate with the costs and associated risks. International experience suggests that such a policy should include provisions to mandate electricity off-take from geothermal generators, simplify price setting to facilitate scale-up, and compensate either the off-taker or the developer for the associated incremental costs.

14. Attempts thus far to develop a comprehensive pricing and compensation mechanism have been done through a piecemeal approach by the GoI, and have had little success. Some progress has been made, including recognition by the Government that the environmental benefits of geothermal are not reflected in the financial prices; and that generators should be paid a (premium) price internalizing these benefits. However, the latest pricing decree[6] does not provide a clear directive to pay a premium to compensate developers, and instead establishes a ceiling price of 9.7 US cents/kWh. As a result, developers must rely on long, drawn out negotiations to reach agreement on a power purchase price with PLN, which undermines efforts to scale-up geothermal development. PLN, which is already under pressure to reduce its costs, is reluctant to off-take more expensive electricity without clear direction from GoI as to the mechanism through which they will be compensated for the associated incremental cost. Through the support of the *Geothermal Power Generation Development Project,* the GoI has now mobilized international consultants to help them refine the existing policy framework and develop an adequate and comprehensive pricing and compensation mechanism. These efforts are also supported through the series of *Climate Change Development Policy Loans,* collectively provided by the World Bank, Japanese International Cooperation Agency (JICA), and Agence Française de Développement (AfD). However, it will take some time to develop consensus, design the mechanism, identify the resources, and implement the recommended policies.

15. The World Bank is also assisting GoI with additional geothermal related reforms and activities. For example, international experts were mobilized to help identify geothermal resource risks and mitigation options,[7] to assist GoI efforts. The World Bank also helped the GoI host geothermal developers and investors from around the world at the 2010 *World Geothermal Congress.* After facilitating the sale of carbon emission credits in support of the *Lahendong II Geothermal project,* the World Bank is now helping the GoI with technical assistance to gain greater access to carbon revenues that could be an important complement to the design of the pricing and compensation policy currently underway. To transparently allocate new geothermal fields, both the World Bank and IFC are advising the GoI on developing a tender process that investors would find credible. The WBG is also making a specific effort to directly finance

[5] Sector reform project funded by a US$4 million Global Environment Facility (GEF) grant that is currently under implementation.
[6] Ministerial Decree No. 32 of 2009
[7] "An Assessment of Geothermal Resource Risks in Indonesia", 2010, funded by PPIAF.

geothermal projects that are at an advanced stage of development. To this end, IFC is in discussions to reach an agreement with a private developer to support its geothermal investment. The World Bank is working with Pertamina Geothermal Energy (PGE), the leading public sector geothermal developer, to help immediately stimulate the development of the significant resources under its control. This effort is also in support of Indonesia's voluntary pledge to reduce its GHG emissions by up to forty one percent conditional upon receiving international assistance.[8] However, the GoI has also made it clear that such efforts to mitigate climate change cannot be at the expense of the poor; and that any climate change assistance should be in addition to development commitments previously made. Such support will enable the immediate expansion of geothermal development while also providing valuable time necessary to successfully design and implement the sector reforms. To this end, the WBG together with the ADB, helped the GoI secure US$400 million in concessional financing from the Clean Technology Fund (CTF); of which, US$300 million is allocated on a priority basis specifically to support geothermal development. The concessional financing is vital to expanding geothermal without burdening electricity consumers and with minimal impact to the fiscal budget.

16. The proposed engagement to support the GoI geothermal development program is one of the first fully green finance projects in the IBRD and CTF portfolio which will have a truly transformational impact since it will revive development of geothermal energy after a decade of relative standstill. It would help demonstrate an immediate scale-up in geothermal projects in the country, and therefore help revive the confidence of other developers in the sector. Moreover, IBRD and CTF financing can fill a critical gap where the private sector is reluctant to invest, and help push the boundaries by enabling the development of higher risk greenfield projects. The proposed fields are also located in islands where investments are more limited despite considerable power supply shortages. In addition to providing financing, the World Bank can draw on its experience from geothermal projects financed in other parts of the world, and extract lessons to help overcome technical and institutional challenges faced by developers in Indonesia. By helping to strengthen the capacities of public developers in Indonesia, the World Bank would also contribute to establishing credible institutions that are independently capable of meeting international and industry standards in their operations. These public institutions can become reliable partners for private sector investors through strategic public-private partnerships or partial/full privatization in the future. They would be well placed to continue to advance geothermal development in Indonesia over the long-term.

C. Higher Level Objectives to which the Project Contributes

17. The proposed project will make a key contribution towards achieving the GoI geothermal development target, and promote a more balanced, lower carbon path to power generation in Indonesia. As such, it is a major component of the GoI's overall development agenda that intersects the nexus of energy and environment. The proposed project will also contribute towards efforts to enhance the policy framework in the sector, by providing cost and other benchmarks; and help strengthen the institutional capacity to sustainably develop geothermal resources in the country over time.

18. The proposed project is fully consistent with the World Bank's *Country Partnership Strategy (CPS): Investing in Indonesia's Institutions*. More specifically, it will support the CPS Core Engagement 2 – Infrastructure, to help "reduce local and global environmental impacts"

[8] See Annex 8 – Clean Technology Fund, for more details regarding Indonesia's plans to reduce its carbon footprint.

and "focus on clean and renewable energy such as geothermal power investments". It is also in line with Core Engagement 5 – Environmental Sustainability and Disaster Mitigation, aimed to "scale-up funding" for Indonesia's "effort to address climate change".

II. Project Development Objectives

A. PDO

19. The development objective of the proposed project is to increase power generation from renewable geothermal resources, and reduce local and global environmental impacts. This will be achieved by assisting PT. Pertamina Geothermal Energy(PGE),[9] a leading public sector geothermal developer, expand power generation capacity in the Ulubelu and Lahendong (Tompaso) geothermal fields located in South Sumatra and North Sulawesi, respectively.

B. Project Beneficiaries

20. There are several beneficiaries of the proposed project. Most directly impacted are the consumers who will benefit from the increase in electricity supply and new connections in the project areas. The general population in these areas will also benefit from the reduced local pollution, while society in general will reap the benefits from the mitigation of greenhouse gases (GHGs). Those living in the project area also stand to gain from business and other tertiary opportunities including the community outreach activities of the implementing agency. Indonesia as a country can also reap the benefits of enhanced energy security since geothermal is an indigenous, non-tradable resource unlike fossil fuels that are commonly exported to meet demand from international markets.

C. PDO Level Results Indicators

21. The achievement of the development objective will be assessed through the successful realization of new geothermal power generation capacity (MW); and the estimated avoidance of GHGs (e.g., CO_2) and local air pollutants (SO_2, NOx, TSP), when compared with equivalent coal-based power developments.

III. Project Description

A. Project Components

22. The proposed project includes a single component with an investment cost estimated at US$574.7 million. Of this total, the World Bank will provide financing of US$175 million through an IBRD loan which complements a US$125 million concessional loan from the Clean Technology Fund (CTF). PGE will contribute up to US$274.7 million from funds secured from its parent company.

- *Investment in Geothermal Power Generation Capacity (US$574.7 million)* – confirmation of geothermal resources, steam field development, construction of the Steamfield Above-Ground System (SAGS), and power plants of approximately 110 MW and 40 MW at the Ulubelu and Lahendong (Tompaso) geothermal fields, respectively. The project component is further detailed in Annex 2.

23. The World Bank is providing technical assistance to PGE with an approximately US$2.5 million grant facilitated through the Government of The Netherlands. It has helped PGE prepare

[9] A subsidiary of Pertamina, Indonesia's state-owned oil and gas company.

the proposed investment to international and industry standards. PGE is also undertaking a considerable recruitment and capacity building effort in anticipation of its substantial expansion of geothermal capacity. Given the globally unprecedented scale-up, PGE together with the World Bank has developed an additional US$7 million technical assistance program to complement and further strengthen its already planned capacity building efforts. This activity is expected to be carried out in parallel to the proposed project and is subject to securing grant funding from donors.[10] If funding is successfully secured, then the technical assistance program will be supervised together with the proposed project.

B. Project Financing

Lending Instruments

24. Pertamina/PGE, after discussion with the Ministry of Finance, has selected a variable spread loan (VSL) from IBRD for US$175 million, with a total maturity of 24.5 years including a grace period of 9 years. The loan will be made to GoI, which will on-lend the proceeds to Pertamina through a subsidiary loan agreement (SLA). The terms and conditions of the SLA will mirror the World Bank's with the exception of a customary interest mark-up of 0.5 percent. Pertamina will in turn make the loan proceeds available to PGE for the purposes of the proposed project through its existing inter-company funding mechanism.

25. The CTF financing of US$125 million is extended under soft concessional terms since the loan supports the development of renewable energy. The CTF loan is offered with a service charge of 0.25 percent with a total maturity of 40 years and a grace period of 10 years. Loan proceeds will pass from GoI to PGE through similar on-lending arrangements as the IBRD loan.

Project Cost and Financing

26. Based on the feasibility studies that were carried out for each proposed geothermal field, the total project financing requirements are estimated to be US$574.7 million. The breakdown of project costs by component and the project financing plan by sources of funding are summarized in Tables 2 and 3, respectively. The upfront costs associated with initial reconnaissance, exploration, land acquisition, permits, drilling and sub-surface services are financed by PGE from funds provided by Pertamina. These investments have already commenced and will be mostly completed by 2011. The cost of the SAGSs, the power plants, and project management will be co-financed by the IBRD and CTF loans.

Table 2 – Estimated Project Cost by Component

Project Components	Estimated Cost (US$ million)			% of Cost
	Foreign	Local	Total	
Geothermal Generation Capacity				
a. Ulubelu	219.9	106.2	326.2	57%
b. Lahendong (Tompaso)	128.0	63.9	191.9	34%
Total Baseline Costs	***347.9***	***170.1***	***518.0***	***91%***
Physical & Price Contingencies (10%)	34.8	17.0	51.8	9%
Total Project Cost	***382.7***	***187.1***	***569.8***	***100%***
Interest During Construction	4.2		4.2	
Front End/MDB Fee (0.25%)	0.8		0.8	
Total Financing Required	***387.6***	***187.1***	***574.7***	

[10] The TA proposal is presently under review by the Government of New Zealand, for potential funding.

Table 3 – Project Financing by Component and Sources of Funding

Project Component		Total	PGE internal sources	IBRD	CTF
		(US$ million)			
Geothermal Generation Capacity					
a.	Ulubelu	326.2	140.2	108.5	77.5
b.	Lahendong (Tompaso)	191.9	105.9	50.2	35.8
Total Baseline Costs		***518.0***	***246.0***	***158.7***	***113.3***
Physical & Price Contingencies (10%)		51.8	23.8	16.3	11.7
Total Project Cost		***569.8***	***269.8***	***175.0***	***125.0***
Interest During Construction		4.2	4.2		
Front End/MDB Fee (0.25%)		0.8	0.8		
Total Financing Required		***574.7***	***274.7***	***175.0***	***125.0***

IV. Project Implementation

A. Institutional and Implementation Arrangements

27. PGE will have the overall responsibility for the implementation of the proposed project. PGE was formally established in 2006 as a subsidiary of Pertamina to focus on developing and operating its geothermal resources. At present, PGE operates 272 MW of geothermal capacity, and has developed a strategy in line with the GoI's second Fast-Track Program to expand its geothermal production capacity by four fold with an addition of 1,050 MW by 2015. PGE has prior experience with planning and implementing large infrastructure projects.

28. Pertamina, as the shareholder of PGE, provides structured and regular oversight to the company, including the review and approval of its investment plans, provision of funds to carry out investment activities, support for the human resources function as necessary; and now the facilitation of the proposed loan. This process is also formalized through PGE shareholder meetings. The overall coordination of the GoI geothermal development program rests with the Ministry of Energy and Mineral Resources by law, while Bappenas is taking an active role in monitoring results since it is facilitating considerable public financing towards the sector.[11]

29. PGE has well established institutional functions designed (with the assistance of a leading international management consulting firm) to specifically develop geothermal resources; and key positions are staffed with qualified personnel. New projects in PGE are normally developed within the Directorate of Planning and Development and then executed by the Coordination Unit for Monitoring and Implementation. Within the latter, dedicated Project Managers are appointed for each geothermal field with responsibility for overseeing all aspects of development. The Project Managers are supported by various specialists from other specialized departments (i.e. Finance, Supply Chain Management) to oversee activities such as financial planning & management and procurement of goods and services. PGE's Heads of Directorates and its President Director form its Board of Directors (BoD), which formally oversees the company's operations. By in large, the proposed project will follow the same established PGE project implementation process, with the addition of a dedicated Project Implementation Unit (PIU) to help coordinate the work under the proposed loan.

[11] The World Bank is in the process of providing Bappenas with an Institutional Development Fund (IDF) grant to help strengthen its capacity in this regard.

30. The PIU, which was already established through a President Director decree[12] during project preparation, will continue to operate during its implementation. The PIU brings together the various existing functions within PGE, and helps coordinate their efforts including the channeling of loan funds towards implementing the proposed project. As such, it will be responsible for overseeing and coordinating all aspects of project implementation – including procurement, monitoring and evaluation, quality assurance, safeguards, and implementation of the Governance and Accountability Framework (GAF). In order to effectively coordinate these activities, the PIU includes key representatives from PGE's central departments that are responsible for specific functions and activities. This includes representation from the Departments of Finance, Procurement, Safeguards, and Technical Managers in addition to the dedicated Project Managers for the Ulubelu and Lahendong (Tompaso) geothermal fields (see Annex 3, Figure A3.1). The PIU is led by a senior manager from the Planning and Development Directorate, who will report directly to the President Director so that any issues related to the proposed project can be elevated quickly for senior management attention and resolution.

31. Procurement in PGE is centralized under the Supply Chain Management Department (SCMD). However, for the proposed loan, it will be handled by the PIU, which has established a procurement committee that includes specialists designated by various relevant departments; in line with the President Director decree that established the PIU. The PIU's financial management and analysis team will represent PGE's Directorate of Finance. It will ensure that the financial management conforms to the legal agreements reached with the World Bank for the proposed project.

32. Furthermore, PGE will hire consultant services as necessary to assist with additional engineering and design work as well as to help them oversee the construction of project facilities.

33. All project implementation arrangements, discussed and agreed with both Pertamina and PGE, are further detailed in Annex 3.

B. Results Monitoring and Evaluation

34. PGE maintains a statistical system with sufficient data to monitor the outcomes of the project as defined in the results framework and indicators described in Annex 1. Ongoing progress will be regularly monitored by the PIU and reported in periodic progress reports.

C. Sustainability

35. PGE has taken several actions to ensure the sustainability of the project. This includes proper assessments of the capacities of geothermal fields. The steam gathering systems and the power plants were sized to ensure an optimal utilization of the geothermal energy and the best returns on the investment. This has been captured by the detailed feasibility studies. Moreover, PGE has signed long term power purchase agreements with PLN, the electricity off-taker.

36. Appropriate measures to mitigate the social and environmental impacts associated with the project have been developed by PGE and agreed with the World Bank. These will ensure the social and environmental sustainability of the project as summarized in the safeguards framework and related environmental and social impact management plans. The measures also address the safety of workers and the population during the construction and operational period.

[12] PGE President Director Decree No. 055/PGE000/2010-S0 dated January 28, 2010.

V. Key Risks and Mitigation Measures

37. The various risks that would be faced by the project were assessed through the Operational Risk Assessment Framework (ORAF) in Annex 4. The proposed geothermal development is a relatively straight forward operation, but a number of risks were identified at the institutional and project level especially given the significant scale-up that is being undertaken by PGE and due to the fact that, as a first-time client, PGE has limited familiarity with implementing a World Bank loan. A number of key mitigation measures have been taken at the project level to address these risks including the mobilization of the approximately US$2.5 million preparation grant to PGE to ensure that the project is designed to meet technical, environmental, and social standards that are consistent with international and industry good practice. Given these mitigation measures, the overall project risk is assessed to be ***moderate.***

VI. Appraisal Summary

A. Financial and Economic Analysis

38. A financial analysis has been carried out at the company level for PGE and Pertamina, and at the project level to ascertain the sustainability of the proposed investment. A separate analysis was carried out to confirm that the project is economically justified.

39. ***Operational and Corporate Changes Facing PGE.*** PGE was established at the end of 2006 as a wholly owned subsidiary of Pertamina to take over all aspects of the geothermal business of the parent company. Currently, PGE functions mainly as: (i) a constructor and developer of geothermal investments under the oversight of Pertamina; (ii) an operator of steamfields and power plants that Pertamina owns; and, (iii) management of Joint Operation Contracts (JOCs) where for some contracts it oversees the revenues from PLN for existing private geothermal developers.[13] The size and scope of PGE's activities has been relatively contained, given that Pertamina currently has fully developed operations only in a small number of fields with a total capacity equivalent to 272 MW. As a result, it has a lean corporate structure, with permanent staff limited to what is necessary to oversee the contract workers who perform the construction and, in some cases, operational tasks; moreover, since Pertamina has provided funds up to now to finance investments as needed and recaptures "profits" at times when PGE has ample liquidity, most of PGE's corporate functions are also lean.

40. Given PGE's prominent role in GoI's ambitious plan for scaling-up geothermal development in the country, the company will necessarily face considerable changes during the coming years. From 2010 to 2015, PGE plans to develop an additional 1,050 MW of geothermal power generation capacity in a number of locations with a capital expenditure estimated at about US$2 billion (see table 4). This transformational expansion will be equivalent to a ten percent increase in geothermal power capacity in the entire world! Such an expansion also implies that PGE will need to broaden and deepen its corporate functions so that the company is well positioned to oversee a greater volume of construction, operate a larger number of power plants and manage larger amounts of funding. Recognizing this eventuality, Pertamina and PGE have already taken steps to appoint a new Finance Director and a Planning and Development Director

[13] PGE levies a relatively small administrative fee for this service that is commonly referred to as a *Production Allowance*. The JOC revenues from the sale of electricity by private geothermal developers is booked as an off-set against the purchase of electricity from the developers, and therefore, have no impact on PGE's financial position.

for PGE (both experienced professionals from Pertamina), and recruit qualified managers and staff in anticipation of the scale-up in the company's activities.

Table 4 - PGE's Capital Expansion Program
As of December 15, 2010

	2010	2011	2012	2013	2014	2015	Total
Increase in Installed Capacity (MW)	0	20	110	430	260	230	1,050
Capital Expenditure (US$ million[14])	280	329	358	439	409	329	2,144

41. These promising steps are the beginning of Pertamina's gradual efforts to provide greater autonomy to PGE so that it can operate more independently and become a world class geothermal company. Ultimately the scope and scale at which PGE transforms itself will be determined by its success in implementing the scaled-up investment program. Pertamina will formulate and manage these changes while PGE will be responsible for implementing them. The proposed World Bank supported project will contribute towards this end. The formal transfer of the IBRD and CTF loans from Pertamina will serve as one of PGE's first experiences as a borrower with debt servicing responsibility. Given the magnitude of its scale-up, PGE will also need to secure counterpart funds during this period at regular, predetermined intervals, following Pertamina's formal budgetary procedures. The proposed project is also enhancing PGE's technical capabilities in design and implementation of investments so that they meet industry and international standard. By complementing PGE's own capacity building and training programs, the proposed project will contribute towards PGE's attempt to transform itself into a leading global geothermal developer.

42. ***PGE's financial condition.*** During the period from 2007 to 2010, the total sales revenue from PGE's own operations ranged between US$98 million and US$152 million.[15] The majority of the revenues were from the sale of steam from a number of fields to PLN power plants, while most of the remainder was from other fields where they directly produce and sell electricity also to PLN.[16] During this same period, PGE's net income ranged between US$56 and US$77 million. While these figures appear to be satisfactory, given the significant transformation the company will experience, PGE's past financial results will have limited relevance to its future performance.

43. ***Future Finances.*** A summary financial forecast for the period 2011-2015 based on PGE's five-year planning horizon is included in Annex 7. On the basis of the company's capital expansion program, associated increases in production and anticipated prices, the forecast shows that PGE would enjoy considerable growth during this period. The company's sales revenue is

[14] For the purpose of the analysis, a real exchange rate of 1 USD to Rp. 9,300 is used for forecasted figures for the period 2011 -2015.
[15] While installed capacity remained unchanged, PGE's sales revenue increased significantly during 2008 and 2010. This reflects the fact that some of its steam sales contracts are linked to the price of oil, making its revenue fluctuate with changes in prices in international oil markets.
[16] PGE also had revenues of between US$244million and US$322 million in its capacity as the Administrator of Joint Operating Contracts (JOCs), where revenue of other existing private geothermal developers when they sell electricity to PLN, is passed through PGE, as a part of the legacy arrangement under the previous policy regime. PGE levies a fee of about 1.5 percent for this service, which is the extent of PGE's net revenue from these transactions.

expected to grow at an average annual rate of 31 percent from US$145 million in 2011 to US$421 million in 2015. Net income is expected to grow at an average annual rate of 22 percent from US$65 million in 2011 to US$145 million in 2015. The forecasts also show that PGE would be able to meet its cash operating costs and debt service obligations.[17]

44. The figures and trend appear to be encouraging. Yet, PGE faces a number of uncertainties that could pose challenges as it seeks to implement the government's ambitious geothermal development program. Externally, the key challenge is the lack of a predictable pricing policy. However, given the government's commitment to developing the country's geothermal resources, it has helped reach agreement between PGE and PLN on the power purchase agreement for several fields in PGE's upcoming investment plan including the two under the proposed project. Within the Pertamina system, the uncertainties include i) the pace and scope of PGE's on-going transformation, which is in a continuous process of being defined and refined as the company builds its experience and credentials; ii) the two companies' evolving relationship; iii) PGE's untested ability to raise capital if and when it becomes financially independent; and iv) the pace at which the company will need to develop its human resource capability. In view of the support it can rely on from Pertamina, PGE has the capacity to deal with these internal uncertainties as it moves towards greater autonomy.

45. As long as PGE is still largely financially dependent on Pertamina, conventional financial ratios appear to have limited applicability and relevance. That said, while the company is in transition, it would be important to ensure PGE's continued operating capacity and solvency, assess the adequacy of its negotiated tariff levels, ascertain that it would be able to service its new debt obligations arising from the extensive and rapid investment scale-up, and identify the extent of financial support it would require from Pertamina. To this end, a break-even covenant would be included in the legal agreement with PGE. Specifically, the covenant would require PGE to earn revenues of no less than its operating expenditures (excluding depreciation and other non-cash expenses) plus debt service obligations.

46. ***Pertamina's Role.*** Pertamina is expected to provide counterpart funds to meet about 50 percent of the project's capital requirements; to assume the World Bank and CTF loans from the Ministry of Finance (MOF) through an on-lending arrangement and make the proceeds available to PGE through its inter-company transaction mechanism; and to help meet PGE's medium term capital expenditure requirements on a timely basis.

47. Based on the company's financial statements for 2005-2009, Pertamina is financially viable and operating profitably. During this period, its rates of return on net fixed assets[18] and on equity ranged between 19 percent and 40 percent, and 11 percent and 22 percent respectively. The company's level of cash flow and capital structure also appear to be adequate, with current ratios ranging between 1.5-1.7 times, and debt/equity ratios ranging between 49 percent and 60 percent. According to Pertamina's financial forecasts for years 2010-2014, the company is expected to continue to grow and remain financially robust. By 2014, the company's fixed assets are expected to be 2.4 times its 2010 level. During this period, total long-term investment

[17] Projected to be rather modest during initial years due to the long grace periods and concessionary terms of the CTF/IBRD loans and other anticipated bilateral loans.
[18] The assets are valued on historical basis.

at about US$10.2 billion is projected to represent about 60 percent of the company's increases in long term borrowing and equity. Net income is forecasted to grow about 52 percent, and the annual rate of return on NFA is expected to be around 30 percent. The forecasts also indicate that PGE's capital requirements for the same period totaling about US$1.77 billion (or about US$806 million after taking into consideration PGE's internal cash generation of almost US$968 million) are relatively modest as compared to Pertamina's projected asset base and cash flow for the same time period. With regards to the proposed project, the IBRD and CTF loan amount of US$300 million (equivalent to approximately Rp. 2.79 trillion) that it is required to assume on behalf of PGE is relatively modest vis-à-vis Pertamina's overall size; and the bulk of the up-front capital requirement is already met or ascertained. Therefore, the risk of Pertamina not meeting its commitments is not significant.

48. ***Financial analysis of project.*** The financial analysis of the project was conducted from the viewpoint of PGE (equity point of view) using discounted cash flows to assess the impact of different terms of debt and equity and tariff rates on the Project's financial sustainability; and to ensure that project receipts are sufficient to service the Project's debt, and cover its operating and maintenance expenditures and tax obligations.

49. ***Project financial returns.*** If PGE did not have access to the competitively-priced IBRD and concessional financing from CTF sources, it would have to rely on its own funds to finance the entire project. Even though PGE has agreed to a lower nominal return of 14 percent on its equity[19] in geothermal investments, at the tariff rates agreed by PGE with PLN in the PPA (7.53 US cents per kWh for Ulubelu and 8.25 US cents per kWh for Lahendong (Tompaso)), the financial returns are negative at –US$71 million for Ulubelu and –US$56 million for Tompaso. The financial net present value (FNPV) of the combined project is negative at –US$126 million, with a financial internal rate of return (FIRR) of 10.4 percent, well below PGE's hurdle rate of 14 percent. These results are based on the mean values for factors such as well productivity, plant capacity factor and resource availability, and do not reflect the high uncertainty that is inherent with investing in geothermal projects. When such uncertainties are considered, the probability of a negative return for the combined project is close to 100 percent for this scenario.[20] This indicates that the project would not be financially viable if it were financed entirely by PGE's own resources unless it received a higher tariff or PGE agreed to further reduce its required return on equity.

50. With the proposed financing arrangements of a blended IBRD and CTF loan package to buy down the financing costs, the FNPVs of the investment in Ulubelu and Lahendong (Tompaso) are US$47 million and US$4 million respectively. The FNPV of the combined Project increases to US$51 million, and the probability of a negative return is reduced from almost 100 percent to a more manageable 20 percent. If the CTF funding were reduced to a break-even level replaced with PGE equity, then the probability of a negative return would increase substantially to 62 percent, making the project financially unattractive. Moreover, the magnitude of downside risk is of additional concern in this scenario, as there is about a 20 percent probability that the proposed project will suffer a loss of more than US$50 million. With

[19] Available information indicates that the returns for Pertamina's non-geothermal investments can be significantly higher; as would be the returns that private geothermal developers expect from investing in the sector.
[20] Based on results of a Monte Carlo simulation carried out for the project.

full CTF concessional financing, the probability of such a loss is reduced to about 2 percent only. The CTF financing thus performs two essential roles in improving the financial viability of the proposed project: i) it increases the likelihood of a positive return commensurate with the cost and the associated risks of the project; ii) it reduces PGE's exposure to severe downside risks. In the absence of the proposed IBRD/CTF financing package, additional increases in the tariff or a further reduction in PGE's return on equity is necessary to make the project financially viable.

51. Although the agreed tariff rates in the PPAs and the IBRD/CTF loan package makes the project financially viable, it will result in incremental costs. Since PLN can generate coal-based electricity at an estimated cost of 6.4 US cents/kWh,[21] any power purchase tariff paid to PGE above this rate would entail an additional cost, which will need to be covered through the public service obligation (PSO) subsidy to PLN if the GoI does not want to pass it through and burden consumers. A comparison between the agreed tariff in the PPAs for the proposed geothermal project and PLN's cost for coal-based electricity indicate that the estimated incremental subsidy that is required as a result of the project is US$114 million.[22] In the absence of the subsidy, then the FNPV at a tariff equivalent to PLN's cost of coal-based electricity (i.e. 6.4 US cents/kWh) would make the project financially unviable with a FNPV of –US$11 million (see Table 5) and a probability of a negative return of 82 percent. On the other hand, if PGE received a higher negotiated tariff which would enhance the financial viability of the project, this would place an additional subsidy burden on the GoI. Therefore, the CTF/IBRD financing is important to help balance the multiple tradeoffs regarding the level of PSO subsidy, affordability, the significant risks associated with geothermal development and the commensurate financial returns.

Table 5 – Summary of Financial Results

	Financial metrics	**Ulubelu**	**Lahendong (Tompaso)**	**Combined Project**
PGE full equity financing *(@ PPA tariff rates 7.53/kWh for Ulubelu and 8.25/kWh for Lahendong (Tompaso))*	Nominal FIRR	11.0%	9.4%	10.4%
	NPV (US$ million)	-71.1	-55.8	-126.2
	Probability of negative return			>99%
	Present value of additional PSO subsidy (US$ million)			114
With IBRD + CTF financing *(@ coal-based electricity price of US 6.4 cents/kWh)*	Nominal FIRR	14.6%	10.8%	13.4%
	NPV (US$ million)	7.8	-20.1	-11.4
	Probability of negative return			82%
	Present value of additional PSO subsidy (US$ million)			0
PROJECT SCENARIO - with IBRD + CTF financing	Nominal FIRR	17.4%	14.6%	16.5%
	NPV (US$ million)	46.8	4.0	51.4
(@ PPA tariff rates 7.53/kWh for Ulubelu and 8.25/kWh for Lahendong (Tompaso))	Probability of negative return			20%
	Present value of additional PSO subsidy (US$ million)			114

52. ***Economic Analysis.*** The economic benefits of the geothermal projects are the avoided resource costs of developing an alternative comparable coal-fired power plant. These benefits

[21] PLN Statistics, 2009, PT PLN (Persero), July 2010.

[22] The present value of the public service obligation subsidy is estimated as the difference between the present value of the project revenues estimated at the PPA tariff rates, and a social discount rate of 10 percent the present value of the revenues estimated at the levelized cost of coal based generation of 6.4 US cents/kWh.

include the avoided external costs that would have resulted from the emissions of local pollutants such as Sulfur Dioxide (SO_2), Nitrogen Oxides (NOx), and total suspended particulates (TSP) as well as avoided global costs of greenhouse gas (GHG) emissions, although only a small proportion of these global impacts directly affect Indonesians and a majority of global benefits are enjoyed by non-Indonesians.

53. A comparison of the economic costs of geothermal-based generation and coal-based generation was carried out, and the results are summarized in Table 6. The present value of the cost (PVC) of the geothermal project is US$658 million. If the external costs of coal are not considered, the PVC for an equivalent coal-fired power plant is only US$523 million, US$135 million less than the cost for geothermal. However, when the impact of local and global environmental costs are considered, the PVC of the coal-fired power plant increases to US$718 million, which exceeds the cost of the geothermal project. The probability that the cost of coal-based generation (including local and global environmental costs) exceeds that of geothermal is about 83 percent.

54. The benefits of the project were based on fairly conservative assumptions with respect to well productivity among other factors and did not include the hard to quantify benefits of diversification of sources of energy and energy security. Nevertheless, it is important to note that US$150 million of the avoided cost associated with coal production are global costs of CO_2 emissions. Without the consideration of these avoided costs, the economic cost of the geothermal project would be about US$135 million more than that of an equivalent coal plant making the project not economically justified. Since only a small proportion of the benefits of the reduced emissions would accrue to Indonesians, the case for international financial assistance such as CTF support in this case is both justified and critical.[23]

Table 6 - Cost comparison of the Ulubelu & Lahendong geothermal plants with comparable coal-fired power plants in US$ million

Present Value of Costs (PVC)	Ulubelu	Lahendong (Tompaso)	Combined Project
Present value of geothermal costs	449.31	208.62	657.94
Present value of the cost for coal without including externalities	372.72	150.36	523.08
Present value of the cost for coal with local negative externality only	405.71	162.35	568.07
Present value of the cost for coal with both global and local external costs	**514.08**	**203.64**	**717.72**

55. The financial and economic analyses along with supporting documents are in the project files. A detailed summary of the methodology, assumptions and results is included in Annex 7.

[23] The PV of the CTF loan flows discounted at the economic cost of capital is around US$90 million. This amount reflects the subsidy element of the CTF financing to the economy. The subsidy element of the IBRD loan adds another US$60 million of benefits to the Indonesian economy although this will depend on the extent to which IBRD lending in Indonesia is tied to geothermal development.

B. Technical

56. Scientific investigations and stored heat calculations have been carried out by PGE for both fields developed under the proposed project. They were confirmed by international consultants contracted by PGE to carry out the feasibility studies for both sites with the support of a grant provided to them by the GoTN through the World Bank. The technical characteristics of the proposed projects are outlined below.

Ulubelu Units 3&4

57. The Ulubelu geothermal development is in the province of Lampung, on the island of Sumatra. The first stage of the field development, Ulubelu 1&2 (110 MW), is under development by PGE (upstream[24]) and PLN (downstream[25]). It is financed by the Japan Bank for International Cooperation (JBIC). The proposed project focuses on the development of the second stage consisting of two supplementary 55 MW units, referred to as Ulubelu 3&4. PGE is responsible for the development of both the upstream and downstream of units 3&4. The proposed PGE Units 3 & 4 is distinctly different from PLN's power plant units 1 & 2, and does not rely on any of PLN's geothermal facilities for its construction or operation. Feasibility studies for the proposed project were funded by a preparation grant provided by the GoTN and carried out by international consultants, selected according to World Bank procurement guidelines.

58. The scientific investigation and stored heat calculation, backed up by well drilling and testing carried out thus far, concluded that the resources in the Ulubelu can sustain a total capacity of 175 MW for 30 years with a probability of 90 percent, 220 MW with a probability of 60 percent and 255 MW with a probability of 50 percent. Given that the first two units at Ulubelu are already under development by PLN at a capacity of 110 MW (Units 1 & 2: 2 x 55 MW), the remaining field resource, based on the current level of drilling and well testing information, can sustain an additional capacity of 65 MW for 30 years with a probability of 90 percent and 110 MW with a probability of 60 percent.

59. The field development is based on standard design elements including: scattered well pads each containing multiple deviated wells, two-phase pipelines taking a mix of water and steam to centralized separator stations which separate the steam and water, steam pipelines to the power station, brine lines taking the brine from the separator stations to the injection wells (in this case, taking advantage of gravity), power station, and condensate pipelines taking surplus condensed steam from the power stations for reinjection into the reservoir.

60. The power plant concept comprises two 55 MW single flash condensing steam cycle units operating at primary separation pressures between 7 and 8 bars. Turbines will be linked to generators, which are totally enclosed water to air cooled 3 phase units with brushless excitation operating at 50 Hz and a generating voltage between 11 and 13.8 kV. The plant requires step-up transformers to deliver generator output at 150 kV to the PLN switchyard located at the Ulubelu 1&2 plant site. Similarly, auxiliary transformers are required to reduce the generator voltage down to the required voltages for plant auxiliary loads. An outdoor conventional switchyard with rated voltage of 150 kV is included. All necessary balance of plant is included.

[24] "Upstream" = wells and steamfield above ground system (SAGS)
[25] "Downstream" = power station and grid interconnection

Lahendong Units 5&6

61. The Lahendong 5&6 (Tompaso) concept includes two 20 MW units that are to be developed in an adjacent greenfield to the existing Lahendong geothermal field[26] (4 x 20 MW units) situated in the Minahasa area of the northeastern sector of Sulawesi island. The proposed extension will benefit from nearby PGE project offices and the experience accumulated during the development of the Lahendong 1, 2, 3 and 4 units.

62. The scientific investigation and stored heat calculation, backed by well drilling and testing indicate that the resource can sustain 83 MW over 30 years with a 90 percent probability and 124 MW with a 50 percent probability.

63. The design concept is similar to Ulubelu. The power plant includes two 20 MW single flash condensing steam cycle units. One difference from Ulubelu will be that gas can be extracted from the condenser using steam jet ejectors only, because of the lower gas concentration at Tompaso. The switchyard at Lahendong (Tompaso) will be a conventional outdoor type of double bus design and initially constructed as single bus.

Overall Technical Assessment

64. International consultants prepared feasibility studies that have been reviewed by an independent engineer and geothermal expert hired by the World Bank. Extensive comments have been made since the identification of the project through the completion of the feasibility studies during field visits and meetings with PGE and its consultants. *By the end of the technical due diligence, it has been concluded that the project's technical concept and design meet industry and international standards*.

65. The feasibility studies are available in the project files and its findings are summarized in more detail in Annex 2. The Front End Engineering Designs (FEEDs) for both sites are also under preparation by international consultants. The power plants will be developed under competitively procured EPC contracts.[27]

C. Financial Management

66. A financial management (FM) assessment was conducted by the World Bank and actions to strengthen the implementing entity's financial management capacity have been agreed with PGE. The assessment concluded that, with the implementation of the agreed action plan, PGE will satisfy the World Bank's minimum requirements under OP/BP 10.02.

67. Pertamina, prior to changing to its current corporate status, had a special designation with its own governing law that did not require independent audits from an accounting firm. The same applied to PGE, which was a division of Pertamina prior to its establishment as a separate company in December, 2006. Therefore, both companies accumulated a backlog of audits until they were able to establish an opening balance for their accounts. The Pertamina audit report for

[26] Both the Lahendong and Tompaso geothermal fields are classified under the single Lahendong geothermal work area. However, geologically they are two distinct geothermal fields.

[27] EPC contracts, which are commonly used in the industry, are essentially turnkey agreements where the contractor brings together detailed engineering designs, supply of equipment and installation/construction. This is similar to what is commonly referred to in the World Bank as a design, supply, and installation contract. The proposed project will look to make use of the most appropriate version of the Bank's Standard Bidding Documents.

FY 2006 was finally completed in December 2009. Since then, Pertamina and PGE have made a special effort to overcome its backlog. PGE has now completed audits up to FY 2010, and these were issued with an unqualified opinion.

68. During project implementation, PGE will submit the company's audit reports to the World Bank annually within six months of the close of the fiscal year. A paragraph will be included in the audit report providing the loan status and auditor's opinion on the use of project funds. Special purpose financial reports (Interim Financial Report) will be requested for this operation on a quarterly basis to facilitate monitoring. PGE's Internal Audit Department will include the project in their work program to assure achievement of effectiveness and efficiency of operations and reliability of financial data and reports.

69. The project's major risk may arise from potential delays in availability of funds due to Parliamentary budget approval delays. There have been similar instances in projects with other state-owned enterprises (SOEs). The World Bank along with other lenders have helped resolve such issues in the past through joint communication to the MoF urging quick resolution.

70. Annex 3 provides additional information on financial management implementation arrangements. The detailed FM capacity assessment is available in the project files.

D. Procurement

71. A procurement assessment was carried out by the World Bank and it was concluded that PGE has the basic capacity to carry out procurement activities related to the proposed project with assistance from consultants. Key risks were identified during the assessment and mitigation measures were agreed with PGE. The assessment stressed that, although PGE has a dedicated department for procurement and considerable experience, they are less familiar with World Bank procurement policies and guidelines since the company is a new client of the World Bank. There are also differences between PGE regulations and World Bank procurement Guidelines. To mitigate these risks, PGE has secured the services of international consultants to assist them with the procurement of the two large "EPC" contracts;[28] and clear instructions to follow World Bank procurement guidelines for equipment and services financed by the proposed loan is included in the Project Implementation Plan (PIP). PGE has also agreed to adopt the GAF, which includes provisions for complaints handling and a whistleblower system, in order to address potential corrupt and fraudulent practices during procurement. Given the agreed measures to address issues raised during the procurement assessment, the procurement risk is considered to be substantial after mitigation. The Procurement Plan for the project has been approved by the World Bank and will be updated at least annually (or as required) to reflect the actual project implementation needs. A summary of the procurement capacity assessment and the procurement arrangements is provided in Annex 3. The complete procurement capacity assessment is available in the project files.

E. Social Safeguards

72. The key stakeholders in the project are local residents and local governmental units; private and commercial electricity users in the respective provinces; and national investment and regulatory stakeholders who deal with energy issues. PGE enjoys strong support in both Ulubelu and Lahendong (Tompaso), locally and nationally, for its future contributions to the regional

[28] Ibid.

power grid, potential to reduce the country's carbon footprint, investments in local infrastructure, promise to provide modest local employment and stimulate commercial growth, and its responsive and visible corporate social responsibility investments in the local communities.

73. PGE has already purchased virtually all of the land currently identified for the Ulubelu site, almost 47 ha. Almost 16 ha have been purchased for the Lahendong site; additional land will be purchased for one or two more production platforms, the power plant for Units 5&6 and perhaps an additional injection platform. The power units will each be connected by relatively short transmission lines to take the electricity to the PLN Units 1&2 switchyard at Ulubelu (approximately 500 m), and to PLN's Kawangkoan substation at Lahendong (approximately 2.7 km), respectively. PGE will construct these transmission lines in compliance with Bank safeguards policies. In each site, PGE will purchase the small land requirement for the tower footprints, which are estimated to range from 0.1 ha at Ulubelu to 0.4 ha at Lahendong, and the rights of way under the lines, depending on the final design of the two lines.

74. PGE, which is registered as a private company, acquires land through a voluntary willing-buyer/willing-seller process that is consultative, transparent, fair and non-coercive. PGE consistently pays above market prices. No sales have been appealed and no transactions have been subject to claims of irregularity or disputed ownership. Owners are free to refuse to sell land to PGE. On the other hand, the inherent nature of geothermal development provides PGE with the flexibility to revise its design and relocate parts of its operation in the event land-owners do not wish to sell their property. In at least two instances, negotiations failed and PGE relocated the platform site; in another case, the design of the platform was revised to exclude a property for which the owner did not have adequate ownership documentation for a transaction. No relocation of households has occurred and none is expected at either site. As an energy company developing a public resource, PGE can request expropriation through eminent domain, but does not plan to do so.

75. Nonetheless, as expropriation is an option that PGE could request from the government, if necessary, the World Bank's Operational Policy 4.12 *Involuntary Resettlement* is triggered, for which PGE prepared a Land Acquisition and Resettlement Policy Framework (LARPF) acceptable to the World Bank that describes its current land acquisition practices and establishes procedures to be followed in the unlikely event that land expropriation is used. PGE's standard land acquisition practices involve considerable consultation and disclosure at the local level that fully meet Bank requirements. PGE has demonstrated excellent responsiveness when people expressed grievances at each site, but has agreed with the World Bank to establish more systematic, transparent grievance procedures to deal with issues that arise during construction and operation of the facilities. The LARPF is a stand-alone document that has also been incorporated in the Environmental and Social Impact Assessments (ESIAs) prepared for the project, and disclosed for comments from stakeholders on October 7, 2010. The grievance procedures are also included in the ESIAs. The LARPF was revised to address comments, and re-disclosed to the public at the World Bank Infoshop on April 5, 2011.

F. Environmental Safeguards

76. The proposed project will have a significant positive impact given the avoided release of greenhouse gases (GHG) and local pollutants compared with the common alternative to generate electricity from coal. In tons of CO_2 equivalent per MW, the power stations at both sites are estimated to produce GHG at one-tenth the rate of a coal-fired power plant. Although

technically both Ulubelu and Lahendong (Tompaso) are greenfield sites, there are already existing operations[29] developed separately within proximity, and the land at both locations is extensively used for tree crops and other agriculture. Impacts on terrestrial ecology are therefore expected to be minor. The Ulubelu site is surrounded by *Hutan Lindung* (protection forest), under control of the Ministry of Forestry for the purpose of stabilizing steep slopes and protecting watersheds, hence not considered critical natural habitat. There is a small amount of protection forest near the Lahendong site as well. Neither project will physically impact the protection forest, as PGE is maintaining a 500-m minimum separation between any of its facilities and the forest boundary. Air dispersion modeling shows that emissions from either plant will not have any impact on the forest vegetation (natural habitats). Consequently, OP 4.04 is not triggered.

77. World Bank Operational Policy 4.01 *Environmental Assessment* is the only environmental safeguards policy triggered by the proposed project, and a separate Environmental and Social Impact Assessment (ESIA) that includes an Environmental and Social Management Plan (ESMP) has been prepared for each site by independent consultants to PGE. Significant potential adverse impacts at both sites are on surface water quality and aquatic ecology (modified by human activities and are not natural habitats) if there are accidental releases of drilling mud during well-drilling and of brines during well testing and operation. These are mitigated to low levels by design features -- treatment ponds for muds, systems for reinjection of brines, and back-up retention ponds if brine reinjection is for any reason temporarily interrupted. The ESMPs include emergency response plans to deal with well blow-outs and steam or brine pipeline failures.

78. Potential emissions of hydrogen sulfide (H_2S) from power plant cooling towers during operation pose the most significant environmental management challenge in the proposed project. Four different environmental standards or guidelines apply: three that are typical in air quality management -- emission limits, workplace exposure limits, ambient air quality standards -- and an odor standard that is unique to Indonesia. Both plants are being designed to comply with the Indonesian emission limit of 35 milligrams per cubic meter (mg/m^3) averaged over one hour, and with the Indonesian workplace safety standard that sets the maximum H_2S concentration for an 8-hour exposure period at 14 mg/m^3. Both are consistent with international practice. Indonesian regulations do not include a health-based ambient air quality standard for H_2S, and so the World Bank Group *Environmental, Health and Safety Guidelines* are being applied. The Guidelines do not set a Bank standard for H_2S but advise the use of an internationally-accepted standard. PGE has agreed with the Bank to use the health guideline recommended by the World Health Organization as the ambient standard for the project -- 150 micrograms per cubic meter ($\mu g/m^3$) averaged over 24 hours. PGE's ESIA consultant, using the AERMOD dispersion model developed for the US Environmental Protection Agency and the results of initial measurements of H_2S content in the steam, has determined that ambient H_2S concentrations, in the absence of mitigation measures, are likely to exceed 150 $\mu g/m^3$ in several villages in Ulubelu's area of influence but not in any of the villages near Lahendong (Tompaso) Units 5 & 6. At Ulubelu, the ESIA recommends that H_2S emissions from PGE's Units 3 & 4 be

[29] In what comprises the Lahendong geothermal work area (WKP), there already exist units 1-4 with 80 MW under operation in the Lahendong field while the proposed project is located in the adjacent Tompaso field that is also part of the same WKP. At Ulubelu, units 1 & 2, which are being developed under a separate project, are already under construction.

reduced to substantially less than the permitted emission limit to prevent them from causing exceedence of the ambient standard. PGE has committed to implementing this recommendation, and the cost of abatement is included in the loan amount. The amount of H_2S abatement required at Ulubelu Units 3 & 4 is estimated at about 60 percent based on the initial well test results. Testing will continue throughout the development process to allow designers to further refine the abatement level that is ultimately required. In addition, the ESMPs for both plants include (i) continuous ambient H_2S monitoring and periodic monitoring of community health to identify health impacts that could be related to exposure to H_2S and (ii) an H_2S emergency response plan.

79. At Ulubelu, the H_2S situation is complicated by the proximity of PGE's Units 3 & 4 to power plant Units 1 & 2 that is already under construction by PLN as a separate project. Although PGE Units 3 & 4 do not share any of the geothermal facilities of PLN Units 1 & 2 power plant, both projects share a common airshed. The AERMOD dispersion model predicts that, without abatement, once Units 1 & 2 begin operation in 2012, the ambient standard of 150 $\mu g/m^3$ will likely be exceeded at ten of the 44 receptors[30] incorporated in the model, frequently enough to be of concern. This means that the baseline condition that would exist in the airshed when Units 3 & 4 come on line in 2014 would already be one of non-compliance with the WHO ambient standard. The modeling indicates that PGE would need to provide H_2S abatement at Units 3 & 4 to avoid likely exceedences at eight additional receptors. However, even with 100 percent removal of H_2S from PGE's Units 3 & 4, the ambient standard would still be exceeded in the ten receptors affected by unabated emissions from PLN's Units 1 & 2. Air quality in the Ulubelu airshed therefore has to be managed on a coordinated basis to mitigate this adverse cumulative impact. The GoI (BAPPENAS) consequently facilitated a Joint H_2S Abatement Agreement (JHAA) signed on December 31, 2010 in which PLN and PGE have agreed to treat the Ulubelu geothermal area as a common airshed, implement necessary measures, including abatement measures, at their respective geothermal power plants, to reduce H_2S to meet the WHO-based ambient standard and Indonesian standards. The ESIA for Ulubelu Units 3 & 4 indicates that about 60 percent H_2S abatement would be necessary at both PLN's and PGE's plants. Under the JHAA, the two companies have also agreed to collaborate in H_2S monitoring.[31] The JHAA is included in the ESIA for Ulubelu, and its commitments are reflected in the legal agreements for the project in the form of: (i) obligation of GoI to ensure that PLN and PGE implement the terms of the JHAA including installation and proper operation and maintenance of abatement equipment, and (ii) obligation of Pertamina to ensure that PGE implements the JHAA and has sufficient resources to do so. Furthermore, legal agreements also provide for suspension remedies in the event of adverse amendment or non-compliance by any party under the JHAA.

80. At the Lahendong area, Units 5 & 6 located in the Tompaso field are sufficiently distant from PLN's existing development for Units 1-4 in the adjacent Lahendong field that there are no cumulative H_2S impacts. The air quality model shows that emissions from the power plants will not affect the forest vegetation near either Ulubelu or Lahendong 5 & 6. OP 4.04 *Natural Habitat* is therefore not triggered.

[30] Receptors are geographic points for which the model calculates projected ambient H_2S concentrations. The 44 receptors were chosen at locations such as the plant-side edges of residential areas so that worst case conditions will be shown in the model results.

[31] JICA is financing PLN's Units 1 & 2 at Ulubelu. JICA has communicated through a letter to Bank management that they will support the implementation of the JHAA; and they are already coordinating this effort with the Bank so that both financiers can ensure that their respective client follow through on the commitments in the JHAA.

81. The Bank does not have an odor standard for H_2S, nor does it require borrowers to have one. The Indonesian odor standard is expressed as 0.02 parts per million (ppm), equivalent to 28 $\mu g/m^3$ although it falls short of specifying the averaging period, the permissible number of exceedances, or the point of measurement. Nevertheless, this standard is considerably more stringent than the WHO health guideline, and its appropriateness for geothermal projects is debatable since they are normally located in areas where naturally-occurring H_2S concentrations often exceed the odor threshold. Therefore, at the Bank's recommendation, PGE has sought clarification from the Indonesian Ministry of Environment on the applicability and application of the odor standard to geothermal power plants. The Ministry, who is the authority responsible for this regulation, formally confirmed through documented minutes of a meeting held on January 14, 2011 that the odor standard was specifically intended for application to manufacturing industries and not for sectors such as geothermal where H_2S is naturally occurring. The Ministry proposed that a forum be held where stakeholders in the geothermal industry can present evidence regarding the H_2S levels in naturally occurring areas and stated that results of the forum would be taken under consideration for possible future revision of the odor standard. The meeting minutes are included in the ESIA documents that are reflected in the legal agreements.

82. The transmission lines sections that will connect PGE's power plants to the nearest PLN off-take points (switchyard at PLN's Units 1 & 2 at Ulubelu and the Kawangkoan substation at Lahendong) are ancillary to the proposed project under OP 4.01. These lines will be constructed exclusively for the purpose of transmitting electricity from the proposed project, making them reciprocally interdependent with their respective power plants. PGE will construct these ancillary lines in accordance with the same safeguard procedures that apply to the project as a whole. These transmission lines are included in the respective ESIAs.

83. The electricity generated by PGE's Ulubelu Units 3 & 4, once delivered to the switchyard at Units 1 & 2, will be evacuated onwards through the South Sumatra power grid by PLN. PLN is developing a 26-km transmission line that will extend the South Sumatra grid from a connection point near the Batu Tegi Hydroelectric Plant to Ulubelu. This line was conceived to evacuate power specifically from PLN Units 1 & 2, which is confirmed in the ANDAL that was prepared for it in 2004; and since it was designed as a dedicated line for Units 1 & 2, it would have been built irrespective of the decision to develop Ulubelu Units 3 & 4 by PGE. Moreover, the transmission line is already under construction as a part of PLN's Units 1 & 2 development at Ulubelu, with the support from a loan from JICA to PLN, and will be completed before construction begins for PGE Units 3 & 4. The JICA loan for the development of the transmission line, associated substations, and the Units 1 & 2 power plants – as a single package, was signed in 2005, long before the concept for the World Bank loan to PGE for Units 3 & 4 was approved in 2009. Although due to operational delays, PLN signed the construction contract in February, 2010, the transmission line is expected to be completed by mid-2011, in advance of construction of the Units 3 & 4 power plant. Therefore, the Bank has determined that the PLN transmission line is not linked since it does not meet the criterion of contemporaneousness under OP 4.12 because it was neither planned nor constructed at the same time as Units 3 & 4. Furthermore, the transmission line, which is an ancillary facility of PLN's Units 1 & 2 is not considered part of PGE's project's area of influence under OP 4.01 because its corridor is not affected by the construction or operation of Units 3 & 4, nor does it trigger OP 4.04. No changes will be made to the line due to Units 3 & 4, thus it will not generate any additional impacts. Consequently, Bank safeguards policies do not apply. The Bank is relying on the safeguards instruments prepared under Indonesia's AMDAL procedure and the safeguards policies of JICA.

84. Because the transmission line will still be utilized as a part of the South Sumatra grid to evacuate power generated by PGE once units 3 & 4 are commissioned in 2014, the project team reviewed the AMDAL and JICA safeguards instruments and carried out a rapid safeguards assessment of this line to obtain reasonable assurances that PLN is adhering to good environmental and social impact management practices in constructing the transmission line. These steps included review of the ANDAL, RKL and RPL documentation (Indonesian equivalents of ESIA, Mitigation Plan and Monitoring Plan, respectively), which were found to be adequate for a transmission line of this scope and consistent with what would have been required under OP 4.01. The project team also visited representative locations where land has been cleared and footings for transmission towers are being installed. The construction work itself is being carried out in a satisfactory manner, maximizing the hiring of local labor and using labor-intensive methods rather than heavy equipment, thereby causing very little disturbance to the environment outside of the tower footprints. Moreover, although the land for the tower footprints was acquired through expropriation, information from PLN as well as discussions with local residents confirmed that the process involved negotiation with landowners and compensation rates are consistent with or above market prices. The acquired plots are small relative to holdings, thus the loss of the land is not expected to affect household incomes significantly. The project team will observe the results of the line's construction and if it notices any adverse impacts, will bring them to the attention of PLN and JICA.

85. Stakeholder consultations were held at the village level at Lahendong and Ulubelu during the scoping phase of the ESIAs. PGE formally submitted the draft ESIAs to the World Bank and the documents were publicly disclosed on October 7, 2010 at PGE headquarters and applicable regional and local government offices in the affected areas, as well as in the World Bank InfoShop. The ESIA consultants have also prepared and PGE has disclosed non-technical summaries of the ESIAs in Bahasa Indonesia. PGE, assisted by the consultant, conducted public meetings near both sites in late October 2010 to present ESIA findings, including potential exceedances of H_2S ambient standards, and solicit comments. The results of the consultations are documented in the final versions of the ESIAs. Each ESIA contains a plan for public consultation and disclosure that incorporates grievance procedures and arrangements for PGE's ongoing liaison with communities. The ESMPs include detailed measures to monitor implementation of mitigation measures and environmental changes. The ESIAs were revised to address the comments received, and the documents were re-disclosed at the World Bank Infoshop on April 5, 2011.

Annex 1: Results Framework and Monitoring

INDONESIA: Geothermal Clean Energy Investment Project

(Total Project Development in Ulubelu Units 3 & 4 and Lahendong Units 5 & 6)

Project Development Objective (PDO): increase the power generation from renewable geothermal resources in order to reduce local and global environmental impacts.												
PDO Level Results Indicators	**Core**	**Unit of Measure**	**Baseline**	**Cumulative Target Values**					**Frequency**	**Data Source/ Methodology**	**Responsibility for Data Collection**	**Description (indicator definition etc.)**
				YR 1	**YR 2**	**YR3**	**YR 4**	**YR5**				
Indicator One: New geothermal power generation capacity installed	☐	MW	0				150[32]		End of project	PGE/ PIU	PGE	The operating capacity of the power plants
Indicator Two: Avoided local air pollution (NOx, SO_2, TSP)*	☐	Tonnes of NOx SO_2 TSP annually	0					3,000 5,400 2,500	One year after end of project	PGE/ PIU, secondary data	PGE/World Bank	Estimate of three common local pollutants that would have resulted if power was generated from coal-fired plants
Indicator Three: Avoided global GHG pollution (CO_2)*	☐	Tonnes of CO_2 annually	0					1,100,000	One year after end of project	PGE/ PIU, secondary data	PGE/World Bank	Estimate of avoided CO_2, if equivalent coal-fired power capacity was developed instead.
INTERMEDIATE RESULTS												
Intermediate Result: Investment in Geothermal Power Generation Capacity												
EPC contract signed for Ulubelu SAGS+power plant	☐	**Contract Y/N**	**No contract in place**		**Contract signed**				Once, at time of contract signing	PGE/ PIU	PGE	Contract signing indicates beginning of construction
EPC contract signed for Lahendong/Tompaso SAGS+power plant	☐	**Contract Y/N**	**No contract in place**		**Contract signed**				Once, at time of contract signing	PGE/ PIU	PGE	Contract signing indicates beginning of construction

***Emission calculation (following page):**

[32] The power capacity rating is an approximate target in the case of geothermal since the actual capacity may somewhat vary depending on final resource availability and power plant optimization.

Emissions Calculation

Avoided emission (tonnes/year)	**=**	***Electricity generated (MWh/year)[(a)]***	***x***	***Net emission factor (g/kWh)[(b)]***	***÷***	***1000***

Notes:

(a) ***Total electricity generated*** *is calculated as follows:*

Electricity generated (MWh/year)	=	*Installed Capacity (MW)*	*x*	*Capacity Factor (%)*	*x*	*hours per year (8760 hours/year)*

Where:

- ***Installed capacity*** *is the capacity of the geothermal power plants expected to total* ***150 MW*** *once commissioned.*
- *The* ***capacity factor*** *for geothermal plants based on a probabilistic basis is estimated to be* ***92%.***

(b) ***Net Emission Factors*** *are calculated based on the emissions that would occur had the same amount of electricity been generated from a coal-fired power plant rather than a geothermal power plant, less any emissions that would result from the geothermal power plant.*

The following assumptions are made regarding the specific characteristics of the coal that would have been used if a coal-fired plant would have been built instead of geothermal, which determine the emissions from coal that would have resulted: (i) ***lower heat value (LHV) of 4,200 kcal/kg*** *based on the coal proposed for the first Fast track Program in Indonesia, which in turn is characterized as having* ***0.40% sulfur****,* ***6% ash****, and* ***40% carbon****,*[33] *(ii) The commonly used assumption for the average net thermal efficiency of boilers in medium-sized coal fired power plants with subcritical steam, burning somewhat higher quality coals is approximately* ***33%,***[34] *and (iii) the pollutant removal efficiency of the control technology installed for the coal plant is assumed at* ***95% for TSP*** *and* ***0% for SO_2 and NOx****. ,*

The following assumptions are made regarding the emissions from the geothermal power plan, that it ***does not emit TSP, SO_2, or NOx****, and its emissions of* ***CO_2*** *are much lower assumed to be about* ***10%*** *of the emissions from a coal-fired power plant.*[35]

Based on the above mentioned assumptions, the net emissions factors that are utilized in calculating the emissions from the project are as follows:

- *TSP =* ***2.11 g/kWh***
- *SO_2 =* ***4.47 g/kWh***
- *NOx =* ***2.5 g/kWh***[36]
- *CO_2 =* ***917 g/kWh***[37]

The emissions calculation methodology and step-by-step calculations are included in a note in the project files.

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[33] Based on published specifications of Indonesian 4,200 GAR coal, *Indonesia Coal Index Report*, Argus/Coalindo.
[34] Based on International Energy Agency Clean Coal Centre publication.
[35] Based on US Geothermal Energy Association publication.
[36] NOx emission is largely dependent on the boiler design and combustion technology, but not on coal characteristics. For subcritical coal fired power plant, a generic emission factor is used.
[37] The net emission factor for CO_2 is estimated based on emissions from coal (1011g/kWh) less emissions from geothermal (94g/kWh)

Annex 2: Detailed Project Description

INDONESIA: Geothermal Clean Energy Investment Project
(Total Project Development in Ulubelu Units 3 & 4 and Lahendong Units 5 & 6)

1. The development objective of the proposed project is to increase power generation from renewable geothermal resources, and reduce local and global environmental impacts. This will be achieved through the development of geothermal power generation capacity in fields under the control of PT. Pertamina Geothermal Energy (PGE).

2. The physical investments include the development of a total of 150 MW electricity generation capacity in two geothermal fields: 40 MW Lahendong 5&6 (Tompaso) and 110 MW Ulubelu 3&4 developments. PGE is developing both the upstream (wells and steamfield above-ground system or "SAGS" for energy supply to the station) and downstream (station) components in both project sites. The short transmission links to the nearby substations within the electricity grid will also be constructed by PGE and operated by PT. Perusahaan Listrik Negara (Persero) (PLN), the off-taker, transmitter and distributor of electricity in Indonesia.

3. The Ulubelu geothermal field is situated in the province of Lampung, on the island of Sumatra. The first stage of Ulubelu Unit 1&2 (capacity approximately 110 MW) is under development by PGE (upstream) and PLN (downstream) that is financed separately by the Japanese Bank for International Cooperation (JBIC). The proposed project focuses on the development of the second stage consisting of two supplementary 55 MW units, referred to as Ulubelu 3&4. The PLN Units 1 & 2 project is distinctly separate from the proposed PGE units 3 & 4 project although they are located in close proximity to each other. The construction of the PLN project is underway.

4. The Lahendong 5&6 (approximately 40 MW) units are being developed in the Tompaso geothermal field, which is an adjacent green field to the existing Lahendong geothermal field (4 units totaling 80 MW units) situated in the Minahasa area of the northeastern sector of the Sulawesi island.[38] The proposed extension will benefit from PGE's nearby project offices and the experience accumulated during the development of the Lahendong Units 1, 2, 3 and 4.

Investment in Geothermal Power Generation Capacity

5. The description of the physical component is based on detailed feasibility studies for each field carried out by international consultants.

The Ulubelu Development

6. The Ulubelu geothermal development is in the province of Lampung, on the island of Sumatra. A first stage of the geothermal field (approximately 110 MW) is under development by PGE (upstream[39]) and PLN (downstream[40]) that is financed by JICA. The proposed project focuses on the development of the second stage consisting of two supplementary 55 MW units,

[38] Both Lahendong and the adjacent Tompaso geothermal fields are located within a single designated geothermal work area (WKP) called Lahendong WKP. Therefore, although the Tompaso field is a physically separate development, the GoI refers to it as Lahendong 5&6. In this documentation, the geothermal field will be designated as Lahendong (Tompaso).
[39] "Upstream" = wells and steamfield above ground system (SAGS)
[40] "Downstream" = station and grid interconnection

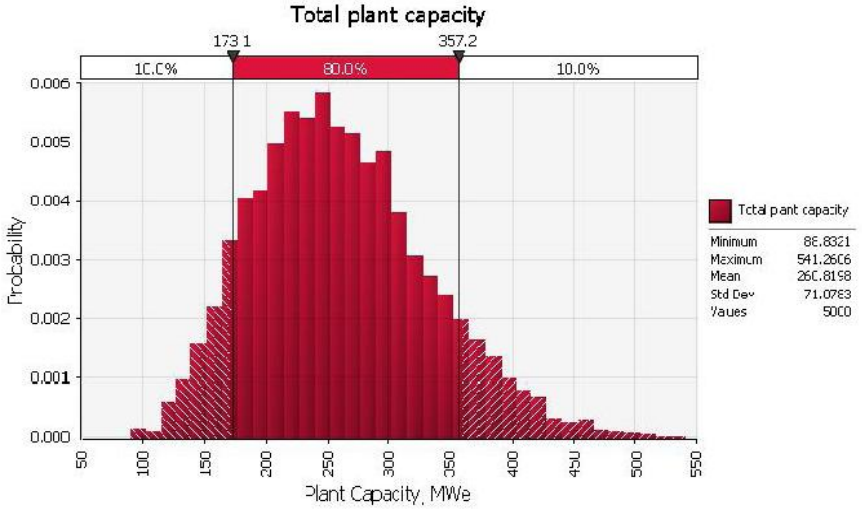
referred to as Ulubelu Units 3&4, for which PGE will undertake upstream and downstream components.

7. Resource: The initial Ulubelu development has involved scientific investigation of the field backed up by well drilling and testing. The information gathered from this first stage is also applicable to understanding the capacity of the total resource, with a view to the subsequent stage of development.

8. The main conclusions of the feasibility report are summarized as follows:

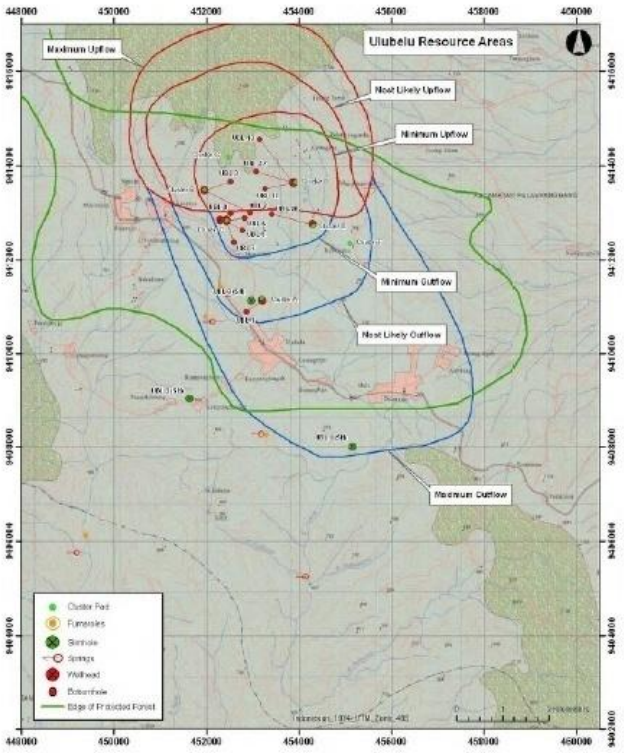
- The field is located within a clearly defined NW-SE trending "graben" (a fault-controlled depression filled in with sediments and volcanic deposits), with upflow in the NW towards Mt. Rendingan and outflow towards the south.
- The chemistry of the surrounding springs and from the wells is consistent with a common source of fluids.
- Measured temperatures in wells have reached 280^{o}C, but fluid chemistry indicates that the source temperature is at least 290^{o}C with indications of some fluid being sourced from a deep 320^{o}C upflow.
- Fluids within the field will not pose any unusual operational problems. They have low gas contents (assessed at 1.15 percent by weight in the steam, though the higher level of 1.5 percent was used for plant design) such that station parasitic loads should be low.
- The current drilled area is about 6.5 km^2 and produces steam to fuel around 90 MW that will provide most of the output needed for the first 110 MW PLN plant. An additional 9 km^2 or so of resource area will be developed to produce steam to accommodate 220 MW net generation capacity that will include the proposed units 3 & 4 power plant.
- A stored heat calculation has been undertaken which indicates 90 percent probability that the resource for the total field can sustain 175 MW, a 60 percent probability that it can sustain 220 MW and 50 percent probability that it can sustain 255 MW for 30 years, as shown in Figure A2.1 below.

Figure A2.1 – Geothermal Resource Capacity and Probability for Ulubelu 3&4



9. The following map (Figure A2.2) shows some of the assumptions around field area, distinguishing between levels of confidence and between hot upflow and cooler outflow.

Figure A2.2 – Map Showing Assumptions About Area for Ulubelu



10. No part of the Ulubelu resource can be considered a Reserve, but 90 MW can be classified as the Measured Resource (though this does not take into account inter-well interference), another 75 MW can be classed as Indicated Resource, and about 90 MW can be classed as Inferred Resource[41] (by subtraction at the 50-percent confidence level).

Overall Development

11. The following concept has been developed for the Ulubelu stage 2 development. The concept is based on standard design elements including: scattered well pads each containing multiple deviated wells, two-phase pipelines taking a mix of water and steam to centralized separator stations which separate the steam and water, steam pipelines to the power station, brine lines taking the brine from the separator stations to the injection wells (in this case taking advantage of gravity to avoid the cost of reinjection pumps), power station, and condensate pipelines taking surplus condensed steam from the power stations for reinjection into the reservoir

[41] The terms Reserve, Measured Resource, Indicated Resource and Inferred Resource all have meanings as defined in the Australian Code of Geothermal Resource and Reserves Reporting.

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Box 1 – Geothermal Resource Assessment

As for any resource assessment, there is a measure of uncertainty associated with geothermal resources. Standard methods have been developed for the assessment of these resources, coupled with a measure of interpretation.

Stored heat calculations are a standard method of assessing available energy in a resource at an early stage of development. Once fields have been operating for a period then numeric reservoir simulation models can be developed. Stored heat calculations are the most appropriate method for the current state of development of the Ulubelu and Lahendong (Tompaso) geothermal fields.

Input factors into this calculation include reservoir area, thickness, average temperature, rejection temperature, rock density, rock porosity, recovery factor (an assessment of how much of the heat in the reservoir can actually be extracted from the reservoir), energy conversion factor (from heat to electricity), etc. Because of uncertainties in interpretation, it is common practice to specify a range of values for each parameter, and then undertake a Monte Carlo analysis to give a sense of the overall likely range of the result.

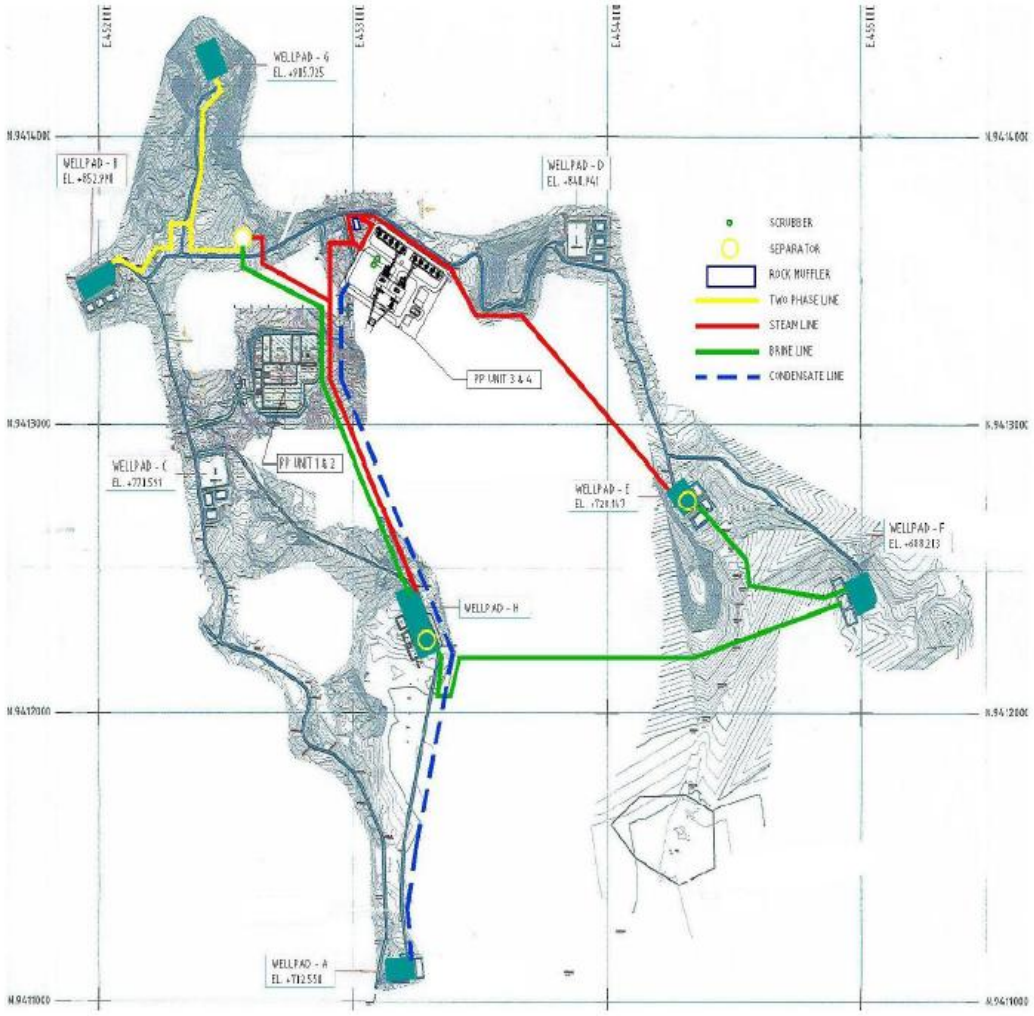
The various parameters are assessed using the evidence gathered during scientific assessment, drilling and well testing. As examples:

- Area – based on resistivity surveys and an envelope around productive wells
- Thickness – possibly based on drilling coupled with core analysis and resistivity measurement of the top of the reservoir, along with an assessment of depth from which fluid might be extracted by wells
- Average temperature – this will be by a combination of measured well temperatures and reservoir temperature information inferred from the chemistry of the wells and nearby springs
- Rejection temperature – this can vary with subtleties in the calculation method but can either be taken as ambient air temperature or a minimum temperature below which the reservoir will no longer be useful (around 180^{o}C)
- Density and porosity – this depends on the type of host rock
- Recovery factor – this is a function of the calculation method, temperature and porosity
- Energy conversion factor – commonly around 10 to 20 percent.

The final result of the calculation is shown in a probability distribution. Geothermal developments are usually based on values between 10 and 50 percent confidence level, depending on risk preferences of investors. The World Bank financed Leyte geothermal development in the Philippines based on 50-percent level of confidence.

12. It should be noted that both stage 1 and 2 developments at Ulubelu are in the same vicinity, but are separate projects. PGE Units 3 & 4 development does not rely on any geothermal facilities in PLN units 1 & 2 power plant. Each geothermal well is also distinctly dedicated to supplying steam to either Units 1 & 2 or Units 3 & 4 operations. What is not shown in the following Figure A2.3 are the separate pipe routes for the stage 1 development which may run in parallel or cross over stage 2 piping in places, e.g. between well pads D and B.

Figure A2.3 – General Layout for the Ulubelu 3&4 Development



Wells and Well pads

13. The production well pads are pads B, G, E and H, with B and G. Other well pads may be developed in the North Eastern area of the field closer to the upflow in future. One well will be used from well pad B and another from well pad A for condensate reinjection. Each well that supplies steam to PGE units 3 & 4 are dedicated to the proposed project, and are not shared with the PLN units 1 & 2.

14. A typical well pad with six wells requires an operational area of approximately 150 meters by 120 meters, and more where battered slopes are needed in steep country.

15. Average production from the wells (mostly large diameter) is 7.6 MW at a separation pressure of 6 kscg, the minimum recommended pressure to avoid silica scaling problems. In total 16 production wells will be required, i.e. 14 new wells, these being large diameter (12-inch diameter production casing) wells. There will be approximately even numbers of wells per pad.

All four brine reinjection large diameter wells will be drilled from well pad F, of which two already exist. A single condensate large diameter well will be drilled on well pad A.

16. An allowance of 5 percent per annum is made for output rundown with both plants operating. It is estimated that three new wells every two years would be needed for the proposed project.

Steamfield Above-Ground System

17. Figure A2.3 above also indicates pipe routes, and site roads will parallel these routes.

18. To take advantage of the relative elevation of production well pads, three separator stations (SSs) each consisting of a single separator will be constructed. A high elevation SS will take fluid from well pads B and G. Other SSs will be located on the two other production well pads E and H.

19. From the SS, the last 500 meters of the steam line will be used as a scrubbing line to clean the steam before delivering it to the two steam scrubbers located at the power station.

20. Brine from SS G will flow downhill to well pad H, where the brine will combine with SS H brine before flowing downhill to well pad F.

21. Condensate flows downhill from the power station to one of the available wells on well pad A.

Power Station

22. The concept is for a single flash condensing steam cycle operating at primary separation pressures of between 7 and 8 bars. The powerhouse has been assumed to be a single building housing 2x55 MW condensing steam turbines.[42] Turbines will be linked to generators which are totally enclosed water-to-air cooled 3-phase unit with brushless excitation operating at 50 Hz and a generating voltage between 11 and 13.8 kV. The power plant would use direct-contact condensers where the cooling water is sprayed directly into the condenser, mixing with and condensing the incoming exhaust steam, the condensers being made of (or internally clad with) Grade 316L stainless steel. The hot water is cooled in the mechanical draft cooling towers. Non-condensable gas will be extracted from the condensers using a hybrid system of steam jet ejectors and liquid ring pumps, and 40 percent of the gas will be discharged into the cooling tower plume, while the remainder will be taken to an H_2S abatement plant. The main cooling water system comprises hot well pumps, cooling towers and large diameter circulating water pipe work and valves. The plant requires step up transformers to deliver generator output at 150 kV to the PLN substation located at the Ulubelu 1&2 plant site. Similarly, auxiliary transformers are required to reduce the generator voltage down to the required voltages for plant auxiliary loads. An outdoor conventional switchyard with rated voltage of 150 kV is included. All necessary balance of plant is included.

23. The gas abatement plant is an addition to the project following careful analysis by the environmental consultant. This analysis showed that H_2S concentrations are expected to be an

[42] At an early stage of the project, efforts were directed at the development of performance-based contracts that could allow bidders to offer the design they thought could be most competitive. As an example, this could have led to the selection of a single 110 MW turbine. PGE reviewed their contractual obligations and decided that the development had been specified as 2 x 55 MW so needed to be more tightly defined.

important issue in some local villages without abatement. PGE has committed to the additional investment in abatement plant to meet WHO standards.

24. A range of abatement technologies have been applied to geothermal developments elsewhere, and final selection of technology will be made at the detailed design stage. The abatement plant has been identified as a component in prequalification documents. Because only 60% gas abatement is required, the FS consultant has shown that the more expensive indirect contact condensers can be avoided. Abatement requirements are higher than can be achieved through 'secondary' treatments applied to the cooling tower water. A portion of the gas will be directed to an abatement plant based around iron chelate catalyst treatments which will oxidize the hydrogen sulfide to sulfur. This plant has been budgeted for in the project.

25. The situation at Ulubelu is complicated by the development of stage 1 by PLN prior to the commissioning of stage 2 by PGE. The PLN plant by itself will make the hydrogen sulfide exceed WHO standards, whereas currently this is not a problem. PLN has been alerted to the issue, and has agreed to monitor the effect and implement a solution in parallel with PGE. Retrofitting of the required plant will not be difficult within the plant area or a small extension of it.

26. In the case of Ulubelu, it is very likely that the local population would benefit from the rigorous air dispersion analysis undertaken in bringing this project documentation to Bank standards.

Connection to the Grid

27. Stage 2 will involve a short transmission connection of about 500 meters that PGE will construct between the outgoing feeders from the AC switchyard to the PLN switchyard for Units 1 & 2. PLN will then evacuate the power through a transmission line that was designed to extend the South Sumatra grid from the Batu Tegi hydropower plant to Ulubelu. This is a part of the overall reinforcement of the grid, which is underway.

The Lahendong 5&6 (Tompaso) Development

28. The Lahendong 5&6 (Tompaso) (2 x 20 MW) units are being developed in an adjacent green field to the existing Lahendong geothermal field (4x20 MW units) situated in the Minahasa area of the northeastern sector of Sulawesi island. The proposed extension will benefit from the nearby PGE project offices and the experience accumulated during the development of the Lahendong 1, 2, 3 and 4 developments.

29. Resource: The Lahendong (Tompaso) resource is being developed as an extension of the existing Lahendong geothermal developments, though it is physically separate from Lahendong geothermal field. The existing Lahendong developments include two previous stages of 2 X 20 MW condensing turbine developments. This project is labeled as "Lahendong 5&6" because of this past development, while it is in fact a separate greenfield development.

30. The key conclusions of the feasibility study related to the resource are as follows:

- The reservoir appears to be located in Andesite breccia in a setting with combinations of Northwest-Southeast trending strike-slip faults and some North-South cross faults. North-South faults appear to have been sealed by mineralization. Permeability is still poorly understood. The reservoir is capped by a silicified zone, which is thicker to the west.

- The location of the field is determined through a combination of location of surrounding springs and thermal activity, and through magnetotelluric (MT) surveys. Following recent drilling, these surveys are now interpreted as showing an upflow in the southwest towards Mt Sempu volcano with outflow to the northeast. The southern-most area has yet to be tested by drilling.
- The Tompaso reservoir is characterized by near neutral-pH waters with low gas (assessed at 0.27 percent by weight in the steam, though the higher level of 0.8 percent was used in plant design) and a fluid temperature of up to 310^{o}C based on the discharge chemistry of the two discharged wells, LHD-27 and LHD-34.
- A stored heat calculation has been undertaken which indicates 90 percent probability that the resource can sustain 83 MW and 50 percent probability that it can sustain 124 MW for 30 years. While only a small portion of the field has been tested by drilling, it is likely to be more than adequate to sustain a 40 MW development.
- Based on limited output testing, 18 MW can be classed as the Measured Resource so that 110 MW can be classed as Inferred Resource (by subtraction at the 50-percent confidence level, including rounding).

Overall Development

31. The following concept has been developed for the Tompaso development. It is based on the same standard design elements as Ulubelu, but at a smaller scale. The Tompaso site is physically several kilometers in distance from other Lahendong developments such that no well pads or roads will be shared. The site is relatively open and in close proximity to housing and farming operations. The land gently dips to the north.

Wells and Wellpads

32. The production well pads are pads A, B and E (a new pad). Well pad C in the north will be used for brine and condensate reinjection. Well pad design requirements are similar to that of Ulubelu, with up to five wells per well pad.

33. In this diagram, well pads A, B and C correspond to the existing drilled pads. Well pad E in the south is a new well pad from which more production wells will be drilled to avoid an overconcentration of wells on the current production pads. The diagram also includes a further contingency production and reinjection pad, which has not been costed but has been assessed as part of the ESIA.

34. Average production from the wells (mostly large diameter) is 3.7 MW at a separation pressure of 7 kscg (the minimum pressure to avoid silica scaling problems), but this is a conservative output estimate based on the short term discharge testing of only two of the six currently drilled production wells.[43] In total 13 production wells (seven to be drilled, and all

[43] Based on an extensive survey of 80 percent or over 200 geothermal wells drilled in Indonesia carried out by GeothermEx for the World Bank, the expected value of well productivity based on the probabilistic analysis of the geothermal dataset is about 7.4 MW per well. However, total project cost and allocated budget was based on the well productivity of 3.7 MW per well, based on the currently available field information for Lahendong (Tompaso), to ensure that there is sufficient PGE financing available in the event of low well productivity. The economic and financial analyses in Annex 7, on the other hand, uses a 6 MW per well assumption that is conservative (discounted for some uncertainty), but still more reflective of the national average.

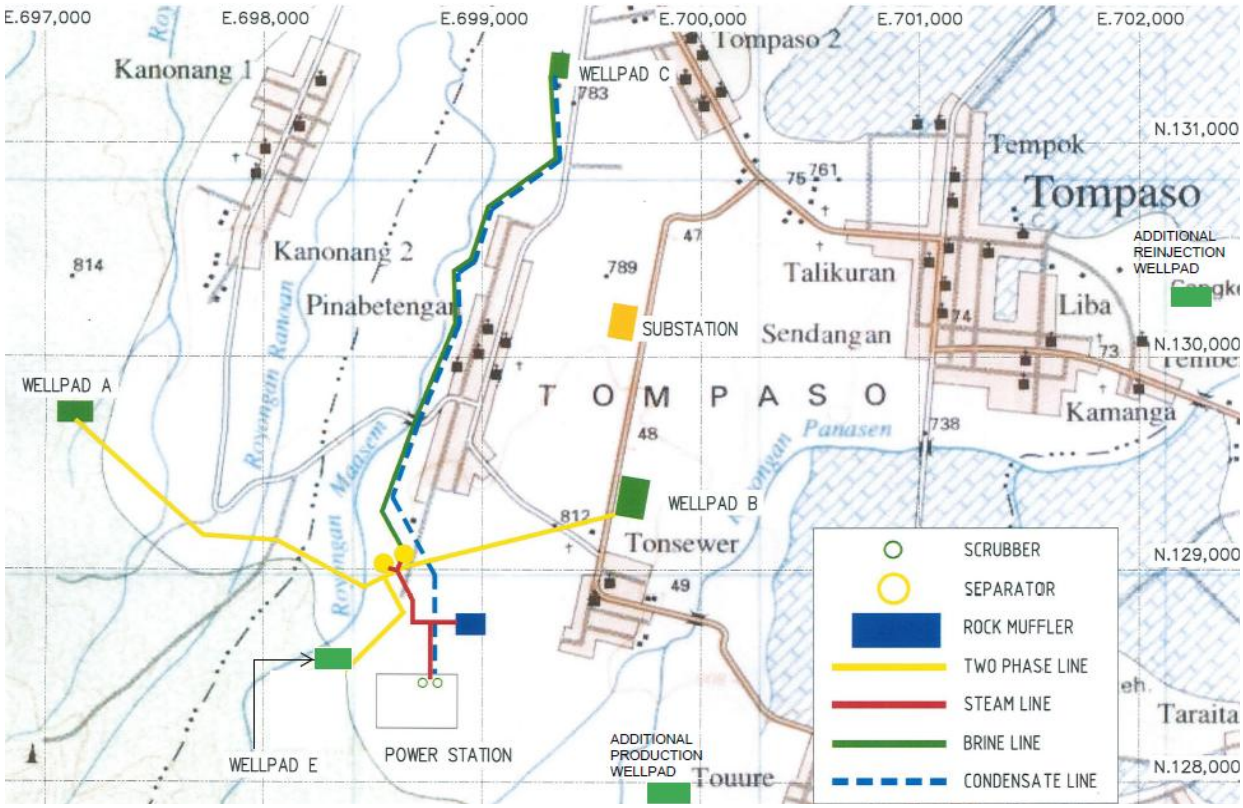
wells assumed to be large diameter), and three large diameter reinjection wells (including one condensate well) are expected based on the well-productivity assumption. There will be four or five wells per well pad, leaving room for an additional one or two future make up wells per well pad as the pads can readily accommodate six wells.

35. An allowance has been made for output rundown such that one production well will be drilled every two years while a work-over of a reinjection well every five years is expected.

Steamfield Above-Ground System (SAGS)

36. Figure A2.4 indicates piperoutes, and site roads will parallel these routes.

Figure A2.4 – General Layout at Lahendong 5&6 Development



37. A single SS will be located almost equidistant from the three production well pads and at a lower elevation to these pads to enable two-phase fluid to drain into the separators. The elevation difference between the SS and the reinjection well pad (or the contingency reinjection pad) will enable brine to flow under gravity into the reinjection wells.

38. As for Ulubelu, from the SS the last 500 meters of the steam line will be used as a scrubbing line to clean the steam before delivering it to two steam scrubbers located at the power station.

39. Condensate will flow downhill to the reinjection well pad C and a dedicated well.

Power Station

40. The concept is similar to Ulubelu, and also involves a single flash condensing steam cycle but on a smaller scale. The power station location maximizes the distance from the nearby villages and is still reasonably central to the production area. The powerhouse has been assumed to be a single building housing 2x20 MW condensing steam turbines. One difference from Ulubelu will be that gas can be extracted from the condenser using steam jet ejectors only, because of the lower gas concentration at Tompaso. The switchyard at Tompaso will be a conventional outdoor type of double bus design and initially constructed as single bus.

41. The Air Dispersion model for Lahendong (Tompaso) indicated that H_2S emission levels would meet WHO standards, therefore H_2S abatement is not required. This is in part due to interactive consideration of power station sites between PGE, the FS consultant and the ESIA consultant which lead to a station site selection that minimized effects. Nevertheless, PGE will carry out monitoring H_2S at surrounding dwellings, and a specific contingency sum has been left in the loan to allow a similar level of abatement to that at Ulubelu if monitored emissions would exceed WHO standards. There will be no difficulty in retrofitting an iron chelate abatement plant, which will require minimal area and could be connected during a station shutdown.

Connection to the Grid

42. The short transmission line connection to the grid will be undertaken by PGE within the World Bank project scope, and will be operated by PLN. It is anticipated that the final terminal point between PGE and PLN will be at the outgoing feeders from the AC switchyard. PGE will install a short 2.7 km transmission line from the power station site to the existing Kawangkoan substation.

On-going Field Operation and Maintenance

43. Upon completion of the SAGS and commissioning of the power station, geothermal field development continues during the operation and maintenance phase of the project. Production and injection wells could experience changes in characteristics, such as pressure and temperature declines, over time; therefore the power plant operator would need to drill make-up and new injection wells and associated SAGS to compensate for loss in capacity of the power plant. Adaptive planning is required to update resource management strategies as needed to ensure well production meeting plant capacity requirements. Estimates for these future costs and changes have been included in the financial projections, and are a standard feature of all geothermal developments.

Overall Project Costs

44. The following table outlines the major components of the project, several of which are funded either directly by PGE or through the IBRD/CTF loans (see Table A2.1 below). The figures reflect the detail of the final feasibility studies undertaken by AECOM, an internationally recognized engineering company. The IBRD and CTF loan amount will total US$300 million.

Table A2.1 – Project Cost and Financing Table

Project	Component	Total Cost (US$ '000)	PGE Fund (US$ '000)	IBRD/WB Loan and CTF Loan (US$ '000)
Ulubelu 3 & 4 110 MW	Drilling and Sub Surface	139,200	139,200	
	Steam Gathering System	29,950		29,950
	Power Plant and T. Line.	152,230		152,230
	Power plant & SAGS spares	1,830		1,830
	AMDAL and Permits	600	600	
	Land acquisition	350	350	
	Project management	2,000		2,000
	Sub-Total	**326,160**	**140,150**	**186,010**
Lahendong 5 & 6 (Tompaso 1 & 2) – 40 MW	Drilling and Sub Surface	105,000	105,000	
	Steam Gathering System	18,050		18,050
	Power Plant and T. Line	65,110		65,110
	Power plant & SAGS spares	840		840
	AMDAL and Permits	600	600	
	Land acquisition	250	250	
	Project management	2,000		2,000
	Sub-Total	**191,850**	**105,850**	**86,000**
	Total Base Cost	**518,010**	**246,000**	**272,010**
	Physical & Price Contingencies (10%)	51,801	23,811	27,990
	Total Project Cost	**569,811**	**269,811**	**300,000**
	Interest During Construction	4,165	4,165	-
	Front End Fee (0.25%)	750	750	-
	TOTAL	**574,726**	**274,726**	**300,000**

Annex 3: Implementation Arrangements

INDONESIA: Geothermal Clean Energy Investment Project
(Total Project Development in Ulubelu Units 3 & 4 and Lahendong Units 5 & 6)

Project Implementation Arrangements

1. PT. Pertamina Geothermal Energy (PGE) will have the overall responsibility for the implementation of the project. PGE was established in 2006 as a subsidiary of Pertamina, a state-owned oil and gas company, to focus on developing and operating its geothermal resources. At present, PGE operates 272 MW of geothermal capacity (either as steamfields or power plants), and has developed a strategy in line with the GoI's second Fast-Track Program to expand its geothermal capacity by four folds with an addition of 1,050 MW by 2015. PGE has prior experience with planning and implementing large infrastructure projects.

2. Pertamina, as the shareholder of PGE, provides structured and regular oversight to the company, including the review and approval of its investment plans, provision of funds to carry out investment activities, support for the human resources function as necessary; and now the facilitation of the proposed loan. This process is also formalized through PGE shareholder meetings. The overall coordination of the GoI geothermal development program rests with the Ministry of Energy and Mineral Resources by law, while Bappenas is taking an active role in monitoring results since it is facilitating considerable public financing towards the sector.[44]

3. PGE has well established institutional functions designed (with the assistance of a leading international management consulting firm) to specifically develop geothermal resources; and key positions are staffed with qualified personnel. New projects in PGE are normally developed within the Directorate of Planning and Development and then executed by the Coordination Unit for Monitoring and Implementation. Within the latter, dedicated Project Managers are appointed for each geothermal field with responsibility for overseeing all aspects of development. The Project Managers are supported by various specialists from other specialized departments (i.e. Finance, Supply Chain Management) to oversee activities such as financial planning & management and procurement of goods and services. PGE's Heads of Directorates and its President Director form its Board of Directors (BoD), which formally oversees the company's operations. By in large, the proposed project will follow the same established PGE project implementation process, with the addition of a dedicated Project Implementation Unit (PIU) to help coordinate the work under the proposed loan.

4. During the preparation stage, PGE received an approximately US$2.5 million project preparation grant from the Government of The Netherlands, which was facilitated by the World Bank. The project preparation grant financed the capacity building activities and the technical assistance needed to prepare for the development of the two geothermal fields (Ulubelu and Lahendong (Tompaso)) under the proposed project as well as a third field (Lumut Balai) which will be financed from a loan from the Japanese International Cooperation Agency (JICA). The project preparation activities financed by the grant were managed by a dedicated Project Implementation Unit (PIU).

[44] The World Bank is preparing an Institutional Development Fund (IDF) grant to help Bappenas strengthen its capacity in this regard.

5. For the proposed project, PGE intends to maintain the same PIU which will have the overall responsibility for managing the activities related to the loan and coordinating all aspects of project implementation – including procurement, monitoring and evaluation, quality assurance, safeguards, and implementation of the Governance Accountability Framework (GAF). Consultant services will be secured by the PIU as necessary to help manage its operations.

6. The detailed planning, specifications, quality control, construction supervision, safety assurance, and progress monitoring will be outsourced to a project management consultant (PMC); detailed engineering, procurement of materials, as far as possible, and construction and construction management will be outsourced to engineering, procurement, and construction (EPC) contractors; certification of materials and works will be entrusted to independent inspectors.

7. Additionally, all procurement processing will be overseen by a Procurement Committee established within the PIU, which comprises experienced technical specialist and procurement professionals of PGE. The Procurement Committee is an integral part of the PIU.

8. The detailed roles and responsibilities of the specific entities involved in implementing the proposed project are described in the sections below.

9. ***Project Implementation Unit.*** The PIU was established specifically for the proposed project by PGE President Director Decree No. 055/PGE000/2010-S0 dated January 28, 2010.[45] It is located at the PGE head office in Jakarta and reports to the PGE's Board of Directors through the President Director. The PIU's overall responsibilities include:

- Coordination of internal and external parties to ensure smooth project management and implementation including preparation and updating of the Project Implementation Plan (PIP) and schedule;
- Management of all procurement processes and aspects that utilize loan funds;
- Monitoring and evaluation of the project implementation progress and impacts including social and environmental safeguards;
- Implementation of the GAF;
- Overseeing the quality control and quality assurance function to ensure compliance of the installation with the design specifications;
- Report, regularly, on the progress of the project and update the results framework and outcome indicators;
- Financial management and record keeping of all transactions, preparation of withdrawal application, and overseeing the funds-flow from the loan.

The PIU organizational structure is presented in Figure A3.1. It essentially includes three levels of management: (i) the Head of the PIU, who is a senior manager from the Planning and Development Directorate at PGE; (ii) PIU Managers/Specialists: the Head of the PIU, will be supported by a team of six specialists drawn from within PGE called PIU Managers. This will include Financial, Procurement, Safeguards, and Technical Managers in addition to the (two)

[45] Since its establishment, the PIU has been given responsibility for coordinating all upcoming foreign loans.

Project Managers for each of the geothermal fields who are appointed by PGE's Projects Coordination Unit. Their individual responsibilities are detailed in Table A3.1. The Head of the PIU will report directly to the President Director of PGE, and will oversee the overall project preparation, implementation and various controls. The PIU Managers will be supported by full and part time professionals to perform their respective responsibilities; and (iii) procurement committee that manages the procurement processes, and report to the Head of the PIU. In addition, specialist consultants will be procured as necessary to assist the PIU Managers.

Figure A3.1 – PIU Set-up and Its Interface within PGE

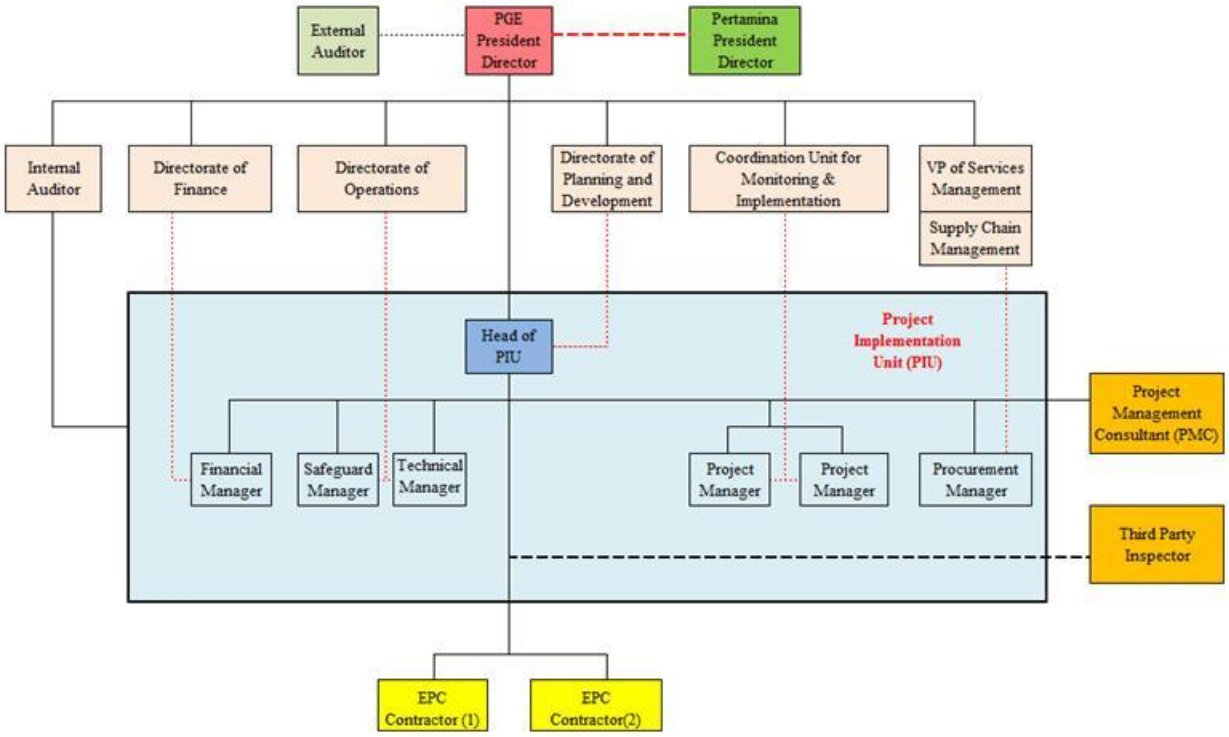


Table A3.1 – Key specialists in PIU and their responsibilities

Specialist	Responsibilities
Project Managers	For each geothermal field that PGE controls, there is a Project Manager assigned to oversee all preparation and construction supervision activities until it is commissioned. The project manager will draw on expertise from various departments within PGE (i.e. technical and safeguards, as described below) in order to carry out their activities. For the implementation of this project, there will be two project managers; one for the development of the Ulubelu field and the other for the development of Lahendong (Tompaso). They will liaise with representatives from the technical, safeguards, and procurement groups under the oversight of the Head of the PIU.

Technical Manager	The development of geothermal field requires various technical expertise that include field surveying, reservoir assessment, drilling, engineering and power plant design. A Technical Manager from the Directorate of Operations will be designated to the PIU. He will ensure that all of these technical functions are observed. The Technical Manager will draw on expertise from the various technical units of PGE and will, in turn, work under the oversight of the Head of PIU to assist each Project Manager with the development of their respective geothermal fields.
Safeguards Manager	The Safeguard Manager is the head of the Safeguards Unit, within the directorate of Operations. This unit is responsible for assisting Project Managers in carrying out the environmental and social safeguards impact assessments; and implementing the monitoring and management plans. Therefore, the Safeguards Manager will represent his unit in the PIU, and will support each Project Manager under the oversight of the Head of PIU.
Procurement	Procurement in PGE is centralized under the Central Procurement Unit (CPU) that is part of the Supply Chain Management Department (SCMD). A representative from the CPU will be included in the PIU, and be responsible to the Head of PIU for procurement of all goods and services under the project. It is important to note that given the technical nature of the expected procurement processes, the Procurement Manager will draw expertise from other PIU appropriate representatives from the technical, safeguards; and other relevant PGE units to setup the procurement evaluation committees for the selection and award of various contracts financed by the loan.
Financial Management	The Financial Manager will represent the Directorate of Finance and will be appointed as member of the PIU in order to ensure that the financial management of the loans are in compliance with PGE requirements as well as the agreements reached with the World Bank, as detailed in the Financial Management section of this Annex.
Internal Audit Task Force	In-line with PGE internal regulation, all activities under the project will be subject to audit by the Internal Audit Task Force of PGE. The audit findings will be communicated directly to the President Director of PGE.

10. ***Procurement Committee.*** A Procurement Committee for the proposed project has been established with seven members representing the various departments including planning and development, operations, finance, services management and the Project Coordination Unit. Procurement procedures, for World Bank financed contracts under the project, will follow World Bank procurement guidelines for goods, works, non-consulting and consulting services, dated May 2004 revised October 2006 and May 2010. The committee is chaired by the PIU Procurement Manager and reports to the Head of the PIU.

11. ***Project Management Consultant***. An external consulting firm will be hired through a competitive selection process to provide assistance to the PGE team on various aspects of project management.

12. ***Engineering, Procurement and Construction (EPC) Contractors.*** Suitably qualified contractors will be engaged through competitive selection to carry out performance based integrated contracts that will include detailed engineering designs, procurement of materials and equipment, and construction of the Steamfield Above-Ground System, the power stations and all associated power transmission installation up to the power off-taker point.

13. ***Third Party Inspector.*** This is a reputable independent inspection firm or institution. They will be selected on an ad-hoc basis and as deemed necessary to inspect and ensure that the SAGS and power plants meet the performance specification as prescribed in the contractor offer.

14. ***External Auditor.*** Please see FM section in this annex for more details.

Financial Management, Disbursement and Procurement

Financial Management

15. A financial management assessment has been conducted by the World Bank and actions to sufficiently strengthen the company's financial management capacity have been agreed upon with PGE. The assessment concluded that with the implementation of the agreed actions, the proposed financial management arrangements will satisfy the World Bank's minimum requirements under World Bank Operational Policy/Bank Procedures 10.02. Overall, the financial management risks for this financing are assessed as "Substantial before and ***Moderate*** after mitigation"

16. Pertamina, prior to changing to its current corporate status, had a special designation with its own governing law that did not require independent audits from an accounting firm. The same applied to PGE, which was a division of Pertmina prior to its establishment as a separate company in December, 2006. Therefore, both Pertamina and PGE accumulated a backlog of audits until they were able to establish an opening balance for their accounts. The Pertamina audit report for FY 2006 was finally completed in December 2009. Since then, Pertamina and PGE have made a special effort to overcome its backlog. PGE has now completed audits up to FY 2010, and these were issued with an unqualified opinion.

17. The project's major risk may arise from potential delays in availability of funds due to delays in approval of budgets by the Parliament.

18. ***Budgeting and Flow of Funds.*** The loan will be treated as a two-step loan, where the World Bank loan would be to Government of Indonesia (GoI) as represented by the Ministry of Finance (MoF) and will be on-lent by GoI to Pertamina through a Subsidiary Loan Agreement (SLA); and therefore, the government financial management system will apply for disbursement and budgeting. These funds received by Pertamina will be made available to PGE through its existing inter-company funding mechanism. Recent experiences in other similar projects suggest that the flow of funds may be affected by possible delays in budget availability due to delayed Parliamentary approval of the SLA budget. This could result in implementation delays and disbursement lags.

19. ***Internal Control***. The PIU for the project has been established and has a sufficient segregation of duties between technical and financial/administration aspects for the project purposes. FM procedures and policies are well documented and apply for field/area offices as well. There are different authorizations for payment validation depending on value of transactions. A sample transaction review carried out during the assessment confirmed that PGE complies with its procedures in practice. PGE's Internal Audit Division will include the project in their annual work program. Under this operation, there will be few contracts for consultants and payments will be centralized.

20. ***Accounting and Reporting***. The accounting and reporting system is integrated and functioning well. All project transactions will be included in PGE's financial statements. Current finance and accounting staff are considered adequate for handling transactions for the drawdown of the loan. Special purpose financial reports (Interim Financial Report) will be requested for this operation on a quarterly basis to facilitate monitoring. The form and content of these reports have been agreed. Quarterly project financial report should be received at the World Bank no later than 45 days after the end of each quarter.

21. ***External Audit Arrangement***. During project implementation, PGE will submit the company's audit reports to the World Bank annually as soon as available, and no later than six months of the close of the fiscal year (also calendar year in the case of PGE). A paragraph will be included in the external audit report providing the loan status and auditor's opinion on the use of project funds.

22. The detailed financial management capacity assessment, including financial management arrangements, is available in the project files.

Disbursement Arrangements

23. The disbursement methods would be (i) Direct Payment, (ii) Reimbursement, and (iii) Special Commitments, subject to minimum amount per withdrawal application at US$100,000 except the last disbursement application. Any expenditures or invoices below the minimum amount need to be paid by PGE and they may be consolidated for submission to the World Bank for reimbursement when the amount reaches the minimum of US$100,000 equivalent.

24. Applications for requesting direct payment and reimbursement will be supported by: (i) list of payments together with records evidencing such expenditures, against contracts for goods, consultants that are subject to the World Bank's prior-review; and/or (ii) statement of expenditures (SOEs) for all other expenses.

25. All documentation evidencing expenditures will be retained by PGE and shall be made available to the external auditors for audit purposes and to the World Bank and its representatives when requested.

Procurement Assessment and Arrangements

26. ***Assessment of the agency's capacity to implement procurement.*** As previously noted, the PIU will have the overall responsibility for overseeing and coordinating all aspects of project implementation including procurement; and will report to the PGE Board of Directors directly through the President Director.

27. An assessment of the capacity of the Implementing Agency identified several key issues and risks concerning procurement that could arise when implementing the project, and measures necessary for mitigation. They are as follows:

- ***Inconsistencies between provisions in PGE's regulation and in the World Bank's Procurement Guidelines.*** Major differences were identified during the assessment. To mitigate this risk, PGE has prepared a section for procurement in the Project Implementation Plan (PIP) that contains simplified and easy to understand sets of

instructions and procedures based on the World Bank's Procurement Guidelines; and clarifications on the differences between PGE's regulation and World Bank's Procurement/Consulting Guidelines. The PIP clearly indicates that World Bank policies apply in the case of conflicts between the World Bank's Procurement/Consulting Guidelines and PGE's regulation or other local rules and regulations, with regards to the implementation of the proposed loan.

- ***Potential for Corruption.*** To mitigate the risks of corruption PGE has developed a Governance and Accountability Framework (GAF) for the project around the company's own Good Corporate Governance principles, described in more detail in this Annex and in Table A3.6). It establishes measures to address issues of corruption that could arise when implementing the project, such as steps to report and investigate cases of collusive, fraudulent, corrupt and coercive practices.
- ***High-value Contracts.*** It is indicated in the draft procurement plan that design, supply and installation (EPC or turnkey) contracts will be used for the SAGS and power plants, and the contract prices can be as high as US$185 million and US$85 million for Ulubelu and Lahendong developments, respectively. To address this risk, it was agreed with PGE that (i) external consultants are/will be employed for preparation of bidding documents and procurement management, and (ii) a detailed schedule of procurement activities for the two contracts will be prepared. Both the PGE and the World Bank teams will closely monitor the progress. The World Bank's SBDs for 'Plant and Equipment Design, Supply and Installation" modified as appropriate and agreed with the World Bank is expected to be used for these procurements.
- ***Workload of procurement committee.*** The procurement committee, which will handle all procurement activities including selection of consultants, could be constrained if they had to simultaneously procure a large number of contracts, and due to the capacities of the committee members: PGE should designate adequate staff with sufficient expertise and establish more committees as necessary to reduce the work load on a single group.

28. Based on the above analysis, the initial risk assessment for project procurement is "High". However, with the agreed mitigations, the procurement risk is rated as ***"Substantial".***

29. ***Applicable Guidelines and Thresholds.*** The procurement for the proposed project will be carried out in accordance with the World Bank's "Guidelines: Procurement under IBRD Loans and IDA Credits" dated May 2004, revised in October 2006 and May 2010, and "Guidelines: Selection and Employment of Consultants by World Bank Borrowers" dated May 2004, revised in October 2006 and May 2010; and the provisions stipulated in the Legal Agreements. The following prior-review and procurement method thresholds are recommended:

Table A3.2 - Procurement Thresholds

	Prior Review Thresholds (US$)	Procurement Method Thresholds (US$)							
		ICB	NCB	Shopping	QCBS	QBS	CQS	Least Cost	SSS
Goods	200,000	≥200,000	<200,000	<50,000					
Works	5,000,000	≥5 million	<5 million	<50,000					
Services	1,000,000	≥3 million	<3 million						
Consulting Services	100,000 for firm SSS: All				default	TBD	<200,000	TBD	TBD

30. ***Procurement Plan.*** PGE has prepared a Procurement Plan for implementing the proposed project, which provides the basis for the procurement methods and review requirements by the World Bank. This plan has been agreed between PGE and the World Bank, and is available in the project's files. Once the project is approved, it will be made available at PGE and the World Bank's external website. The Procurement Plan will be updated in agreement with the World Bank annually or as required to reflect the actual project implementation needs and improvements in institutional capacity within PGE.

31. The Procurement Plan is summarized as follows:

A. Goods, Works, and Non Consulting Services

Table A3.3 – Good, works, and non-consulting series contracts

	Contract (Description)	Estimated Cost (USD 000)	Procurement Method	Pre-qualification (yes/no)	Domestic Preference (yes/no)	Review by Bank (Prior/ Post)	Expected Bid Opening Date
1	Semi IPM Drilling Services (Lahendong 5&6) - incl. Mob & Demob for exploration, production and injection wells as well as the subsurface and surface equipment.	107,850[46]	NBF	No	No	NA	**Ongoing**
2	Semi IPM Drilling Services (Ulubelu 3&4) - incl. Mob & Demob for exploration, production and injection wells as well as the subsurface and surface equipment.	142,150[47]	NBF	No	No	NA	**Ongoing**
3	EPC for SAGS and Power Plant, Spares and short Transmission Line for Ulubelu 3&4	184,010	ICB	Yes	No	Prior	**January 2012**
4	EPC for SAGS and Power Plant, Spares and short Transmission Line for Lahendong 5&6	84,000	ICB	Yes	No	Prior	**March 2012**

[46] Costs include all drilling costs, AMDAL and Permits, Land Acquisition and PGE Project Management costs.
[47] Costs include all drilling costs, AMDAL and Permits, Land Acquisition and PGE Project Management costs .

B. Consulting Services

Table A3.4 – Consulting services contracts

No.	Description	(USD 000)	Procurement Method	(Prior / Post)	Date of Proposal Submissions	Note
1	Preparation of FEED for Ulubelu	900[48]	SSS	Prior	**May 2011**	Amendment to existing contract
2	Supervision Consultant for EPC	500	QCBS	Prior	**September 2011**	
3	Individual Consultants (i.e., project managers, procurement specialist)	0.255	IC	Prior	**December 2011**	

32. ***Frequency of Procurement Supervision.*** In addition to the prior review supervision to be carried out from World Bank offices, the capacity assessment of PGE, the project's implementing agency, has recommended at least one implementation support mission to visit the field during the first two years. The frequency of procurement supervision (including special procurement supervision for post-review/audits) will be further defined after the first two years.

Environmental and Social (including Safeguards)

33. ***Measures taken to address safeguards.*** Under national environmental assessments, PGE was obliged to prepare an environmental impact assessment for Ulubelu 3&4 and environmental management and monitoring plans for Lahendong (Tompaso) 5&6. As these documents did not fully meet international standards, in particular the requirements of World Bank OP 4.01 for projects classified as Category A, PGE engaged an independent international consultant to help prepare an environmental and social impact assessment (ESIAs) for each site. The consultant collected supplemental baseline data and applied up-to-date quantitative techniques including the AERMOD air emission dispersion model developed for the United States Environmental Protection Agency (EPA). The ESIAs include environmental and social management plans (ESMPs) as separate, free-standing volumes. The ESMPs cover all potential environmental and social impacts of construction and operation, the most significant of which are:

- Positive impacts of avoided GHG and air pollutant emissions
- Water pollution and aquatic ecosystem degradation by accidental releases of drilling muds and brines, such as from well blowouts and pipeline failures
- Health and safety effects of H_2S concentrations in excess of World Bank Group Environmental Health and Safety Guidelines (including WHO health guidelines) and national standards in the workplace and nearby communities
- Noise that may exceed World Bank Group and national standards for residential areas at night in a few locations
- Interruption of groundwater flow to nearby drinking water wells

[48] The price of the existing contract is US$1.3 million which is financed by a grant from the Government of The Netherlands. The FEED for Ulubelu Units 3 & 4 is already included in the contract and the preparation of the FEED for Lahendong (Tompaso) Units 5 & 6 will be added to this contract. The total price is estimated to be US$2.2 million and the additional costs will be financed with either grant and/or loan funds.

- Social conflict and increased incidence of HIV/AIDS because of immigrant workers
- Positive impacts of improvements made by PGE to area infrastructure – roads, electricity supply, etc. – to facilitate equipment and materials delivery and construction activity

34. Should any additional geothermal wells be needed at either Lahendong Units 5&6 or Ulubelu Units 3 & 4 to sustain power generation as steam production from the initial well clusters diminishes over time (a situation that is normal in geothermal operations), the measures in the ESMPs will apply to them as well. Expansion of generating capacity at either location would require a supplement to the ESIA, but based on current findings such expansion is not foreseen in the near future.

35. As explained in the main text, the air dispersion model indicates that at Ulubelu, compliance with the ambient air quality standard for hydrogen sulfide can only be achieved through joint abatement of H_2S in cooling tower emissions, because PLN's Units 1&2 will by themselves likely cause exceedances of the standard in nearby residential areas. This would be irrespective of the amount of abatement at PGE's Units 3 & 4 since it would only reduce adding to the exceedances beyond the baseline created by PLN Units 1&2 that will come on line several years earlier. Therefore, Ulubelu should be treated as a common airshed with coordinated efforts amongst all power plant units to address any potential for excessive concentrations of H_2S. Upon the initiative of the GoI, PLN and PGE have forged such an agreement formalized by the signing of a Joint H_2S Abatement Agreement (JHAA). According to the JHAA, both PLN and PGE will take necessary measures with their respective power plants to abate H_2S emissions as necessary to achieve compliance with WHO and Indonesia standards. Furthermore, the JHAA requires the two companies to jointly monitor the ambient concentrations of H_2S at key locations in potentially affected residential areas. The JHAA is included in the ESIA for Ulubelu. The project legal documents will require Pertamina to ensure that PGE carries out its obligations under the JHAA and to provide funding and other support as may be needed. The legal documents will also require GoI to ensure that both PLN and PGE comply with the JHAA, including installation and proper operation and maintenance of the necessary abatement equipment. Furthermore, legal agreements also provide for suspension remedies in the event of adverse amendment or non-compliance by any party under the JHAA. Based on the AERMOD results from conservatively estimated preliminary well test data, the ESIA for Ulubelu indicates that approximately 60 percent provision for abatement is necessary in each power plant in order to comply with the WHO ambient standard for H_2S in the common airshed. PGE has committed to implement the necessary abatement as per its obligations under the JHAA as well as through the ESIA/ESMP that is reflected in the project's legal documents. PGE's technical consultants have been directed to design the required abatement in the Front End Engineering Design (FEED) for the Unit 3&4 power plant. PLN is also obligated to meet the ambient standard under the JHAA; and the GoI has committed through the project's loan agreement to ensure its compliance. Construction of PLN's plant has already begun, and it will therefore have to be retrofitted with H_2S abatement equipment. Such a retrofit is technically feasible, and JICA, which is financing Units 1 & 2, has confirmed through a letter to the Bank that contingency funds in its loan will be sufficient to cover the costs of the abatement equipment. The joint H_2S/health monitoring program, as agreed in the JHAA between PLN and PGE, is expected to be operational in early 2012, and will be able to confirm compliance by the PLN units 1 & 2 or inform of any requirements to adjust the level of abatement. This commitment is also formalized in the ESIA/ESMP and reflected in the legal agreements for the project.

36. As explained in the main text, after the power from Ulubelu Units 3&4 is delivered to PLN at the switchyard for Units 1&2, it will be transmitted through a 26-km line that is currently being constructed to extend PLN's grid from its hydroelectric plant at Batu Tegi. The line is a portion of a 58-km transmission line from PLN's Pageleran Substation, of which the 32-km segment to Batu Tegi was constructed several years ago and is in operation. After extensive deliberation, it was determined that the 26-km line is not ancillary to the proposed project under OP 4.01 or linked as per 4.12; it is therefore not covered in the ESIA for Ulubelu. The reasons for the determination are that: (i) the PLN transmission line is not linked for the purposes of OP 4.12 since it does not meet the criterion of contemporaneousness, being neither planned nor constructed at the same time as Units 3 & 4; (ii) the transmission line is an ancillary facility of Units 1 & 2, and its impacts are therefore being managed under Indonesia's AMDAL procedure and the safeguards policies of JICA; and (iii) it is not considered part of PGE's project's area of influence as defined in OP 4.01 Annex A because its corridor is not affected by the construction or operation of Units 3&4. No changes will be made to the line due to Units 3 & 4, thus it will generate no additional impacts.

37. The Bank is relying on the safeguards instruments required by the GoI and JICA for management of the potential impacts of the 26-km transmission line, and the project team has therefore conducted a review of this safeguards work and is satisfied with its quality. The purpose of the review was to obtain reasonable assurances that PLN adhering to good environmental and social impact management practices in constructing the transmission line. The review by the Bank task team included the examination of the ANDAL (Indonesian term for a full ESIA) and its accompanying RKL (mitigation plan) and RPL (monitoring plan) that were prepared by PLN's consultants in 2004 for the entire 58-km transmission line and incorporated in the environmental assessment for JICA. The RKL and RPL that are based on the ANDAL are sufficient to manage the potential impacts of the transmission line and equivalent to what would have been prepared under OP 4.01. It is particularly noteworthy that the documents recommend selective clearing rather than complete clearing of the right-of-way, because the maintenance of vegetative cover will prevent erosion and preserve habitat under the line. This will also reduce the disturbance to agriculture within the right of way.

38. The task team also carried out a rapid field reconnaissance of the quality of work on the 26-km transmission line. The line requires 78 towers, and for each of them a plot of 15m x 15m or 20m x 20m (for tension towers) was purchased and is being cleared. Most of the towers are located on land being used for tree crops plantations, but some are in rice terraces and 14 are in *hutan lindung* (watershed protection forest). The team visited an example of the work in each type of land use: a location in a banana plantation where the concrete tower footings had been completed, and locations with work in progress in a rice paddy and in protection forest in which coffee is being grown. In all three cases, there was no disturbance of the environment outside the plot for the tower. During construction, the plots were accessed through existing foot and vehicle paths. The contractor is applying labor-intensive methods; the footing excavations are dug by hand, and the materials and equipment are hand-carried to the sites. Laborers are hired and trained in each village territory the line passes. Encroachment by a coffee plantation was evident at the forest location the team visited, and PLN's contractor stated that there was similar encroachment at all but one of the towers in the forest area. In short, the quality of the work done to date on the 26-km line is satisfactory and would be fully in line with Bank safeguards if they were being applied.

39. PLN received use rights for the land for the tower footprints located on hutan lindung and acquired the land for tower footprints located on private land from the landowners through the standard expropriation process. PLN obtained the services of an independent assessor to establish land prices and the expropriation was carried out by the Kabupaten Land Acquisition Team that worked in two different Kecamatan—Ulubelu and Pulau Panggung. Two thirds of the tower sites are in Pulau Panggung, which is more densely populated than Ulubelu and has higher land prices. The Head of the Sub-District (Camat) confirmed that the Land Acquisition Team negotiated with owners and ultimately agreed on prices of Rp 40,000/m^2 for plantation (*kebun*) and Rp 45,000 for paddy land (*sawah*) in Pulau Panggung and Rp 30,000 for *kebun* land in Ulubelu. Discussions with residents and local officials confirmed that these prices are at or above market rates, which enables owners to purchase alternative land. The footprint areas of the acquired land are very small, thus their loss will not adversely affect household incomes. Landowners and users of *hutan lindung* who lost land to PLN are compensated for above ground assets—crops and trees—according to the productive life of the assets, which also enables them to overcome the impact of the loss. The expropriation process was carried out quickly and local officials report that both they and the affected people were satisfied with the process. Therefore, it is concluded that land acquisition for the line does not pose a reputational risk to the Bank.

40. PGE acquires land through a voluntary willing-buyer/willing-seller process that engages local communities in preparatory consultation, as well as direct non-coercive negotiation with affected owners with the participation of local officials and prominent members of the community. The results have been satisfactory and meet Bank standards in terms of transparency, fairness and participation, but PGE has agreed to strengthen its grievance procedures to make them more transparent and systematic. Negotiation failures are well documented and easy to manage, as PGE has flexibility in the re-location of platforms due to the technical nature of geothermal development. At least two platforms were re-positioned because owners did not want to sell their land and one platform was re-designed when one landowner was unable to document ownership to PGE's satisfaction. Nonetheless, because PGE has the option to request expropriation, PGE prepared a Land Acquisition and Resettlement Policy Framework (LARPF) for the project accepted by the World Bank, which provides a detailed description and assessment of current practices and clarifies the steps PGE will take in the unlikely event that it resorts to expropriation in the future. The LARPF is a stand-alone document and has also been included as an annex in each ESIA. The LARPF has been disclosed in line with Indonesian and World Bank requirements.

41. ***Mechanisms to supervise and monitor agreed actions.*** EPC contractors who will be designing and constructing the power plant will be contractually obligated through clauses in the contract to comply with the ESMP (that will be subject to Bank review and clearance). They will be required to prepare detailed Health, Safety and Environment Management Plans (HSEMP) for their operations and have them approved by PGE environmental officers prior to commencement of work. The ESMP spells out in detail the monitoring activities to be undertaken by PGE during construction and operations. For each project site under preparation, a full-time Health, Safety and Environment (HSE) officer is appointed. The HSE Officer reports to the Project Manager (appointed for each field under development) and helps oversee contractor and PGE staff compliance with the ESMP. Once a project transitions to an operational phase, a HSE Supervisor is appointed and an additional HSE officer assigned. PGE contracts with the local university for assistance in environmental impact monitoring. Responsibilities of each member of the HSE team are clearly defined in the PGE Guidelines for

Occupational Safety and Environmental Protection System No. A-001/PGE600/2008-SO. PGE has received a rating of "Green" by the Ministry of Environment, which means it not only meets or surpasses all applicable environmental standards but also practices waste recycling and resource conservation and maintains an active program to support development in the communities where it operates. In addition, an ISO 14001 environmental management system is in place in PGE's Lahendong Area and the certification process is ongoing elsewhere.

42. For land acquisition under the project that follows current practices, PGE will provide the World Bank with documentation regarding consultation, negotiations, valuation and payment. PGE will also report quarterly on the status of grievances and implementation of the grievance procedures that are incorporated in the ESIAs and have been agreed to by PGE in the ESMPs. In the event that PGE utilizes expropriation to acquire land in the two sites, it will follow the procedures specified in the LARPF, including the preparation of a Land Acquisition Plan acceptable to the World Bank that incorporates an appropriate monitoring and evaluation plan.

43. PGE's portfolio of geothermal projects is expected to expand rapidly given their ambitious investment program. The company is in the process of recruiting two additional environmental staff that it considers necessary in headquarters to keep up with the expanding workload. The positions are expected to be filled by December 31, 2011.

44. The Bank's project team will include environmental and social specialists throughout construction, commissioning and initial operation. They will oversee implementation of the ESMP and LARPF through at least two annual implementation support mission and review of quarterly progress reports from PGE that will include social and environmental information.

45. There are no environmental and social risks that go beyond the coverage of the safeguard policies.

Governance and Accountability Framework (GAF)

46. PGE-staff has substantial experience in implementing projects similar to the proposed Project. The capacity assessments that have been carried out for financial management and procurement concluded that project risks are moderate and substantial respectively, after mitigation.

47. ***Objective.*** The objective of the Governance and Accountability Strategy is to identify governance risks and applicable mitigation measures. The intention is to support PGE in strengthening the implementation of its Code for Good Corporate Governance (GCG) and provide improved transparency for Company activities and actions.

48. This project provides an opportunity for the World Bank to support PGE in establishing strong and sustainable measures as part of the corporate culture of PGE. To this effect, the Governance and Accountability Framework (GAF) will, as far as possible, build on existing Company policies to ensure that the proposed measures would be used for Company activities as a whole.

49. PGE-staff has experience in implementing projects similar to the proposed Project. The financial management and procurement capacity assessments carried out as a part of the World Bank due-diligence notes a substantial Financial Management risk before and ***moderate*** after mitigation (expected once the audit reports have been submitted); and a high procurement risk before and ***substantial*** after mitigation.

50. While more detailed program specific control systems are outlined in the Financial Management, Disbursement Arrangements, and Procurement Arrangements sections of this Annex, the GAF action plan included in this section maps areas where governance could be strengthened and presents program activities that are designed to do so.

51. ***Initial Governance Assessment.*** Pertamina Geothermal Energy (PGE) was established on December 12, 2006, as a subsidiary of Pertamina with the purpose that it would eventually take over all the geothermal business handled by the parent company. As such, PGE is a relatively new stand-alone company and is in the process of developing its independent company profile. The PGE Board of Directors has taken numerous steps in this direction and it is expected that PGE will have an independent identity in the foreseeable future. Current areas where there are still strong linkages with Pertamina, as the parent company, include the following: (a) human resources (some staff of Pertamina are seconded to PGE) and (b) fixed and movable assets have not been fully transferred from Pertamina to PGE although there are ongoing actions to complete the said transfers. Independent audit reports for PGE's financial statements are available since 2007.

52. PGE is committed to improving its governance environment and adopted a GCG policy soon after incorporation.[49] The first assessment conducted by external assessors of the actions and implementation of responsibilities of PGE's Shareholders and the Boards of Commissioners and Directors took place in December 2009 (for the period July 1, 2008 to December 31, 2009). The assessment covered 50 indicators grouped into five main fields, (a) Understanding Shareholders'/General Meeting of Shareholders' (GMOS) rights and implementing responsibilities, (b) GCG Policy, (c) Application of GCG Policy, (d) Disclosure, and (e) Commitment to implementation. The report showed an actual score of 70.18 out of 100 with two areas of relative weakness: (a) the application of GCG policy, and (b) disclosure activities. These scores confirm an overall commitment to good governance among the Commissioners and Directors of PGE.[50] PGE also decided to undertake these assessments on an annual basis.

53. PGE has a strong internal commitment to continue and expand good governance measures included in the GCG Framework. These initiatives focus on four reform themes, (a) High Level commitment to GCG evidenced by the Board of Commissioners signing the PGE Charter and the Board of Directors signing the Integrity Pact; (b) Guidance to staff on governance related issues; (c) Culture change of the Company through workshops, which are conducted in collaboration with Indonesia Corruption Eradication Commission (KPK), and have been attended by over 1,500 staff to date; and (d) Compliance with GCG, including the appointment of a Chief Compliance Officer to monitor the enforcement of GCG within Pertamina/PGE and report to the Board of Directors on his/her findings. PGE also implementing an e-procurement system[51] and has a procurement strategy based on improving competition.

54. PGE's GCG Code includes the following values of excellence (known as "Five-M Geothermal"), summarized in Table A3.5, which is used as the basis for any business activity

[49] PGE's GCG policy is modeled after the policy of its parent company, Pertamina. Prior to project concept review, upon the request of the World Bank Indonesia Country Director, the project team undertook a review of this policy and found it to be adequate. Independent evaluations of the Pertamina GCG policy have also confirmed the adequacy and vast improvements in its application.

[50] PGE's score is rated "Adequate" while a rating of "Good" would require a score of 75 or higher.

[51] The PGE E-Procurement system will not apply to this project.

and behavior of all Company employees. The project aims to assist PGE in implementing systems and behaviors in those functions that are impacted by the project.

Table A3.5 – PGE Value of Excellence: Five-M Geothermal

Input Values	Process Values	Output Values
Honesty: Being truthful, acting out the belief one holds inside.	**Visionary:** Anticipating the changing business environment both at present and in the future, to be able to keep growing and developing the Company business.	**Global:** Having a world-wide scope of knowledge.
Integrity: Being capable to realize the commitment one has into real action.	**Focus:** Optimally using various competences the Company has to increase added value.	**Environmental Commitment:** Having high degree of concern on environment to create a sustainable development of the business.
Motivation: Having the spirit and capability to accomplish things.	**Excellence:** Providing best in all aspects of business management and being capable to work in a smart and industrious way.	**Optimum:** Using all available resources in an effective and efficient way.
	Empowerment: Empowering to all Company resources to increase their performance.	**Transparency:** Appreciating transparency as high value.
	Mutual Respect: Respecting each relevant party as equal in doing business.	**Respectable:** Maintaining a good business image.
		Auditable: Maintaining good Company management based on standard criteria.
		Loyal: Prioritizing the Company interest above all others.

55. Areas where PGE can further improve transparency are (a) improving the current complaints handling mechanism, (b) instituting a Whistle Blower System and (c) setting up systems to report on these cases as well as those relating to internal investigations on corruption/collusion. The action plan below in Table A3.6 specifically includes actions to support such improvements.

56. Overall, PGE shows good commitment to improving transparency and strengthening governance measures. The overall governance risk is assessed to be average.

57. ***Associated risks and mitigation measures.*** Experience in World Bank projects in Indonesia show that the activities for an action plan could be arranged in specific areas, namely: (a) Enhanced disclosure, and transparency, (b) General Stakeholder oversight, (c) Mitigating collusion, fraud and nepotism, (d) Robust complaints handling, and (e) Sanctions and Remedies.

58. ***Agreed Implementation Measures.*** PGE shall, on semi-annual (six monthly) basis and as part of project implementation, assess progress made with the implementation of the GAF action plan and include it in the quarterly progress reports to be submitted to the World Bank.

Monitoring and Evaluation

59. PGE maintains a statistical system with sufficient data to monitor most of the outcomes of the project as illustrated in results framework and indicators in Annex 1. Results indicators related to the construction work (output indicators) and other intermediate outcome indicators will be regularly monitored by the PIU and reported in periodic progress reports to be submitted to the World Bank.

Table A3.6 – Action Plan for the Governance and Accountability Framework

Risk Area: Enhanced disclosure and transparency **Level of Risk**: Medium **Opportunity for weak governance**:	
Mitigation Actions	1. PGE shall publish its Annual Reports and audited Financial Statements on its web site before **June 30** of each following year and after approval at the Annual General Stakeholders Meeting (GCG Part II, 1.1). For years where this is not possible, an amended date shall be agreed in writing between PGE and the Bank.
	2. PGE shall submit the Audited Financial Statements for the Project Accounts to the Bank before **June 30** every year.
	3. PGE shall publish a General Procurement Notice describing its planned procurement activities on an annual basis for procurement activities financed by the World Bank.
	4. Public openings for ICB and QCBS (opening of Expressions of Interest and technical proposals) processes will be open for both the bidders/consultants and independent parties. PGE will invite such Agencies/Ministries (for example, Ministry of Energy and Mineral Resources and/or the Indonesia Geothermal Association) to send representatives to the relevant procurement meetings. Experience in other projects strongly suggests that the unit being monitored should not control the selection and briefing of such representatives Therefore a third-party, acting on behalf of the Project, may be required to perform these roles. Details concerning the selection and briefing of representatives must be recorded. Guidelines on appropriate procedures will be provided in the Project Manual.
	5. The reports / records of public openings for all prior review contracts (financed by the World Bank) shall be submitted promptly to the World Bank within two days of opening.
	6. For World Bank-financed project activities and in line with the Procurement Guidelines, within two weeks of contract award (Bank's no objection) publish in UNDB online, dgMarket, on PGE website, and send to those who submitted bids/proposals, contract award information identifying the bid and lot numbers and the following information (a) name of each bidder who submitted a bid (b) bid prices as read out at the bid opening, (c) name and evaluated prices of each bid that was evaluated; (d) name of bidders whose bids were rejected and the reason for their rejection; and (e) name of the winning bidders, and the price it offered, as well as the duration and summary scope o f the contract awarded.
	7. PGE shall, for the World Bank-financed project and as part of the regular quarterly implementation progress reporting, submit to management and the Bank, a status of payments to all contractors and consultants showing dates and values of actual interim payment certificates received and dates on which payments have been made. The update would be done every quarter.
Risk Area: General stakeholder oversight **Level of Risk**: Medium **Opportunity for weak governance**:	
Mitigation Actions	1. Please also refer to Requirement 4 under "Enhanced disclosure and transparency".
	2. Directors and Commissioners should disclose their shares and interest in other companies and as defined in PGE GCG Part II (A) 2.3 and 3.2 respectively.
Risk Area: Mitigating collusion, fraud and nepotism **Level of Risk**: Medium **Opportunity for weak governance**:	
Mitigation Actions	1. PGE has adopted an independent whistle blower system (WBS). The whistleblower system will initially be administratively managed as part of the current WBS of Pertamina (PERSERO) where an independent firm receives all calls and initiates all reviews/investigations from an off-shore 24-hour hotline based in Singapore.

	PGE will publish on its website and in its annual reports information on any such complaints or any submissions regarding PGE working level misconduct actions. PGE will assess the efficiency of the combined WBS over time and may, based on experience gained, replace/improve the initial WBS.
	2. PGE will provide the following information in the PIP, the PGE- website, and in all the bidding documents: "The contact point for complaints related to the Project: To: **PIU Manager** PGE Tel: Fax: e-mail: To: **Whistle Blower information here** Tel: Fax: e-mail: To: **World Bank Fraud and Corruption Unit** Email: investigationshotline@worldbank.org Website: http://www.worldbank,org/integrity If you prefer to remain anonymous, you may wish to make use of a free email service (such as Hotmail or Yahoo) to create an email account using a pseudonym. This way, we could correspond with you, as necessary, to seek clarification or additional information. This would be helpful for us in pursuing your allegation. Through a Fraud and Corruption Hotline hired by INT for this purpose: (24 hour day; translation services are available) Toll-free: 1-800-83 1-0463 Collect Calls: 704-556-7046 Mail: PMB 3767, 13950 Ballantyne Corporate Place Charlotte, NC 28277, United States"
	3. PGE shall report annually in the Annual Report on the actual number of cases reported with data on actions taken.
	4. PGE will publish on its official website for all World Bank-financed contracts: • All Invitations to Bid, • Bidding documents and drawings, and • Information on contract award. The manual system will continue to run in parallel for contractors who wish to use it. This system is in line with the PGE GCG for all procurement where GCG Part III, 1(d) states "The Company objective in doing procurement of goods / services is to obtain the required goods / services in the right quantity, quality, price, delivery time and source, in an efficient and effective

	manner, based on clear, detailed and accountable purchase contract provisions." Part III, 4 (e) and (h) builds on this vision and requires e-procurement and an Agreement, Purchase Order or Instruction Letter (SPK) which mentions the rights and obligation of each party, respectively. PGE has developed an e-procurement system, which is currently under early stage of implementation. PGE could, based on the experience gained by publishing the agreed procurement data on its official web site, consider rolling out the e-procurement system for all its procurement activities.
	5. Bidding documents will be available for download on-line to provide easier access to documents for interested bidders. (GCG Part III, 4(e))
	6. Bid Evaluation Report to be complete and submitted within 4 weeks after bid opening. Any extension of bid validity period for the second time or for cumulatively greater than 8 weeks requires Bank no objection.
	7. PGE will, in the office of the Supply Chain Management Department, maintain proper project and procurement filing for Bank-financed project activities including filing of advertisements, bidding documents, evaluation reports, contract award and final contract documents. Recording and appropriate referral of all incoming complaints will be undertaken by PGE with each case generating an automatic, standard format report to the Bank. Tracking of the status of investigations and measures taken will be reported in monthly reports to management and the Bank. Complaints deemed possible serious infringements may be further investigated by the Bank.
Risk Area: Robust complaints handling **Level of Risk**: Medium **Opportunity for weak governance**:	
Mitigation Actions	1. PGE will coordinate with Pertamina to use phone number 500000/+6221-79173000 as the basis for its complaints handling mechanism. The system will include a project complaint log that will be used to monitor the status of follow up of each received complaints. The mechanism will include provision for follow up investigations of substantial complaints by the internal Auditors, or third party audit to ensure independency and reliability of the system. ***Complaint Handling System*** All complaints, related to the Bank-financed Project, received shall be responded to by the Project Implementation Unit (PIU) within **7** days of receipt, with copy to PGE and the Bank. For the complaint mechanism to function, it is essential that information concerning the alternative conduits for complaint (telephone hotline', dedicated e-mail and PO Box) is widely disseminated. Strict procedures to ensure anonymity of informants will be enforced.
Risk Area: Sanctions and Remedies **Level of Risk**: Medium **Opportunity for weak governance**:	
Mitigation Actions	1. PGE will establish the actions and sanctions for cases of fraud and corruption that are reported and for which evidence is found. This will include sanctions to staff proven to be involved in such cases, as per the Consensus Working Agreement of PGE.
	2. All contracts under the Bank-financed Project, shall include clauses stating that evidence of fraud, corruption, collusion, coercive and obstructive practices will result in termination of the relevant contract, possibly with additional penalties imposed (such as fines, blacklisting, etc. in accordance with Bank and/or PGE regulations and may result in suspension of disbursement of funds with respect to that contract. Any entity that is found to have misused funds may be excluded from subsequent funding.
	3. Information regarding such cases, with lessons learned and data on the retrieval of funds, as applicable, will be widely disseminated, both on the PGE-website and the relevant annual report.
	4. Disbursement to any given contract/location can be suspended or stopped completely if cases of corruption are not dealt with effectively.

Annex 4: Operational Risk Assessment Framework (ORAF)

INDONESIA: Geothermal Clean Energy Investment Project

(Total Project Development in Ulubelu Units 3 & 4 and Lahendong Units 5 & 6)

Project Development Objective(s)	
The proposed project aims to increase power generation from renewable geothermal resources and reduce local and global environmental impacts.	
PDO Level Results Indicators:	1. New power generation capacity from geothermal resources (MW)
	2. Avoided Greenhouse Gases due to displacement of coal-based power (tonnes CO_2)
	3. Avoided local pollutants due to displacement of coal-based power (tonnes SO_2, NOx, TSP)

Risk Category	Risk Rating	Risk Description	Proposed Mitigation Measures
Project Stakeholder Risks			
Stakeholder	Low	Given the multitude of stakeholders that are associated with the project including the GoI, Pertamina, PGE, PLN and people living in project areas, there is always potential for a specific group to feel as if project is not in their best interest.	Considerable coordination and information dissemination has taken place during project preparation to increase awareness about the proposed project. The GoI's "*Fast-Track Program*" to increase power generation capacity clearly includes the proposed projects, and government agencies have been facilitating discussions amongst various stakeholders. The GoI has also discussed with bilateral and multilateral agencies and clearly allocated the projects to be developed by the public sector to specific interested financiers. Consultations conducted during the preparation of the environmental and social documentation of the project indicates strong support from the population in project areas. Although majority of stakeholder risks are mitigated during project preparation, the project team will carefully monitor for any unforeseen issues that may arise during project implementation.

Implementing Agency Risks (including FM & PR Risks)			
	High	Pertamina has a long history of developing geothermal, but PGE itself is a relatively newly established entity attempting a significant scale-up in its operations requiring substantial financial and human resources. Pertamina has considerable expertise in drilling and geophysics as the national oil and gas company, but historically, geothermal has been a very small part of the SOE's business. Furthermore, Pertamina and PGE have largely operated in developing upstream geothermal steam fields, and have limited experience in constructing and operating power plants. Pertamina and PGE are not familiar with World Bank policies and procedures. Therefore, there could be risks related to procurement and financial management, especially for procurement of high-value contracts.	Over the past year, PGE has undertaken a human resource assessment to identify critical gaps and upcoming recruitment needs in anticipation of its scale-up in development. They are now in the midst of a major recruitment drive and training program to upgrade their human resource capacity at all levels to meet the demand of the scale-up, including for the proposed project. The World Bank has also mobilized a US$2.5 million preparation grant (w/ funds from GoTN), which has provided PGE with expert consultants support during the preparation of the proposed projects as well as strengthen the overall capacity of the company. The World Bank has undertaken an FM and Procurement Assessment to evaluate PGE's capacity in this regard and proposed additional measures where necessary, including conducting several procurement trainings. PGE has also become more familiar with World Bank procurement processes during the implementing the preparation grant. The major procurement packages for the proposed project relate to securing the service of two Engineering Procurement and Construction (EPC) companies, and the procurement of the EPC services will be supported by the consultants who are carrying out the feasibility studies. Project manual (or PIP) has been prepared which will describe procedures of procurement to be followed and clarify differences between national and Bank rules and procedures. Detailed schedules will be prepared for procurement activities so that both PGE and the Bank can monitor the progress.
Project Risks			
Design	Medium-I (Low likelihood – High Impact)	The adequacy of the resource (geothermal steam) for the proposed design specifications could introduce technical risk. Commercial risk if an adequate PPA is not concluded in a timely manner.	PGE has already invested its own funds for drilling, and has confirmed resources to acceptable levels based on precedent and industry standards. With the support of the US$2.5 million project preparation grant provided by the World Bank from GoTN funds, PGE has secured the services of international consultants to help it conduct a

			detailed feasibility study for each field in developing its technical design. PGE has already entered into a Heads of Agreement with PLN regarding off-take; and agreed on a Power Purchase Agreement for the geothermal fields under the proposed project which was facilitated by GoI.
Social & Environmental	Medium-I (Low likelihood – High Impact)	The project is environmentally beneficial. However, there are still impacts from the project particularly during the construction phase that need to be mitigated to the extent possible. H_2S concentrations exceed recognized health standards, particularly in the Ulubelu joint airshed where PLN is also constructing a power plant, outside the scope of the proposed project. PGE has already acquired a majority of the necessary land for the proposed projects through its willing-buyer, willing-seller process. The project will also require the acquisition of land for the drill pads and the power station as well as for the SAGS. The concerns of the impacted people need to be adequately addressed, especially if PGE	With the support of the US$2.5 million project preparation grant provided by the World Bank from GoTN funds, PGE has secured the services of international consultants to prepare Environmental and Social Impact Assessments for each of the proposed developments. The environmental impacts of the project have been carefully evaluated, mitigation measures were designed to address all issues related to the project PGE has also conducted more consultations in the project areas than is required by policy; and has disclosed the draft safeguard documents, and provided the public in excess of 120 days to provide comments before finalizing the documents. PGE has obtained ISO 14001 Environmental Management System certification for some of its facilities and is in the process of expanding that to all of its infrastructure. The GoI has facilitated a JHAA between PGE and PLN where the two companies agree to abatement of H_2S at Ulubelu to jointly meet World Health Organization (WHO) and Indonesia standards. H_2S abatement is incorporated in the feasibility study for Ulubelu and its costs are accounted for in the proposed loan. Although the H_2S levels at Lahendong are not predicted to exceed standards, PGE has agreed to regularly monitor the area; and sufficient funds are allocated in the loan should a need arise to incorporate H_2S abatement. The independent international consultants hired through the project preparation grant have also assisted PGE in fully documenting its voluntary land acquisition policy into a Land Acquisition and Resettlement Policy Framework that also covers procedures to be followed if expropriation is used. The document will be publicly disclosed in affected areas.

		decides it needs to utilize expropriation procedures for specific plots.	
Program & Donor	Medium-L (High Likelihood – Low Impact)	The proposed Technical Assistance for Capacity Building component is scaled-back or eliminated due to lack of commitment of donor funds.	The project preparation grant has begun to provide capacity building assistance to PGE already; and additional TA for Capacity Building is now a potential parallel activity. As a result, funds are being sought from other interested donors for additional TA support to PGE.
Delivery Quality	Medium-L (High Likelihood – Low Impact)	Possible implementation delays due to procurement or technical challenges.	The proposed two major contracts are designed in a turnkey manner, in which PGE will procure an experienced developer to provide integrated engineering, procurement, construction EPC services; reducing the technical burden on PGE. The consultants hired through the project preparation grant will support PGE through the entire procurement process of the two major EPC contracts.

Overall Risk Rating at Preparation	**Overall Risk Rating During Implementation**	**Comments**
Medium-I (Low likelihood – High Impact)	**Medium-I** (Low likelihood – High Impact)	The various risks that would be faced by the project were assessed through the Operational Risk Assessment Framework (ORAF) in Annex 4. The proposed geothermal development is a relatively straight forward operation, but a number of risks were identified at the institutional and project level especially given the significant scale-up that is being undertaken by PGE and due to the fact that, as a first-time client, it is less familiar with implementing a World Bank loan. A number of key mitigation measures have been taken at the project level to address these risks including the mobilization of an approximately US$2.5 million project preparation grant to PGE to ensure that the project is designed to meet technical, environmental, and social standards that are consistent with international good practice. Given the actions taken to mitigate the identified risks, the overall project risk is assessed to be moderate.

Annex 5: Implementation Support Plan

INDONESIA: Geothermal Clean Energy Investment Project
(Total Project Development in Ulubelu Units 3 & 4 and Lahendong Units 5 & 6)

Strategy and Approach for Implementation Support

1. The strategy for implementation support has been developed based on the design of the project and its risk profile. It aims at providing sufficient technical support to Pertamina Geothermal Energy (PGE), the implementing agency, ensuring fiduciary compliance with World Bank guidelines, and adequately carrying out all risk mitigation measures defined in the ORAF during project. Specifically, the strategic approach for implementation support includes the following:

A. **Technical:** The World Bank team will work closely with PGE and the feasibility study consultant, who is providing technical expertise in procurement, to ensure that (a) the engineering designs of the SAGS and the geothermal power plants meet industry and international standards, (b) all equipment and supplies procured are of good quality, and (c) the construction of SAGS and power plants meet industry standards.

B. **Environmental and Social Safeguards:** The World Bank team will supervise the implementation of the agreed Environmental Management Plan and Land Acquisition and Resettlement Policy Framework (LARPF) for the project; and ensure compliance with World Bank safeguards policies.

C. **Procurement:** The investment component of the project will be implemented through two large engineering, procurement and construction (EPC) contracts. Therefore, procurement of the EPC contracts is on the critical path of timely project implementation and would dictates delivery quality of the project. The World Bank team will provide sufficient support to PGE to ensure timely review, evaluation and submission of key bid documents. Support will also include necessary training workshops provided to PIU staff responsible for procurement prior to commencement of project implementation. Other procurement support would be with consultant services especially those associated with the capacity building component.

D. **Financial Management:** Supervision of project financial management will be performed applying a risk-based approach. The supervision will review the project's financial management system, including but not limited to accounting, reporting and internal controls.

E. **Governance:** The World Bank team will monitor the implementation of the agreed action items detailed in the Governance and Accountability Framework (GAF) and provide guidance in resolving any issues indentified during supervision.

Implementation Support Plan

2. To successfully implement the Geothermal Clean Energy Investment Project, the task team consists of experts on the geothermal sector as well as other relevant subject matters. The task team will be comprised of members that are based in Indonesia as well as internationally. Formal supervision and field visits will be carried out at least twice each year. Detailed inputs from the World Bank team are outlined below:

A. **Technical:** International experts in geothermal energy and power generation on the task team will review and provide input to the detailed engineering design for the SAGS and power plants constructed under the project. The experts will also participate in project supervision and field visits during the construction stage to monitor and inspect the works performed under the two major EPC contracts. The geothermal engineer and, if necessary, power engineer will also be responsible for technical review of bid documents and evaluation reports. Implementation support missions will be carried out semi-annually to review progress during the construction phase of the project (approximately 24 months), then annually thereafter. However, give the importance of the construction period to project success, the geothermal specialist will provide input and guidance to the client throughout this time on an as needed basis.

B. **Fiduciary requirements and inputs:** Supervision of project financial management and procurement will be performed on a risk-based approach. During implementation and in coordination with the task team, the procurement and FM specialists will conduct annual reviews, including reviewing of requisite reports as per the Project Agreement, checking for compliance with agreed procurement and FM procedures, indentifying potential capacity gaps, and evaluating adequacy of documentation and record keeping arrangements. Trainings will be provided to PIU staff by country office-based World Bank procurement and financial management (FM) specialist prior to the commencement of project implementation. Formal supervision will be carried out at least twice per year, and continuous support will be made available by the Indonesia based specialists as required by the client.

C. **Pertamina and PGE financial review:** The financial specialist will review the financial condition and forecasts mostly for PGE and to some degree for Pertamina, to ensure that the company's operational performance can be sustained; and that they are in compliance with the financial covenants agreed with the World Bank.

D. **Environmental and social safeguards:** The experienced environmental and social specialists on the task team will monitor and evaluate the implementation effectiveness of the agreed Land Acquisition and Resettlement Policy Framework (LARPF) and the Environmental Management Plan. Formal supervision will be carried out bi-annually, and continuous support is available as required by the client.

E. **Governance:** The Governance and Accountability Framework provides a detailed action plan, agreed by both the World Bank and PGE, which will serve as the guide during project implementation. The task team leader and institutional specialist, in consultation with fiduciary specialists, will review the adequacy of recordkeeping required per the GAF, and discuss with PGE any issues or concerns that may arise. Supervision will be carried out twice a year.

F. **Operations:** A Senior Infrastructure Specialist based in Jakarta will provide day-to-day supervision support, and will be assisted by an operations specialist. They will liaise closely with the client and coordinate efforts within the task team.

Table A5.2 – Skills Mix and Resources Required

Skills Needed	Number of Staff Weeks (SWs)	Number of Trips	Comments
Task Team Leader	6 SWs annually	2 trips annually, field visits as required	
Operations Officer	8 SWs first year, then 6 SWs annually in the following years	Field visits as required	Country office based
Geothermal Engineer	4 SWs annually	2 trips annually	
Power Engineer	4 SWs annually	2 trips annually	
Institutional Specialist	4 SWs annually	2 trip annually	
Social Safeguards Specialist	3 SWs annually	1 trip annually	
Environmental Specialist	3 SWs annually	1 trip annually	
Financial Analyst	3 SWs annually	1 trip annually	
Procurement Specialist	6 SWs first year, then 2 SWs annually in the following years	Field visits as required	Country office based
Financial Management Specialist	4 SWs annually	Field visits as required	Country office based
Operational Support	4 SWs annually	Field visits as required	Country office based

Annex 6: Team Composition

INDONESIA: Geothermal Clean Energy Investment Project
(Total Project Development in Ulubelu Units 3 & 4 and Lahendong Units 5 & 6)

World Bank staff and consultants who worked on the project:

Name	Title	Unit
Migara Jayawardena	Task Team Leader / Senior Infrastructure Specialist	EASIN
Noureddine Berrah	Energy/Institutional Advisor, Consultant	EASIN
Brian White	Geothermal Engineer, Consultant	EASIN
Thomas E. Walton	Environmental Specialist, Consultant	EASIN
Stan Peabody	Social Safeguards Specialist, Consultant	EASIN
Khairy Al-Jamal	Senior Infrastructure Specialist	EASIS
Imad Saleh	Procurement Hub Leader	EAPPR
Zhentu Liu	Senior Procurement Specialist	EAPPR
Rajat Narula	Senior Financial Management Specialist	EAPFM
Ben Gericke	Lead Specialist – Governance	EASIN
Joseph Tham	Economist, Consultant	EASIN
Ivy Cheng	Financial Specialist, Consultant	EASIN
Jamil Sopher	Financial Advisor, Consultant	EASIN
Yan Li	Financial Specialist, Consultant	EASIN
Baher El-Hifnawi	Lead Transport Specialist/Economist	EASIN
Sameena Dost	Senior Counsel	LEGES
Melinda Good	Senior Counsel/Indonesia Country Lawyer	LEGES
Georges Khoury-Haddad	Procurement Specialist, Consultant	EASIN
Iin Arifin Takhyan	Geothermal Advisor, Consultant	EASIS
Ninin Dewi	Social Safeguards Specialist, Consultant	EASIS
Budi Permana	Procurement Analyst	EAPPR
Christina I. Donna	Financial Management Specialist	EAPFM
Emil Elestianto	Development Specialist, Consultant	EASIS
Defne Gencer	Energy Specialist	EASIN
Shawna Fei Li	Junior Professional Associate	EASIN
Hua Du	Operational Specialist, Consultant	EASIS
Heddy Suryantono	Operations Specialist, Consultant	EASIS
Sri Oktorini	Program Assistant	EACIF
Melissa Ortega Sanchez	Program Assistant	EASIN
Cristina Hernandez	Program Assistant	EASIN

Peer Reviewers of the project:

Richard Spencer	Country Sector Coordinator	EASVS
Jamie Fergusson	Investment Officer	IFC
Magnus Gehringer	Senior Energy Specialist	ETWES
Subir Sanyal	CEO of GeothermEx, Consultant for CTF Review	EASIN

Annex 7: Economic and Financial Analysis

INDONESIA: Geothermal Clean Energy Investment Project
(Total Project Development in Ulubelu Units 3 & 4 and Lahendong Units 5 & 6)

1. Financial and Economic analyses were carried out for the proposed project as well as for the implementing and executing agencies. The results of these analyses are summarized in this annex in two Sections. Section I covers the implementing and executing agencies: (a) PGE, the project Implementing Agency – the company's current financial performance and future financial viability, and financial loan covenants; and (b) Pertamina, the parent company of PGE referred to as the project Executing Agency since it will channel the loan to PGE – its financial performance and fiscal capacity to support PGE and the project.

2. Section II covers the financial and economic analyses of the project starting with a discussion of the energy demand in Indonesia and the project's regions. The financial analysis assesses the financial sustainability of the proposed project as a stand-alone investment under different capital structures. The economic analysis assesses whether the project is economically justified by evaluating whether it is beneficial from the point of view of Indonesia as a country. A risk analysis was carried out to assess the robustness of the project's economic and financial returns.

I. Financial Performance of Pertamina and PGE

A. The financial performance of PGE

3. PGE was established at the end of 2006 as a wholly owned subsidiary of Pertamina, Indonesia's state-owned oil and gas company, to take over all of the geothermal operations and investments of the parent company. Prior to that, the geothermal operations were handled by a division within Pertamina.

4. PGE's revenue is derived from the sale of steam at certain fields, the sale of electricity it generates in other fields, and the production allowance that it levies as the manager of Joint Operating Contracts[52] (JOCs) with other private developers. As of 2010, PGE is operating its own installed capacity equivalent to 272 MW. The steam sales that average about 31 percent of its total sales revenue from 2007 to 2010 is where a majority of the company's recent profit is derived. The electricity sales at present is largely from JOCs that are a pass-through where the revenues of other private developers are channeled through PGE and it collects an allowance of that range from 2%-4% of contractors' net operating income. (Refer to Table A7.1 for PGE's total revenues and costs, as well as those associated with its own operations.) Going forward, PGE will continue to develop both upstream geothermal developments that will sell steam to operate power plants, and "total" integrated projects where PGE generates and sells electricity from geothermal resources. Under the current policy regime in the sector, there will be no new JOCs, as private developers in the future are expected to contract directly with the off-taker. At present, geothermal pricing is based on negotiated Steam Sales Contracts (SSCs) and Power Purchase Agreements (PPAs), which are contracted with PLN and its subsidiary Indonesia Power, since they effectively represent the single off-taker in Indonesia. The Government of

[52] Under the previous policy in the sector before the 2003 Geothermal Law, Pertamina was given the responsibility by GoI to administer private concessions including the pass-through of its revenues for a fee. This obligation, which was grandfathered when the current Geothermal Law was issued, is now transferred to PGE.

Indonesia (GoI) is currently preparing a pricing and compensation policy for geothermal that could change the present arrangements. In the meantime, however, tariff negotiations are being facilitated by the GoI since PGE and PLN are both government owned; and because there is an urgency to reaching agreements if they are to maintain the ambitious timelines and achieve GoI's geothermal development targets.

5. Besides assuming operating assets that are progressively being transferred from Pertamina, PGE also has an ambitious geothermal expansion program that is a key part of GoI's second *Fast-Track Program.* Up to the present, Pertamina has been funding the preliminary investments in PGE's capital expenditure program either through its internal sources or from funds it raised. While PGE has functioned much like a contractor and has not taken on any direct long term debt for these new constructions, it pays what its parent company considers its share of interest on loans borrowed on its behalf. In addition, PGE has also been distributing 20%-40% of its net income to Pertamina as a dividend since 2007. The transfer of funds in both directions is recorded in various inter-company transaction accounts.

6. Given the above circumstances, PGE cannot be considered a financially autonomous entity at this time. Several of the company's key historical financial data and indicators for the years 2007-2010 are summarized in the following Table A7.1. PGE's revenues has increased during this period largely due to several of its steam sales contracts being linked to the international price of oil, which was relatively high at the time. The exceptionally high balances in the accounts receivable and payable reflect the large amounts of transactions between PGE and Pertamina. The flexible nature of some of the payables also means that even though the current ratios were significantly less than one,[53] PGE did not experience any real liquidity issues.

Table A7.1 - PGE's Key Financial Data and Indicators 2007-2010 (in Rp. billion)

	2007	**2008**	**2009**	**2010**
	Audited	**Audited**	**Audited**	**Audited**
Electricity & Steam Revenue	3,264	4,486	4,351	4,276
of which: from PGE's own operations	925	1,495[54]	1,250	1,365
Operating Cost	2,458	3,237	3,371	3,260
Net of pass through purchases	163	289	344	402
Income from Operations	763	1,249	980	1,015
Net Interest Expense	(4)	19	20	-
Net Income	531	841	646	729
Total Accounts Receivable	817	814	650	656
Current Assets	907	936	1,043	1,683
Total Accounts Payable	1,341	1,340	2,243	3,735
Current Liabilities	1,346	1,350	2,443	3,999
Operating Ratio (%)	75%	72%	77%	76%
Current Ratio (times) [55]	0.67	0.69	0.42	0.42

[53] While having current ratios of less than one is not uncommon for a utility that is financing its expansion through borrowing, PGE carries no debt on its books.

[54] The sales figure in 2008 was inflated on account of a pricing provision for Kamojang 2&3 which allows the price of steam to vary with the price of oil that was at historically high levels in nominal terms. This provision will end in 2012.

[55] These current ratios in the period 2007- 2009 are disproportionally low because PGE had been accounting for the value of asset transfers as accounts payable, and the audit confirms this treatment. Had the values of these transfers

7. To-date, the arrangements between Pertamina and PGE appear to have served the companies well and both are financially viable. However, given PGE's mandate to take on the role of a key player in developing Indonesia's geothermal power potentials and eventually to operate as an autonomous entity, PGE would need to take more financial responsibilities and progressively become more accountable for its management decisions and actions. In early 2010, as a sign of PGE's acquiring more financial responsibility, the company was given the authority to retain and manage its receipts from the steam and electricity sales, though their actual allocation still requires Pertamina approval. The formalized passing through of the proposed IBRD and CTF loans from Pertamina also serves as PGE's first experience with external borrowing and direct debt servicing responsibilities. The relaxation of direct financial control by Pertamina and the expansion of PGE's financial responsibilities are clearly positive steps in transforming PGE's current profile as facility operator and contractor into a more autonomous entity.

8. That said, it would be in the mutual interest of the companies to continue to modify their current financial relationship and put in place a structure that would eventually allow Pertamina to focus on setting financial policies for its subsidiary while leaving PGE to focus on managing its own finances as part of its progression to become an independent and efficient operator and developer of geothermal facilities. As a means to support PGE's management to evaluate its financial performance under the existing setup, and to anticipate and manage future financial challenges and opportunities, a financial forecast for the period 2010-2015 was prepared based on PGE's current expansion program with a planning horizon of five years as presented in the following Table A7.2.

Table A7.2 - PGE's Capital Expansion Program (in Rp. billion)
As of December 15, 2010

	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**Total**
Increase in Installed Capacity (MW)	0	20	110	430	260	230	1,050
Capital Expenditure	2,514	3,057	3,328	4,082	3,807	3,064	19,852

9. On the basis of the above capital expansion program, associated increase in production and anticipated prices, the forecast shows that PGE would enjoy considerable growth during the period 2010-2015 with a 4.9X expansion in capacity; a 3.0X increase in revenue from its own operations; and a 2.2X increase in net income after tax. The forecasts also show that PGE would be able to meet its cash operating costs and debt service (which is projected to be rather modest during the initial years due to the long grace periods and concessionary terms of the CTF/IBRD loans and other anticipated bilateral loans). Internal cash generation over the five year period is projected to total about Rp. 6.94 trillion (about US$746 million equivalent), or about 42 percent of capital requirements not expected to be met by PGE direct borrowing or grants. Key income and debt service data are summarized in the following Table A7.3.

been accounted for as long-term or perpetual liabilities, the current ratios for 2007-2009 would have been 1.24, 1.71 and 1.08. Beginning in 2010, PGE changed its accounting method to classify the value of fixed asset transfers as paid-in capital, thereby solving this problem for future years.

Table A7.3: PGE's Key Financial Data and Indicators 2011-2015 (in Rp. billion)
As of December 15, 2010

	2011	2012	2013	2014	2015
PGE Steam Available for Sale (MWh)	1,715	2,048	2,665	3,763	4,209
PGE Installed Capacity (MW)	292	402	832	1,092	1,322
Total Sales Revenue	4,299	4,761	4,574	6,214	7,221
of which: from PGE's Own Operation	1,346	1,422	1,169	2,741	3,917
Operating Cost	3,441	4,043	4,155	4,789	5,237
of which: PGE O&M	489	704	749	1,315	1,933
Depreciation	139	305	305	635	1,045
Income from Operation	858	719	420	1,426	1,984
Interest Expense					
Net Income	605	513	316	981	1,350
Total Debt Service[56]					
Cash Operating Cost & Debt Service	3,441	4,043	4,155	4,789	5,237

10. The figures and trend appear to be encouraging. Yet, PGE faces a number of uncertainties that could pose challenges as it seeks to implement the government's ambitious geothermal development program. Externally, the key challenge is the lack of a predictable pricing policy. However, given the government's commitment to developing the country's geothermal resources, it has helped reach agreement between PGE and PLN on the power purchase agreement for several fields in PGE's upcoming investment plan including the two under the proposed project. Within the Pertamina system, the uncertainties include i) the pace and scope of PGE's on-going transformation, which is in a continuous process of being defined and refined as the company builds its experience and credentials; ii) the two companies' evolving relationship; iii) PGE's untested ability to raise capital if and when it becomes financially independent; and iv) the pace of which the company will need to develop its human resource capability. In view of the support it can rely on from Pertamina, PGE has the capacity to deal with these internal uncertainties as it moves towards greater autonomy.

11. In effect, circumstances created by the government's decision to expand its use of geothermal electricity require that PGE transforms itself from limited operations into a larger and more independent company, capable of managing multiple complex facilities and projects. The proposed project is expected to assist this transition and enable PGE to become accountable for the efficient and effective use of financial, human and material resources. As a first step, the relationship between PGE and its parent company needs to follow formal processes, whereby Pertamina provides resources and can expect PGE to deliver on its obligations without additional intervention. Fortunately, Pertamina does use systems, processes and mechanisms capable of enabling accountability; therefore, what is needed is for Pertamina to ascertain that its own rules would be followed in relating to PGE.

12. In order for PGE to assume its expanding role and deal with potential financial issues effectively, the company would need to build-up its internal capacity and strengthen its financial team. They have recently appointed a new Financial Director and a Planning and Development Director (both experienced professionals from Pertamina); and also begun a substantial recruitment drive in anticipation of the scale-up in its operations.

[56] Total debt repayments are modest and equivalent to the interest payments on the concessional loans. There are no repayments of principle during this period due to the grace period of the same loans.

13. Financial Covenants. Pertamina and PGE are currently relying on inter-company accounts to record the flow of funds between them. Accordingly, for the proposed IBRD and CTF loans, an Inter-Company Transaction Account is expected to be set up to record all financial transactions related to the use of these loan proceeds, and the payment of associated interest and principal. For the first time in the history of PGE, the "onlending" terms of these pass-through capital expansion funds would be explicit, and an agreement is expected to be formalized between Pertamina and PGE. This setup improves transparency and accountability, and provides a valuable precedence for management of other inter-company affairs. It is understood that the process for PGE to achieve full financial autonomy is complex, challenging and will take time. As an initial step, current inter-company processes and governance arrangements have been examined and are considered to be satisfactory. At negotiations, PGE and Pertamina will be asked to agree that PGE will follow Pertamina's standard internal processes for arranging periodic financial transfers in advance of anticipated needs.

14. As long as PGE is still largely financially dependent on its parent company conventional financial ratios appear to have limited applicability and relevance. While the company is in transition, it would be important to ensure PGE's continued operating capacity and solvency, assess the adequacy of its negotiated tariff levels, ascertain that it would be able to service its new debt obligations arising from the extensive and rapid investment scale-up, and identify the extent of financial support it would require from Pertamina. To this end, a break-even covenant would be included in the legal agreement with PGE. Specifically, the covenant would require PGE to earn revenues of no less than its operating expenditures (excluding depreciation and other non-cash expenses) plus debt service obligations.

15. As noted in the section on Financial Management, agreement will be reached for PGE to submit its annual audited financial statements as soon as available, and no later than six months following the end of the fiscal year. In addition, assurances will be sought that the company would prepare and furnish to the World Bank by April 30 of each year commencing in 2011 a five-year financial plan containing forecast income statements, funds flow statements and balance sheets for the year and the next four years. The initial forecast would be for the years 2011-2015. It is anticipated that with the aid of such annual financial plans, PGE would be better equipped to rationalize decisions, monitor and evaluate its performance, and design and implement measures to continue to stay financially viable and sustainable at a time of rapid expansion.

16. PGE's future financial performance depends heavily on the successful implementation of its substantial investment scale-up program; and its corresponding steam and power sales contracts with PLN. For the proposed project, it is particularly important that the final tariff level should take into consideration Pertamina/PGE's cost of capital, risk taken, and quantity and reliability of its geothermal power supply. In this regard, assurances will be sought that the PPA between PGE and PLN would be established in accordance with good practice and other pricing principles discussed and agreed with the World Bank.

B. The financial performance of Pertamina

17. The focus of this analysis is to assess the parent company's capacity to fulfill its financial obligations to PGE, specifically to provide counterpart funds to meet about 48 percent of the project's capital requirements; to assume the World Bank and CTF loans from MOF through an on-lending arrangement and make the proceeds available to PGE through its inter-company

transaction mechanism; and to help meet PGE's medium term capital expenditure requirements as presented in Table A7.2 on a timely basis.

18. Pertamina's core business is as an oil and gas company. Based on Pertamina's financial statements for 2005-2006 (audited) and 2007-2009 (unaudited), the parent company of PGE is financially viable and operating profitably. From 2005-2009, its rates of return on net fixed assets[57] ranged between 19 percent and 40 percent, and its rates of return on equity ranged between 11 percent and 22 percent. The company's level of cash flow and its capital structure also appear to be adequate. Over the same five year period, the company's current ratios ranged between 1.5-1.7 times, and its debt as total debt and equity ratios ranged between 49 percent and 60 percent.

19. Table A7.4 below presents some salient features of Pertamina's financial statements for the years 2008-2014. The forecast over the period 2010-2014 shows that the company will continue to grow and remain financially robust. By the end of the forecast period, the company's fixed assets are expected to be 2.4 times the current level. Total long-term investment at about Rp. 95 trillion (about US$10.2 billion equivalent) during the five year period is projected to represent about 60 percent of the company's increases in long term borrowing and equity (at Rp. 97 trillion and Rp. 63 trillion or about US$10.4 billion and US$6.8 billion equivalent respectively) during the same time period. Net income is projected to grow about 52 percent over the five year period, the annual rate of return on net fixed assets is expected to be around 30 percent. It also indicates that PGE's capital requirements for 2010-2014 totaling about Rp. 16.5 trillion (about US$1.77 billion equivalent), or about Rp. 7.5 trillion (about US$806 million equivalent) after taking into consideration PGE's internal cash generation of almost Rp. 9 trillion (about US$968 million) are relatively minor as compared to Pertamina's projected asset base and cash flow for the same time period.

Table A7.4 - Pertamina's Financial Statements (in Rp. trillion)

	2008	2009	2010	2011	2012	2013	2014
	Actual		Projected				
Operating Revenue	554	372	387	400	408	424	441
Operating Income	44	26	36	41	42	50	59
Net Income	30	16	25	27	28	33	38
Current Assets	155	154	163	164	164	164	164
Fixed Assets	140	162	148	184	234	292	352
of which: Long-term Investments	11	8	23	38	60	90	118
of which: Net Fixed Assets	76	89	71	93	116	132	150
Current Liabilities	92	105	91	97	108	120	133
Long-term Debt	12	18	37	59	83	109	134
Total Equity	150	140	141	148	163	182	204
Rate of Return on Net Fixed Asset	44%	19%	31%	33%	27%	27%	27%
Current Ratio	1.7	1.5	1.8	1.7	1.5	1.4	1.2
Debt as % of Debt and Equity	49%	56%	55%	57%	59%	60%	61%

20. With regards to the company's commitment to provide counterpart funds to finance the proposed project, as Pertamina's input is for the up-front development of the steam fields, the bulk of the capital requirement is already met or ascertained. Furthermore, the combined IBRD and CTF loan amount of US$300 million (equivalent to approximately Rp. 2.79 trillion) that it is

[57] The assets are valued on historical basis

required to assume on behalf of PGE is relatively modest vis-à-vis Pertamina's overall size. Hence the risk of Pertamina not meeting its commitments is negligible.

21. Annual financial audits and preparation of rolling five-year financial forecasts are part of Pertamina's routine reporting requirements. Given the information is useful for ascertaining its ongoing financial condition and the reports do not entail much extra effort, an understanding will be sought that a copy of each report would be shared with the World Bank on an annual basis along the same timeframe as PGE's corresponding reports.

II. Financial and Economic Analysis of the Project

22. The financial analysis was conducted from the viewpoint of PGE (equity point of view) to assess the financial sustainability of the project under different tariff rates and financing terms. It examines how the different terms of debt and equity impact the financial sustainability of the project and demonstrates the need for concessional finance. This section proposes a financing package under the negotiated PPA tariffs that ensures that project receipts are sufficient to service the Project's debt, cover its operating and maintenance expenditures and tax obligations and provide an adequate return to PGE towards enabling it to operate as an autonomous entity without unduly increasing the government's public service obligation (PSO) subsidy.

23. The economic analysis was conducted to assess the economic viability of the Project and to determine whether it adds to the net wealth of Indonesia as a whole or not. Unlike the financial analysis, which is based on the financial costs and prices and includes taxes, tariffs, financing and transfer payments, the economic analysis takes the perspective of the national economy of Indonesia. It is based on resource costs and excludes all transfer payments. The economic analysis assesses whether the government's intervention to promote the utilization of geothermal energy for power generation from Ulubelu and Lahendong (Tompaso) as an environmentally sustainable source over the likely alternative, namely coal-based capacity, will result in a net gain to Indonesian society. A key environmental global benefit of the Project is the reduction in Greenhouse Gases (GHGs) as a result of the avoided emissions from coal, which will proportionally impact the Indonesian economy. In addition, Indonesians will directly benefit from the reduction in the emission of local pollutants such as Sulfur Dioxide (SO_2), Nitrogen Oxides (NOx), and total suspended particulates (TSP). Other important benefits to geothermal development that are not quantified include enhancing energy security and guarding against the volatility in fuel prices through the diversification of generation sources.

24. Section A, below, reviews the future demand and supply of power in (i) the Indonesian market in general, taking into account the expected growth rate and the role of renewable energy in the overall development strategy of Indonesia; and (ii) in the project regions. Sections B and C present the financial and economic analyses respectively.

A. National and Regional Energy Demand and Supply

25. ***The demand for energy.*** For three decades, from 1967 to 1997, Indonesia averaged an annual growth rate in GDP of 7 percent.[58] While this rate declined sharply following the East Asian financial crisis that began in 1997 reaching negative levels in 1998, GDP growth gradually resumed thereafter. The GDP growth rate is expected to reach 6 percent in 2010, and is forecasted to reach 7 percent by mid-decade.[59] The robust economic growth has been driving the demand for electricity which has been estimated at 7-9 percent annually between 2009 and

[58] World Bank, Indonesia development policy review: enhancing government effectiveness in a democratic and decentralized Indonesia, Nov 2009.
[59] World Bank, Fourth Infrastructure Development Policy Loan, Project Document, 2010.

2020.[60] Investments in the sector, which had slowed down, are being scaled up as demand has begun to outstrip supply. The expansion in power generation is expected to relieve shortages and meet growing demand for electricity.

26. Despite the increase in investment in the sector, a lot more is still needed. The electric power consumption per capita of 566 kWh is low compared to countries in the lower middle income group and the shortage of power supply has resulted in energy rationing and rotational blackouts in a large number of areas. Such shortfalls in the supply of electricity will have adverse impacts on economic growth and hamper the government's ability to achieve its broad development agenda, which includes extending electricity access to 90 percent of the population by 2020[61] and increasing its availability to the underserved parts of the country.[62]

27. ***The regional picture.*** Outside of the island of Java that serves as Indonesia's economic center, the contribution of the islands of Sumatra and Sulawesi to Indonesia's GDP is significant at nearly 30 percent of the total, and is expected to grow in the coming years. The fast-paced economic growth in Sumatra and Sulawesi has fueled a surge in demand for electricity. PLN, the national power company, expects the recent trend of increased electricity consumption to continue at an annual average rate of 9.8 percent in Sumatra and 8.3 percent in Sulawesi. A continued increase in demand would place added strain on the power grids' already deficient capacities, which are causing acute power shortages with long wait lists for new connections. In Sumatra, there were nearly 350,000 residential applicants who were not able to obtain a connection in 2009, and in Sulawesi, the waitlist included over 150,000 households. Even for many with connections, frequent blackouts are common place in these regions. Many industrial consumers who engage in energy intensive operations have to rely on their own captive power generation to meet their electricity needs. In Sumatra, the use of captive power is significant, amounting to 606 MW, while in Sulawesi, 66 MW of demand is met by captive power.

28. PLN has aggressive plans to keep up with the growing demand for electricity. These include building power generation facilities to meet the projected demand in Sumatra and Sulawesi, as well as reducing system losses from 10.4 to 8.5 percent in Sumatra, and from 12 to 8.5 percent in Sulawesi to enhance system efficiency and reliability. Since Sumatra and Sulawesi are endowed with significant geothermal resources estimated at 13 GW and 2 GW respectively, a sound long-term strategy would be to develop these geothermal resources, which is a more environmentally-friendly alternative to coal-based generation. Currently, geothermal resources are significantly underutilized in Sumatra since only 12 MW of generation capacity is installed. In North Sulawesi, geothermal generation accounts for 31 percent of total power generation capacity on its grid (or 18 percent in the entire island of Sulawesi).

29. ***Fast-Track Program.*** In light of the significant unmet energy demand and in recognition of the importance of electricity for economic growth and social progress, the government mandated PLN to build 10,000 MW of coal-fired power plants in 2006.[63] With its abundant reserves of coal, and plans to reduce the consumption of oil fuel, the coal-based generation of electricity is a low-cost strategy for Indonesia, from a financial perspective, to expand the supply

[60] World Bank, Indonesia Rising, energizing the power sector: Policy priorities for 2010 and beyond, Policy Brief.
[61] Op. cited. World Bank, Indonesia development policy review: enhancing government effectiveness in a democratic and decentralized Indonesia, Nov 2009, and World Bank, Electricity for all: options for increasing access in Indonesia, Dec, 2005.
[62] World Bank, The Little Green Data Book, 2010. For an overview of the energy sector in Indonesia, see the APEC Energy Review 2009, March 2010.
[63] Presidential Decree 71/2006.

quickly in the short-term. Commonly referred to as the first *Fast-Track Program,* these power plants are fully under construction and are expected to be commissioned soon.

30. ***Renewable energy.*** CO_2 emissions in Indonesia increased 122 percent between 1990 and 2005.[64] Energy is the second largest source of CO_2 in Indonesia after land-use change. The emissions from the sector continue to increase rapidly, and could almost triple to 716 $MtCO_2e$ by 2030 without a substantial shift to renewable energy.[65] Cognizant of the negative environmental impacts of coal-based generation, at both the local and global levels, the Government of Indonesia (GoI) is committing significant resources to the development of renewable energy sources and to a cleaner environment. Recently, GoI announced major voluntary commitments to reduce GHG emissions (see Annex 8 on the Clean Technology Fund for more details).[66] The promotion of renewable energy benefits the local inhabitants by reducing the pollution that they would have experienced with coal-based generation. In addition, this will result in a reduction in GHG emissions, a global benefit.

31. GoI's commitment to meeting the rapidly increasing demand for electricity and to protecting the environment is also demonstrated in Phase II of the second *Fast-Track Program* to develop another 10,000 MW of generation capacity, of which 60 percent will be based on renewable sources, and of this 4,000 MW will be geothermal power.

32. ***Diversification and national security.*** In addition to meeting the energy demand, and reducing the negative impacts on the environment, a diversified approach to electricity generation provides substantial economic benefits. The utilization of renewal sources of energy, and a reduction in the use of oil, is central to GoI's General Policy on Energy and contributes to the enhancement of the country's energy security by reducing its exposure to the price volatility of fossil-based fuels.[67] The fluctuations in the prices of fossil fuels create uncertainty in the economy and have adverse impacts on the profitability of businesses. The generation of electricity from renewable and non-oil based sources provide a valuable hedge against future price increases of oil.

B. Financial Analysis

33. The financial analysis examines the financial viability and sustainability of the Project from the perspective of the equity holder, PGE. All cash inflows (receipts) and cash outflows (expenditures) are included in the analysis. Financial outflows include investment expenditures, operating and maintenance expenditures, financing flows and taxes. Inflows include the receipts from the sale of electricity as well as loan receipts. The net cash flow is constructed and discounted using the appropriate financial cost of capital.

Financial Costs/Expenditures

34. *Investment cost.* Table A7.5 presents the financial investment cost for both fields. The physical contingency has been taken at 10 percent and price contingency has been built into the financial model based on a US dollar inflation rate of 2 percent per annum over the next 30 years.

[64] Op. cited, World Bank, The Little Green Data Book, 2010.
[65] PEACE. 2007. Indonesia and Climate Change: Current Status and Policies.
[66] World Bank, Program Document, Climate Change Development Policy Loan (CCDPL).
[67] Opt cit, APEC Energy Review, 2009.

Table A7.5 - Financial Capital Cost for Ulubelu & Lahendong
(US$ million, real 2010 prices)

	Ulubelu (110 MW)	**Lahendong (Tompaso) (40 MW)**
Land and permits	0.95	0.85
Drilling costs	139.20	80.54
Management costs	2.00	2.00
Steam Above-Ground Gathering System (SAGS) and spares	31.78	18.89
Power plant	152.43	65.26
Physical contingency (@ 10% of total)	32.56	16.67
Total	**359.00**	**184.27***

* The total cost for Tompaso in Table A7.5 is lower than that in Table 2 and Table A2.2 due to the use of a different drilling cost for developing the upstream resource. Tables 2 and A2.2 use a more conservative estimate for well productivity to ensure that there will be sufficient financial resources in the event that additional wells need to be drilled. For the financial analysis and in Table A7.5, an expected value for well productivity based on a probability distribution of well productivity in Indonesia as a whole is used. This in turn is used to determine the number of wells and the total drilling cost.

35. The real 2010 capital investment cost per MW of capacity is significantly higher for Lahendong (Tompaso) (US$4.6 million per MW) than for Ulubelu (US$3.3 million). Drilling costs (including physical contingencies) account for respectively 48 and 43 percent of total capital costs in Lahendong (Tompaso) and Ulubelu; and the drilling cost per MW is significantly higher for Lahendong (Tompaso) than it is for Ulubelu (US$2.2 million versus US$1.4 million respectively). Drilling costs are directly correlated to the number of wells drilled which in turn depends on the expected productivity per well.

36. The expected average output per well in Ulubelu is 7.6 MW which is based on an assessment of wells drilled and tested in that field (mainly from those drilled for units 1 & 2). On a MW basis these tests yielded a range of 5.5 MW to 30 MW per well. Rather than simply taking the mean of all well outputs, average mass flow curves were used and the energy/mass associated with the expected reservoir temperature was taken into consideration to arrive at the expected output of 7.6 MW per well in Ulubelu.[68] Since such specific technical information is not available at this stage of development for Lahendong (only two wells were tested), the Indonesia-wide average of 7.4 MW per well was considered as a starting point. This value was reduced by 20 percent to be conservative, and an output of 6.0 MW per well was used for Lahendong (Tompaso).[69] Different levels of well productivity in Lahendong (Tompaso) are analyzed in the risk analysis. In the risk analysis, probability distributions for the expected output per well were developed based on the available data and modeled to estimate probability distributions for the expected financial and economic returns to the Project.

37. ***Plant Factor***. A plant factor of 0.92 was used for the geothermal plants in the analysis. This was the expected value of the probability distribution for a range of possible plant factors based on the experience from other geothermal plants and the expertise of technical specialists. The probability distribution for the plant factor was used in the risk analysis.

38. ***Operating and maintenance (O&M) costs.*** Table A7.6 provides the O&M costs for both fields. These include the annual costs as well as the periodic costs of overhaul and makeup and reinjection wells. Annual O&M costs include a fixed part for general and overhead costs such as

[68] The initial output estimate is 8.1 MWe per well. The expected output takes into account a rundown rate of 3% per year for the first 2 years of plant operation due to fluid extraction from the existing geothermal plant.
[69] This is addressed in more detail in Annex 2 on the technical description of the Project.

insurance, salaries, routine steam field maintenance and other overhead, as well as a variable part for operation of the plant, consumables, spare parts and salaries. Make-up wells are constructed every two to three years to compensate for the expected annual decline in output of the existing production wells in these two fields. The fixed cost component is dominated by station labor and management costs and is assessed on a kW-per-year basis. Variable costs are also dominated by station costs. The labor requirements for major overhauls can be similar for large and smaller projects, thus these values do not change significantly with project size. Total annualized cost for Ulubelu and Lahendong (Tompaso), using PGE's real rate of return of 11.7 percent (nominal rate of 14 percent), are US$20.7 and US$6.7 million respectively.

Table A7.6 - Operating and Maintenance Costs for Ulubelu & Lahendong (Tompaso)
(US$ million, real 2010 prices)

	Ulubelu	**Lahendong (Tompaso)**
Annual Fixed O&M costs	5.6	1.8
Annual Variable O&M costs - 0.25 US cents per kWh plus US$0.5 million per year to run the H_2S abatement plant for Ulubelu - 0.30 US cents per kWh plus US$0.3 million per year to run the H_2S abatement plant for Lahendong	2.8	1.3
Major plant overhaul costs, every three years	2.1	1.5
Makeup wells, every two-three years	18	6
Reinjection wells, every five years	1	1
Annualized Costs		
Annualized O&M costs, including plant overhaul and reinjection wells	11.3	4.5
Annualized cost, makeup wells	9.4	2.2
Total Annualized O&M Costs	**20.7**	**6.7**

Financial Revenues/Receipts

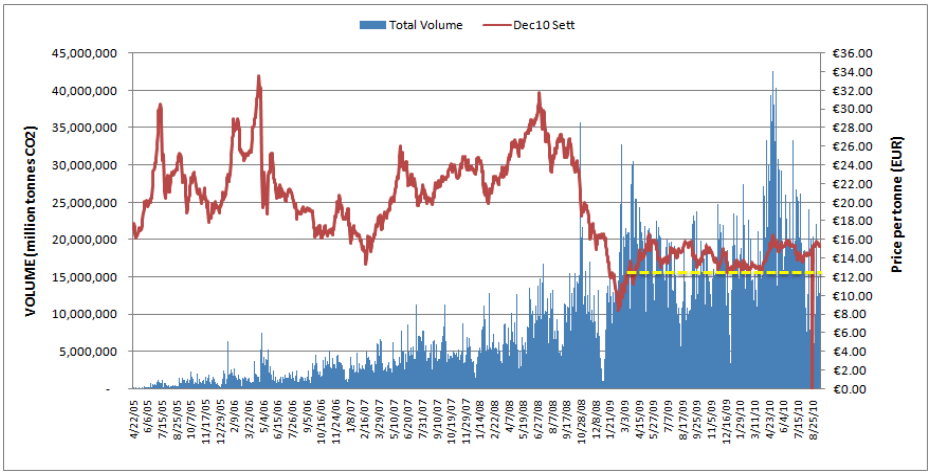
39. The financial inflows from PGE's point of view consist of the *tariff revenues* from the sale of electricity as well as the loan disbursements. The tariff rates used are those agreed to in the PPAs with 7.53 US cents per kWh for Ulubelu and 8.25 US cents per kWh for Lahendong (Tompaso).[70] Different tariff scenarios were also analyzed to assess the impact of different tariffs on the project's returns and risks. More importantly, since PLN can generate coal-based electricity at a cost of 6.4 US cents/kWh,[71] the financially least cost base-load alternative, any power purchase tariff paid to PGE above this rate would entail an additional cost, which will need to be covered through the PSO subsidy to PLN if the GoI does not want to pass it through and burden consumers.[72] Consequently, an analysis of the project's risks and returns at this tariff rate was carried out; while the same was considered under different tariff levels taking into account the PSO subsidy under each scenario.

[70] It is important to note that since conditions such as field characteristics and cost structures vary across regions and locations, the ultimate financial costs and consequently the required tariffs will also differ.
[71] PLN Statistics 2009, PT PLN (Persero). July 2010.
[72] The GoI is obliged under the Law on State-Owned Enterprises (Law No. 19 of 2003) to ensure that any SOE that incurs losses as a result of implementing GoI policy should be adequately compensated. Since both PLN and PGE are ultimately owned by the GoI, it will be incumbent upon it to ensure that the two companies remain financially whole at the end of this process.

40. In addition to the tariff revenues, the Project could also benefit from the *sale of carbon credits* that will accrue as a result of the net avoided CO_2 emissions.[73] This would enhance the financial viability of the project. However there is significant uncertainty regarding the future structure of the carbon market given the expiration of the current Kyoto protocol commitment period in 2012; as well as uncertainty created by the extended time it takes for registering projects with the Clean Development Mechanism (CDM) Executive Board so that the emission reductions (ERs) from the project can be certified. Furthermore, the current CDM methodology for renewable energy[74] under which geothermal CDM transactions will need to be processed does not account for the direct displacement of future coal-based capacity through geothermal development.[75] Therefore, the financial analysis does not include receipts from the sale of carbon credits. However, potential carbon revenues that could further enhance the financial cash flows of the project are calculated separately using grid emission factors of 0.74 and 0.18 for Ulubelu and Lahendong (Tompaso) respectively for a crediting period of 10 years.[76] The grid emission factors are calculated based on the entire power generation mix of the grids where the projects are located, which in this case are Sumatra for Ulubelu and North Sulawesi for Lahendong (Tompaso). CO_2 emissions from all power generation facilities in the grid, reflecting all generation technologies employed, are used to derive a weighted average emission factor as the grid emission factor.[77]

41. Figure A7.1 shows the historical settlement price for carbon since April 2005 based on the European Carbon Exchange (ECX) EUA Futures Contracts. The figure shows that the price of CO_2 has been varying between 12 and 16 Euros per ton since January 2009. Prices between 2005 and 2008 were higher ranging between 14 and 32 Euros per ton of CO_2. A conservative price of US$20 per ton of CO_2 was used in the analysis. [78]

Figure A7.1 – Settlement price of carbon credit trading on European Carbon Exchange



[73] The CO_2 emissions from geothermal generation are about one tenth of the emissions from coal-based generation. See Annex 1 for a detailed calculation of the net CO_2 abatement.
[74] Based on "Tool to calculate the emission factor for an electricity system" published by CDM Executive Board
[75] The current methodology requires consideration of the emission factor in the existing grid rather than the marginal displacement, which in the case of the proposed project, is entirely coal-based power.
[76] Grid emission factors are endorsed and published by Indonesia's National Commission for Clean Development Mechanism, which is the Indonesian Designated National Authority.
[77] Grid emission factor is calculated by CDM project entity, and later verified by the CDM designated validator.
[78] In IEA's *Projected Costs of Generating Electricity, 2010 edition*, a carbon price of 30 USD per ton of CO_2, was included in LCOE calculations; and it was determined by a group of officially appointed national experts, industry experts and academics as the most realistic assumption for plants being commissioned in 2015.

Cost of Capital

42. The financial viability and sustainability of the Project depend on the tariff charged and the cost of capital. The cost of capital in turn depends on the terms of the debt and equity financing. Two main scenarios for the cost of capital are considered in this analysis. The first scenario is based on PGE financing the entire project through its own funds to determine whether the project can be financially sustainable without some form of financial support. PGE receives its equity capital from its parent company, Pertamina. The financial cost of capital as reflected by Pertamina's nominal required rate of return from geothermal investments is 14 percent (11.7 percent real) although available returns from Pertamina's non-geothermal investments tend to be significantly higher. Given its public good nature and to facilitate the development of a GoI priority sector, Pertamina and PGE have agreed to settle for a rate of return on its geothermal investments that is lower than what Pertamina typically receives with the understanding that the GoI would provide lower-cost financing to offset the incremental costs and risks associated with the company's geothermal investments. Therefore, the second scenario examines the impact of blending IBRD and concessional CTF financing with equity financing from PGE on the financial viability of the Project.

43. ***IBRD and CTF Financing.*** GoI is expected to receive a US$175 million loan from IBRD and US$125 million loan from the CTF[79] for the proposed project. Both loans will be on-lent to Pertamina so that PGE can utilize the funds towards the development of the proposed geothermal project. The IBRD loan will have a maturity of 24.5 years with a grace period of 9 years. The rate will be LIBOR plus a variable spread. Given the particularly low rates of LIBOR at present (less than 1 percent), a fixed rate of 5.02 percent based on a forward LIBOR[80] was used in the analysis over the life of the IBRD loan. The CTF loan, which is being provided to a relatively small number of projects that have a positive impact on climate change, is highly concessional carrying an annual service charge of 0.25 percent with a 40-year tenure, including a 10 year grace period. The blend of a low-rate IBRD and a highly concessional CTF will compensate for the significant (higher) risks incurred in the upstream development of the two geothermal (green) fields.

44. With the blending of the CTF financing, the IBRD funds and PGE's equity funds, the nominal weighted average cost of capital (WACC) is estimated at 8.03 percent as shown in Table A7.7 (the real WACC is 5.91 percent). The full impact of the CTF funding is not reflected in the simple WACC calculation because it does not account for the special terms of the CTF, namely, long tenure and grace period.[81] The availability and amount of CTF funds has a significant impact on the cost of capital and provides PGE flexibility in negotiating lower tariffs, which would ultimately reduce the burden on electricity consumers and/or the fiscal budget that would need to supplement these incremental costs. If the CTF were to be replaced by PGE Equity, the WACC would increase by over 300 basis points. If the CTF loan was to be replaced by an IBRD loan, the WACC would increase by over 100 basis points.

[79] The CTF Trust Fund Committee endorsed the US$125 million commitment to the project on December 22, 2010, subject to loan approval by the World Bank Boards of Executive Directors.

[80] The fixed-rate comprises of a 30-year forward LIBOR of 3.87 percent as of November 12, 2010 and a fixed spread of 1.15 percent currently associated with IBRD long-term fixed spread loans.

[81] The WACC, however, will increase over time as the debt is reduced and PGE's equity increases. This issue has been avoided by discounting the Equity Holder's net cash flow at the equity discount rate (instead of the Total Invested Capital cash flows at a varying WACC). The simple WACC has been estimated to give a sense of the impact of the IBRD and CTF financing on the Project's financial cost of capital.

Table A7.7 - Nominal WACC with IBRD and CTF funds

	Amount	Rate	Weight
CTF	*125.00*	*0.250%*	*22.69%*
IBRD	*175.00*	*5.02%*	*31.76%*
PGE Equity	*250.97*	*14.00%*	*45.55%*
Total	***550.97***		***100.00%***
WACC		***8.03%***	

Results of the Financial Analysis

45. ***Financial returns and additional PSO subsidy at the PPA tariff rates of 7.53 US cents per kWh for Ulubelu and 8.24 US cents per kWh for Lahendong (Tompaso), and All Equity Financing.*** In the absence of low cost and concessional financing, PGE would have to rely on its own funds to cover the entire cost of the project. The nominal cost of these funds, as explained earlier, is 14 percent for geothermal investments.[82] At the tariff rates agreed by PGE with PLN in the PPAs, the financial returns are negative at –US$71 million for Ulubelu and –US$56 million for Tompaso. The financial net present value (FNPV) of the combined project is negative at –US$126 million, with an FIRR of 10.4 percent, well below PGE's hurdle rate of 14 percent (see Table A7.8). These results are based on the mean values for factors such as well productivity, plant capacity factor, and resource availability, and do not reflect the high uncertainty that is inherent with investing in geothermal energy. When such uncertainties are considered, there is close to a 100 percent probability of a negative return for the combined project for this scenario.[83] It is hence clear that the project would not be financially viable if it were financed entirely by PGE's own resources. This helps explain why PGE began to scale-up its upstream investments (i.e. drilling program) only when the prospects for securing concessional financing became a possibility.

46. Although the agreed tariff rates in the PPAs and the IBRD/CTF loan package makes the project financially viable, it will result in incremental costs. Since PLN can generate coal-based electricity at a cost of 6.4 US cents/kWh, any power purchase tariff paid to PGE above this rate would entail an additional cost, which will need to be covered through the public service obligation (PSO) subsidy to PLN if the GoI does not want to pass it through and burden consumers. At the tariff rates agreed in the PPAs, the implicit incremental subsidy required is US$114 million.

Table A7.8 - FIRRs and FNPVs for Ulubelu & Lahendong at the PPA tariff rates of 7.53 US cents per kWh for Ulubelu and 8.24 US cents per kWh for Tompaso, and all equity financing

Financial metrics	Ulubelu	Lahendong (Tompaso)	Combined Project
Nominal FIRR	11.0%	9.4%	10.4%
NPV (US$ million)	-71.1	-55.8	-126.2
Probability of negative return			>99%
Present Value of additional PSO subsidy (US$ million)			114

[82] Available information indicates that the returns for Pertamina's non-geothermal investments can be significantly higher; as would be the returns that private geothermal developers expect from investing in the sector.

[83] Probability distributions were determined for two key variables (well productivity and plant utilization factor) and modeled using Monte Carlo simulation to arrive at a probabilistic distribution of possible project outcomes. Crystal Ball software was used.

47. ***Financial returns and additional PSO subsidy when using the PPA tariff rates of 7.53 US cents per kWh for Ulubelu and 8.24 US cents per kWh for Lahendong (Tompaso), with IBRD and CTF Financing.*** Table A7.9 shows the financial returns when the SAGS and the power plants are financed through a blended IBRD and CTF loan package while the drilling costs are still funded through PGE's own resources, as envisaged under the proposed project. With a blended IBRD and CTF loan package to buy down the financing costs, the FNPVs of the investment in Ulubelu and Lahendong (Tompaso) increase to US$47 million and US$4 million respectively. The FNPV of the combined Project increases to US$51 million (see Table A7.9), and the probability of a negative return is reduced from almost 100 percent to a more manageable 20 percent. The proposed financing arrangement thus substantially improves the financial viability of the project by increasing its likelihood of earning a positive return commensurate with the cost and associated risks.

Table A7.9 - FIRRs and FNPVs for Ulubelu & Lahendong at the PPA tariff rates with IBRD and CTF financing

Financial metrics	Ulubelu	Lahendong (Tompaso)	Combined Project
Nominal FIRR	17.4%	14.6%	16.5%
NPV (US$ million)	46.8	4.0	51.4
Probability of negative return			20%
Present Value of additional PSO subsidy (US$ million)			114

48. ***CTF concessional financing, by lowering the cost of capital, helps improve the project return, and reduce its associated subsidy burden and price premium.*** While it would still be possible for the project to generate a positive FNPV with a lower loan contribution from the CTF, it is important to factor the project risk into the investment decision. For example, the proposed project could break even with only 44 percent of CTF concessional financing with the remaining 56 percent being replaced by PGE equity. However, the probability of a negative return in this case would be as high as 62 percent, making the project financially unattractive. Moreover, the magnitude of downside risk is of additional concern in this scenario, as there is about a 20 percent probability that the proposed project will suffer a loss of more than US$50 million. With full CTF concessional financing, the probability of such a loss is reduced to about 2 percent only.

49. ***Financial returns and PSO subsidy when using the financial cost of coal-based power of 6.4 US cents/kWh, as PLN's alternative; with IBRD and CTF Financing.*** Table A7.10 shows the financial returns when the tariff is set at 6.4 US cents per kWh, the cost of PLN's coal-based generation. With the blended debt financing, the FNPV for the investment in the Ulubelu field is US$7.8 million, while the FNPV of the Lahendong (Tompaso) project is negative at –US$20.1 million. Combining the results of the two fields, the FNPV for the Project is negative at –US$11.4 million. The high levels of uncertainty and risk associated with geothermal development will make it further unattractive as the probability of a negative return in this scenario is about 82 percent. So while the project in this scenario will not require any additional PSO subsidy obligation beyond what may be paid in the case of coal-based generation, the financial returns and the riskiness of the project do not make this scenario a credible option.

Table A7.10 - FIRRs and FNPVs for Ulubelu & Lahendong at a tariff per kWh of 6.4 cents, and all IBRD and CTF financing

Financial metrics	Ulubelu	Lahendong (Tompaso)	Combined
Nominal FIRR	14.6%	10.8%	13.4%
NPV (US$ million)	7.8	-20.1	-11.4
Probability of negative return			82%
Present value of additional PSO subsidy (US$ million)			0

50. Looking to enhance the project's financial viability by raising the tariff rates would have significant implications for affordability and/or public service obligation subsidies. If a maximum allowable tariff of 9.7 US cents/kWh is used, compared to the alternate tariff that PLN could pay for its coal-based generation (6.4 US cents/kWh), the Present Value of the subsidy required in such a case is estimated to be as high as US$282 million, adding significant burden to the government budget.[84] Table A7.11 shows the implicit incremental subsidy required at each tariff level as compared to PLN's cost of coal-based electricity.

Table A7.11 – Implicit Subsidy Required at Different Tariff Rates

Tariff Rates (US cents/kWh)	**Present Value of Additional PSO Subsidy** (million USD)
6.4	0.0
7.0	51.4
7.4	85.6
8.0	137.0
8.4	171.2
9.0	222.6
9.7	282.5

51. ***Impact of carbon financing***: Carbon revenues would further enhance the financial viability of the project. Assuming a conservative value of US$20 per MT of net emission reductions, a 10-year crediting period, and using a nominal discount rate of 14 percent, the present values of the carbon revenues based on the current CDM methodology for Ulubelu and Lahendong (Tompaso) are US$46.6 million and US$2.1 million respectively. As previously indicated, the carbon revenues are not included in the estimation of the financial returns, but PGE intends to register the proposed projects with the CDM Executive Board for securing carbon offset financing.

IV. Economic Analysis of the Project

A. Methodological Approach and Key Assumptions

52. In the economic analysis, the net (economic) resource flow statement is constructed and resource flows are estimated using the economic opportunity cost of capital. Economic distortions, such as taxes and subsidies are excluded because they are transfers within the economy. Financing flows are also excluded as they do not represent real resource flows. A foreign exchange premium is added to tradable goods and tradable good components.

[84] Ministerial Decree No. 32 of 2009 by the Ministry of Energy and Mineral Resources sets the maximum allowable tariff for geothermal-based power at 9.7 cents per kWh.

53. Local externalities, such as environmental benefits and costs, are included in the economic resource flow statement. Global externalities from which Indonesians stand to gain have also been estimated. Technically, global externalities should not be included in their entirety in the economic analysis unless Indonesia is being compensated for its actions through, for example, carbon credit payments that reflect these costs. While these benefits are included in the analysis to provide a sense of their magnitude and their potential importance for influencing the decision to develop Indonesia's geothermal prospects and contribute towards the GoI's voluntary emission reduction targets, it should be recognized that only a proportion of these benefits accrue to Indonesians.

54. Section A provided a discussion of the shortages, and required capacity, for electricity in Indonesia both nationally and in the project regions. Indonesia has predominantly relied on coal-based power for meeting its base-load requirements, as exemplified by the first *Fast-Track Program*. Consequently, the benefits of the geothermal project are measured by the avoided economic resource costs that would have been incurred in the event of a comparable coal-fired power plant. The economic resource costs include external costs associated with coal production. This approach is equivalent to the selection of the lower-economic-cost option of the two technologies for power generation: coal and geothermal.

55. A comparison of the costs for the two technologies was carried out. In the case of geothermal-based generation, the economic cost consisted of the direct resources used in power production, while in the case of coal-based generation, the economic cost consisted of (i) the direct costs of production and (ii) the local and global environmental costs. In the case of geothermal-based generation, the environmental costs are considerably less than coal-based generation.

Key Parameters for Coal

56. ***Cost of coal-based generation***. Capital cost per kW varies substantially with the unit size of the steam turbine; medium-sized coal plants cost about US$1,400/kW[85] excluding the cost of installing flue gas desulfurization (FGD) equipment. [86] The capital costs in this case were further adjusted for the purposes of the analysis to account for the fact that an equal capacity geothermal plant would produce significantly more electricity (with an estimated capacity factor of 92 percent) than a similar coal-fired power (with an operating capacity of 75 percent.)

57. ***Capacity factor.*** As a base load generation option, coal-fired power plants that are properly operated and well maintained have a capacity factor of around 75%. This is in line with results published in the Electric Power Annual Reports by the US Energy Information Agency, which shows that all coal-fired power plants in the United States have achieved an average capacity factor of 72.2% and 73.6% for 2008 and 2007, respectively.

58. ***Thermal efficiency.*** The commonly used assumption for the average net thermal efficiency of boilers in medium-sized coal-fired power plants with subcritical steam is approximately 33 percent.

59. ***Fuel cost.*** The cost of fuel is a key operational factor, particularly for coal-fired power plants. PLN, the operator of the majority of coal-fired power plants in Indonesia, has access to a relatively low calorie coal sourced from Sumatra and Kalimantan intended primarily for domestic use. PLN's coal-fired generation facilities presently employ coal with an average heat content of 4,200 kcal/kg, which will also be used in all new coal-fired generation facilities under

[85] Based on the Feasibility Study, AECOM.
[86] The coal plants under GoI's first 10,000 MW *Fast-Track Program* are not equipped with FGD.

the first *Fast-Track Program*. PLN indicates in its 2010-2014 Business Plan that the estimated cost of 4,200 kcal/kg grade coal is US$35/ton excluding transportation costs. For coal-fired power plants outside Sumatra/Kalimantan, PLN accounts for a freight charge of US$5/ton in Sumatra, and US$15/ton elsewhere, translating to a total cost of US$40/ton in Sumatra and US$50/ton elsewhere for 4,200 kcal/kg grade coal.

60. ***Coal quality.*** The quality of coal is the primary determinant of the externality costs of coal-fired generation. The 4,200 kcal/kg grade coal used in PLN's coal-fired generation is estimated to contain 0.40 percent of sulfur, 6.0 percent ash, and 40 percent carbon.[87]

61. ***Operations and Maintenance (O&M) cost.*** The O&M costs for coal-fired power generation facilities are based on international and domestic operational experience. The O&M costs are estimated at US$45/kW, including both fixed and variable components.

National Parameters

62. Two national parameters critical for the estimation of the economic analysis of the Project are the economic cost of capital and the economic cost of foreign exchange.

63. ***Economic opportunity cost of capital (EOCK).*** The economic opportunity cost of capital is used to discount the economic resource flow statement. It is estimated as a weighted average of the cost of supply of funds (the rate of time preference) and the return from investment (marginal productivity of capital), where the weights are the relative responsiveness of supply and demand to changes in the cost of capital (interest rate).[88] From 1999 to 2008, the average rate of time preference (as proxied by the real interest rate) in Indonesia was 4.20 percent.[89] The marginal return of investment is assumed to range between 12 and 14 percent. Assuming that the weight for the supply of funds is 1/3 while that for the demand for funds is 2/3, the EOCK is estimated at 10 percent.

64. ***Economic opportunity cost of foreign exchange.*** The economic opportunity cost of foreign exchange is used in the economic analysis instead of the financial cost to reflect the true resource cost of a unit of foreign exchange. Tax distortions (primarily trade taxes and subsidies) affect the economic opportunity cost of foreign exchange.[90] A foreign exchange premium reflecting the difference between the value of the economic and financial exchange rates is a function of two components: trade distortions and the domestic consumption taxes. Using data from the WDI for 2001 to 2004, the economic opportunity cost of foreign exchange is estimated to be 10.8 percent.[91] All tradable goods and tradable good components of the resource flows are increased by the foreign exchange premium.

Social and Environmental Externalities

65. The correct comparison of the costs of power generated from geothermal and that generated from coal must take into account the external (or social) costs. A coal-fired plant generates both local pollutants (in the form of NOx, SO_2 and TSP) and a global pollutant (CO_2).

[87] Based on the published specifications of 4200 kcal/kg coal in Indonesia. Source: Argus/Coalindo Indonesian Coal Price Index.
[88] See Harberger and Jenkins (1991), Cost-Benefit Analysis of Investment Decisions, Harvard University.
[89] Data is taken from the WDI database of the World Bank.
[90] See Glenday, G. (2010), Economic Opportunity of Foreign Exchange, Lecture notes, Program on Project Appraisal and Risk Management (PARM), Duke Center for International Development (DCID).
[91] The trade distortion premium ρ_1 equals import and export duties divided by the sum of imports and exports. The formula for the domestic consumption tax premium ρ_2 is $(0.3\times T + 0.75)\times V$, where T is the effective tariff rate and Vis the effective VAT. See op cited, Glenday (2010).

By comparison, a geothermal plant generates very little pollution. The costs of the negative externalities were incorporated in the total economic resource cost of the equivalent coal-fired plant.

66. ***Local Externalities.*** Three studies were considered in the estimation of the cost of local negative externalities associated with coal-fired power plants. A recent study for the Suralaya coal-fired power plant[92] estimates a range for the monetary cost of the negative externality for NO_x, SO_2 and TSP between US$0.0020/kWh and US$0.00646/kWh in 2000 US dollars. These values have been updated to 2010 USD in the estimation of the environmental cost. Two other studies from China and Australia were considered. The China study is a joint study by the China State Environmental Protection Agency (SEPA) and the World Bank, and the Australia study is by the Australian Academy of Technological Sciences and Engineering (ATSE). The negative impacts of pollution on local inhabitants was measured by the benefit transfer method by using studies from other countries and adjusting for the GDP per capita. Table A7.12 below shows the results of the three studies. The results of the Suralaya study were in between those of China and Australia. The adjusted estimates based on the China study were considerably low compared to those of Suralaya study while the adjusted estimates of the Australia study were significantly higher. As a result, an average of the low and high estimates for Suralaya, (US$0.00423 per kWh) was used in the analysis. Adjusted to 2010 value, the estimate is US$0.00546 per kWh.

Table A7.12 - Estimates of the cost of local externalities (in 2000 USD/kWh)

Pollutants	Suralaya Study	China Study	Australia Study
TSP	n/a	0.00103	0.00135
SO_2	n/a	0.00018	0.00735
NOx	n/a	0.000	0.005
Total	**0.0020 - 0.00646**	**0.0013**	**0.0139**

67. ***Global Externalities.*** Paragraph 41 and Figure A7.1 show the historical settlement price of carbon since 2005. In both the financial and economic analyses, a conservative value of US$20 per ton of CO_2 was used even though the marginal cost of damage created by a ton of CO_2 has been estimated in various studies over the past few years at considerably higher values reaching over US$100.

Results of the Economic Analysis

68. ***Geothermal.*** The present value of the economic resource cost is estimated at US$449.3 million for the Ulubelu geothermal plant and US$208.6 million for the Lahendong (Tompaso) geothermal plant.

69. ***Coal.*** The present values of the economic cost (excluding the externalities) for coal-fired power plants that would generate the same energy as the planned geothermal plants in Ulubelu and Lahendong (Tompaso) are US$373 million and US$150 million respectively.

70. While the capital costs for a geothermal plant are higher than those for a comparable coal-fired power plant, the operating costs for a geothermal power plant are lower than those for a comparable coal-fired plant and the average annual plant factor for a geothermal plant is typically higher than that for a coal-fired plant as mentioned above. In total, the present value of economic cost of production (excluding externalities) is about one third higher for geothermal than it is for a comparable coal-fired power plant.

[92] Environmental Impact Assessment of Java's Electricity Generation Using SimPacts Model, Liun *et al*.

71. The difference in the Present Value of the cost for the two technologies drops significantly once the external environmental costs associated with coal-based generation are added to the economic production costs. Table A7.13 below shows the economic cost for geothermal-based generation as well as the economic cost for coal-based generation. The present value of the cost of coal-based generation is broken down into (i) production cost, (ii) local external costs and (iii) global external costs. The estimated benefits do not take into account other key benefits of geothermal generation that are not easily quantifiable such as diversification of the sources of supply and energy security.

72. The Present Value of the cost of a geothermal plant in Ulubelu is less than that of an equivalent coal-fired plant once the external costs associated with coal production are taken into account (US$449 million versus US$514 million). The PV of the local external costs associated with Ulubelu is about US$33 million, while the global costs are much higher at US$108 million. For Lahendong (Tompaso) the economic cost of geothermal generation is estimated to be US$5 million higher than an equivalent coal-fired plant once the external costs associated with coal production are taken into account. For the combined project, the economic cost of the geothermal generation is US$60 million lower. The probability that the cost of coal-based generation (including local and global environmental costs) exceeds that of geothermal is about 83 percent showing the robustness of the project's economic return.

Table A7.13 - Cost Comparison of the Ulubelu & Lahendong geothermal plants with comparable coal-fired power plants in US$ million

Present value of the costs (PVC)	Ulubelu	Tompaso	Ulubelu and Tompaso
Present value of the cost for geothermal	449.31	208.62	657.94
Present value of the cost for coal without including externalities	372.72	150.36	523.08
Present value of the cost for coal with local negative externality only	405.71	162.35	568.07
Present value of the cost for coal with both global and local external costs	514.08	203.64	717.72

73. The benefits of the project were based on fairly conservative assumptions with respect to well productivity and the price of coal among other factors and do not include benefits that are complex to quantify such as diversification of the power generation mix and the enhanced energy security. Nevertheless, it is important to note that US$150 million of the environmental impacts from the avoided GHG emissions are global benefits. Without taking these avoided costs into consideration, the economic cost of the geothermal project would be about US$135 million more than that of a coal plant making the project not economically justified. This is evidence that international concessionary financing is an appropriate mechanism to channel funds towards developing the proposed project since one of its major impacts extends beyond Indonesia and benefits the global environment. [93]

[93] The PV of the CTF loan flows discounted at the economic cost of capital is around US$90 million. This amount reflects the subsidy element of the CTF financing to the economy. The subsidy element of the IBRD loan adds another US$60 million of benefits to the Indonesian economy although this will depend on the extent to which IBRD lending in Indonesia is tied to geothermal development.

74. ***The impact of changes in coal prices on the Project's viability.*** Table A7.14 and A7.15present two different scenarios for coal prices. Table A7.14 shows that even if the price of coal would drop 15 percent, the project would still be economically justified. More importantly, Table A7.15 shows that if the price of coal increased 15 percent, the economic viability of the project is significantly enhanced but this viability remains strongly dependent on the global benefits of carbon reduction, again bringing out the importance of concessional financing to the Project. It is important to note that the costs of geothermal generation and coal-fired generation are positively correlated, therefore the relative cost competitiveness of the two technologies will largely remain.[94]

Table A7.14- Cost Comparison of the Ulubelu & Lahendong geothermal plants with comparable coal-fired power plants, with Coal prices 15% lower than current level (in US$ million)

Present value of the costs (PVC)	Ulubelu	Lahendong (Tompaso)	Ulubelu & Lahendong (Tompaso)
Present value of the cost for geothermal	449.31	208.62	657.94
Present value of the cost for coal without including externalities	351.33	142.58	493.90
Present value of the cost for coal with local negative externality only	384.32	154.57	538.89
Present value of the cost for coal with both global and local external costs	492.69	195.86	688.55

Table A7.15 - Cost Comparison of the Ulubelu & Lahendong geothermal plants with comparable coal-fired power plants, with Coal prices 15% higher than current level (in US$ million)

Present value of the costs (PVC)	Ulubelu	Lahendong (Tompaso)	Ulubelu & Lahendong (Tompaso)
Present value of the cost for geothermal	449.31	208.62	657.94
Present value of the cost for coal without including externalities	394.12	158.14	552.26
Present value of the cost for coal with local negative externality only	427.11	170.13	597.24
Present value of the cost for coal with both global and local external costs	**535.48**	**211.42**	**746.90**

[94] A World Bank analysis that was carried out in 2007 and update in 2010 confirmed that, although coal prices changes significantly during this period, so did the cost of developing geothermal since the demand for many common inputs also rose. As a result, the estimated incremental costs largely remained consistent despite the variations over time in both coal and geothermal costs.

Annex 8: Clean Technology Fund

INDONESIA: Geothermal Clean Energy Investment Project
(Total Project Development in Ulubelu Units 3 & 4 and Lahendong Units 5 & 6)

Table A8.1 – Summary of CTF Impact Indicators

Key Indicators	CTF/IBRD Project	CTF/IBRD leveraged project	PGE's Scale-Up Program	Government Long-Term Program
New geothermal power generation capacity	150 MW	260 MW	1,000 MW	9,500 MW
Additional power generation (kWh per year)	1,209 million	2,095 million	8,059 million	76,562 million
Avoided CO_2 (tCO_2) - tonnes per year - lifetime (30 year cumulative)	1.1 million; 33 million	1.9 million; 57 million	7.3 million; 219 million	69.5 million; 2,085 million
CTF Investment leverage ratio	4.7	8		
CTF Investment cost effectiveness (per tonnes of CO_2 avoided)	US$3.80	US$2.19		
Environmental co-benefits in terms of avoided local pollution (tonnes per year)	NOx - 3,000 SO_2 - 5,400 TSP - 2,500	NOx - 5,200 SO_2 - 9,400 TSP - 4,400	NOx - 20,100 SO_2 - 36,000 TSP - 17,000	NOx - 191,400 SO_2 - 342,200 TSP - 161,500
Public health benefits from avoided local pollution over project life-cycle (in 2010 US$)	US$45 million	US$78 million	US$300 million	US$ 2,850 million
Number of potential new residential connections	Up to 955,000			
Improved energy security	Increased RE Share (incl. hydro): *Sothern Sumatra* from 38% to 42% *Northern Sulawesi* from 61% to 70%			
Other non-quantifiable benefits	- Development of local industry - Increased employment - Cost reduction			

I. Introduction

1. Indonesia's Greenhouse Gas (GHG) emissions are globally significant, with a substantial majority of it due to impacts from Land Use Change and Forestry. The energy sector, electricity generation in particular, is the next largest source of GHG emissions, and one of the fastest growing. Indonesia's *Second National Communication under the UNFCCC* (November, 2009) reports that energy is the largest non land-use source of emissions which increased from about 330 million tonnes of CO_2 in 2000 to nearly 400 million tonnes CO_2 in 2005. The Government of Indonesia (GoI)'s *Technology Needs Assessment for Climate Change* (TNA, 2009) predicts that under a business-as-usual (BAU) scenario, where new power generation capacity is mainly coal based and where there are negligible initiatives for conservation or improving energy efficiency, emissions will nearly triple by 2025. Projections by the International Energy Agency

(IEA), among others, indicate that, if current trends were to continue, energy-related emissions in Indonesia will be the largest source of GHG by 2030.

2. The GoI has demonstrated a strong commitment to redirect the BAU emissions trajectory of the country. President Yudhoyono pledged at the 2009 G20 Summit to unilaterally reduce Indonesia's emissions by 26 percent and further decrease it by an additional 15 percent ***with international assistance***. This pledge demonstrates Indonesia's voluntary commitment to addressing climate change. A number of policy documents have been prepared by GoI to further define its low carbon growth strategy including the *National Action Plan* (NAP, 2007). It proposes a range of mitigation measures in the energy sector that primarily focus on improving efficiency and greater utilization of renewable resources. The GoI has also made it clear that efforts to mitigate climate change must be consistent with its development goals, that these efforts cannot be at the expense of the poor; and that any bi-lateral or multilateral climate change assistance should be in addition to development commitments made previously because the country cannot afford the incremental costs induced by renewable energy development without burdening electricity consumers.

3. Indonesia has an abundance of renewable energy potential where a large portion remains untapped. Instead, up to now, most energy sector needs have been met through the utilization of fossil fuels. This is particularly the case with regards to power generation, where supply shortages have prompted the GoI to implement the first *Fast-Track Program* aimed at developing 10,000 MW of coal-based capacity to meet base-load needs. These power plants, located throughout the country, utilize Indonesia's abundant and relatively cheaper coal resources, but will exacerbate local and global environmental impacts. Therefore, in order to meet the needs of the power sector in an environmentally friendly manner, the GoI has proposed a second *Fast-Track Program,* which is predominantly based on renewable resources, geothermal in particular.

4. Geothermal is an ideal renewable resource to develop in Indonesia. With an estimated potential of 27,000 MW, Indonesia has the world's largest concentration of geothermal resources. It is a base-load generation technology that is not subject to the intermittency and fluctuations of many other renewable energy options. Furthermore, as an indigenous resource, geothermal power capacity will also enhance Indonesia's energy security. Due to its non-tradable nature, geothermal will serve as a hedge against the volatility of international prices of fossil fuels by diversifying the country's energy mix. It is estimated that about 8,000 – 10,000 MW of geothermal capacity in Indonesia are already economically justified when local and global environmental benefits are considered, although only 1,189 MW have been developed up to now. However, the targets established in the second *Fast-Track Program* ambitiously calls for the rapid development of 4,000 MW additional capacity by 2014 contributing towards the longer term goal of 9,500 MW of geothermal capacity by 2025.

5. The ambitious targets and the rapid scale-up of geothermal development will require significant assistance. A key constraint is that the financial cost of producing electricity from geothermal under current market conditions requires either electricity price increases that would adversely affect power consumers, especially the poor and the vulnerable, or subsidies beyond the governments' budgetary capacity. The high costs stem mainly from the risks associated with the development of the resource, especially when new (green) geothermal fields are being explored. The GoI is facing a considerable challenge to mobilize the estimated US$10 - 12 billion in financing that is needed to achieve the 4,000 MW second *Fast-Track Program* target. Limited domestic capacity in various aspects of geothermal development also remains an issue. These barriers are also further exacerbated by investor concerns about the overall investment

climate in Indonesia including in the power sector in general, due to their inability to secure returns on investments commensurate with the risks they face.

6. In order to overcome these challenges and realize its geothermal target without jeopardizing its development objectives, Indonesia sought assistance from international financial institutions (IFIs) as well as bilateral partners in the form of financial support and technical assistance. A number of institutions, including the World Bank, JICA, AfD, USAid, and the Australian Treasury, are supporting the GoI to reform its geothermal sector policies so that the investment climate can be enhanced. Many of them, including the World Bank, ADB, JICA, AfD and KfW, are also exploring ways to contribute to the momentous financing needs of the sector. The GoI also directed most of the concessional funding from the Clean Technology Fund (CTF) to leverage co-financing from the World Bank Group and ADB along with their own-funds to the geothermal development program given its important contribution to achieving the country's climate change agenda.

II. Indonesia's Investment Plan for CTF

7. The GoI's Investment Plan (IP) that was submitted to the CTF Trust Fund Committee primarily focused on improving energy efficiency and expanding the utilization of renewable energy.[95] The aim was to finance transformational investments that would contribute towards achieving the following GoI goals: (i) providing 17 percent of total energy use from renewable sources by 2025;[96] (ii) delivering a majority of the new generation capacity in the second *Fast-Track Program* from renewable sources including geothermal power; (iii) improving energy efficiency to help achieve demand side emissions reductions; and (iv) achieving modal and technology shifts in transport. On March 15, 2010, the CTF Trust Fund Committee reviewed the Indonesia IP and approved an allocation of US$400 million to co-finance World Bank Group and ADB loans in support of select climate change initiatives in Indonesia's energy sector.

8. The Indonesia IP earmarks three quarters of its allocation, or US$300 million, towards supporting key investments in GoI's geothermal development program. The CTF funds are expected to directly leverage other financing sources, including multilateral loans,[97] and support a progressive series of the geothermal investments that is expected to ultimately lead to the development of 800 MW generation capacity. These developments will give a significant boost to achieving the 4,000 MW of geothermal capacity that is currently targeted in the second *Fast-Track Program;* and to eventually reaching the long-term goal of 9,500 MW[98] by 2025. The proposed geothermal investments will be developed in a phased manner based on the readiness of each field for development. Unlike conventional power generators, who acquire their fuels from well functioning markets, geothermal developers have to undertake considerable advanced preparation work including initial exploratory drilling to confirm the resource potential in fields before the requisite feasibility studies can be carried out ahead of full scale development. Based on the results of these studies and other safeguard assessments, a field development concept can be designed and an implementation timeline can be ascertained. As a result, the time necessary for preparing and developing geothermal fields is riskier and can take considerably longer than

[95] The CTF IP also highlighted low carbon transport but no specific investments were identified at the time.
[96] In line with the targets established through Presidential Decree 5/2006.
[97] In addition to the proposed project to be financed by the World Bank, the IP also includes investments to be subsequently financed by ADB and IFC.
[98] This target is consistent with the results of an analyses carried out by the World Bank, which confirms that approximately 10,000 MW of geothermal potential in Indonesia are economically viable when local and global environmental benefits are considered.

the construction of conventional power plants. Therefore, the CTF supported program will be sequenced according to the readiness of each project for full-scale development.

9. The World Bank is assisting PT. Pertamina Geothermal Energy (PGE), the leading public sector geothermal developer, to prepare and implement its geothermal development program, which makes up the majority of the publicly held geothermal fields (around 1,000 MW or over eighty percent of the geothermal allocation amongst existing public developers in the second *Fast-Track Program*). The specific projects proposed for World Bank financing were selected because of advanced preparation work undertaken by PGE complemented by studies and dedicated assistance by a grant that the World Bank facilitated from the Government of The Netherlands. These sites are now ready for full scale development. The ADB is in discussions to support additional public sector geothermal investments including those being developed by the recently established PLN-Geothermal (PLN-G). Currently, the ADB expects the loan to be signed towards the end of 2011. In the IP, the GoI also indicated its intent to attract private investments into the geothermal sector. However, it also recognized that there is a need for further improvements in the current policy and regulatory framework for the sector in order to attract investors; and also address their concerns regarding the investment climate in Indonesia in general. This is a process that needs time. The recent downturn in private financing in emerging markets, particularly in the energy sector, further exacerbates the situation. As a result, although a majority of the new greenfield geothermal prospects are earmarked for private development under the second *Fast Track Program*, none of the fields that were tendered to date has achieved financial closure. Additional reforms are needed and considerable time for preparation before these fields can be successfully developed. A more effective prospect for mobilizing private financing is to support the existing private developers to scale-up by expanding the resources in the fields they already control (estimated at nearly 1,000 MW) where there is greater confirmation of the resources and better understanding of field characteristics. The International Finance Corporation (IFC) is in discussions with an existing private developer to agree on a financing arrangement for expanding one of its fields. However, in order to maintain longer term prospects and to help achieve the full development target, both the World Bank and IFC are also supporting in parallel the GoI and respective local governments to prepare "bankable" geothermal tenders for private participation on a demonstration basis. The World Bank is helping the Ministry of Energy and Mineral Resources (MEMR) develop a transparent tender process that could then be utilized to transact geothermal projects. IFC is assisting a local government to carry out a couple of such tenders. However, it is likely to take several years before projects can be adequately prepared, transparently tendered, and awarded so that development can start and be scaled-up.

10. The World Bank is assisting PGE in the development of three geothermal fields: Ulubelu, Lahendong (Tompaso) and Lumut Balai. The World Bank facilitated a grant to PGE from the Government of The Netherlands (GoTN) to undertake for the three fields the requisite feasibility studies, engineering designs, environmental and social impact assessments, and other necessary preparation activities. PGE has funded the necessary exploration drilling and confirmed the availability of resources in each field.[99] Based on the feasibility study assessments, it is determined that the Ulubelu and Lahendong (Tompaso) fields are now ready for immediate, full-scale development (i.e. production drilling to develop steamfield, construction steam gathering system and power plant). Therefore, the World Bank is preparing a loan to finance the development of a total of 150 MW of power generation capacity in these two fields - 110 MW in

[99] These findings are further detailed in Annex 2 – Project Description; and the feasibility and other studies that were carried out are in the project files.

Ulubelu and 40 MW in Lahendong (Tompaso). The total estimated financing that is required based on the latest feasibility studies is US$574.7 million. This amount is significantly more than the generic costs based on preliminary scoping that were used in the IP; it reflects the nature of preparing resource-based investments such as geothermal and hydro, where there can be substantial variation in cost estimates as project preparation activities progress. The current cost estimates are more accurate as they are based on the results of exploration drilling and detailed feasibility work; and are comparable with other recent developments that are similar.[100] Nevertheless uncertainty remains with respect to resource levels and well productivity levels – a common aspect of geothermal development. Therefore, the GoI directed the full CTF allocation to be blended with the IBRD loan to improve the financial prospects of the project and keep the required fiscal subsidies at an affordable level.

11. The proposed financing plan for the investments include a contribution from PGE's own funds of US$274.7 million, with the World Bank providing blended concessional financing of US$300 million (US$175 million through IBRD loan and US$125 million in CTF loan[101]). The financial analysis that was carried out for the proposed project shows that if PGE did not have access to the proposed concessional financing package and instead had to rely on using its own funds, the project is unviable. The FNPV of the proposed project given the agreed PPA tariff rates for each field would be –US$126 million, with a financial internal rate of return (FIRR) of 10.4 percent that is well below even the lower hurdle rate of 14 percent PGE has agreed to accept for geothermal investments given its public benefit. When additional risks inherent with investing in geothermal, such as plant capacity factors and resources availability, are considered, the probability of a negative return for the project when financed with PGE's own resources is close to 100 percent. With the proposed financing arrangements of a blended CTF and IBRD loan package to buy down the financing costs, the FNPVs of the proposed investment improves to US$51 million, and the probability of a negative return is reduced to a more manageable 20 percent. If the CTF funding were reduced to a break-even level replaced with PGE equity, then the probability of a negative return would increase substantially to 62 percent, making the project financially unattractive. The CTF/IBRD financing is also important to limit the incremental fiscal subsidies that will be required of GoI (or reduce the burden on consumers if the additional costs of developing geothermal are passed through in retail electricity tariffs). Since PLN can generate alternative coal-based electricity at a cost of 6.4 US cents/kWh[102] to cover its base-load needs, any power purchase tariff paid to PGE above this rate would entail an incremental cost. Based on the agreed tariff levels for the proposed project, the estimated incremental cost subsidy that is required as a result of the project is US$114 million.[103] If more costly financing (compared with CTF/IBRD) necessitated a higher power purchase tariff, then the subsidy burden on GoI would increase further.

12. The financial analysis for the project shows that the proposed IBRD/CTF loan package is essential for PGE to successfully finance the development of the two fields while securing a

[100] The cost estimates are consistent with the development of 280 MW of geothermal power in Kenya financed by the World Bank through the Kenya Electricity Expansion Project (KEEP), which was approved by the Executive Board in May, 2010; and the cost estimates have also been further validated by independent industry experts including the external Peer Reviewer for the proposed project.

[101] The CTF Trust Fund Committee, on December 22, 2010, approved the US$125 million CTF concessional funding allocation to the proposed project, subject to final loan approval by the World Bank's Executive Directors.

[102] PLN Statistics, 2010.

[103] The present value of the public service obligation subsidy is estimated as the difference between the present value of the project revenues estimated at the PPA tariff rates and the present value of the revenues estimated at the levelized cost of coal based generation of 6.4 US cents/kWh.

return commensurate with the risks they face, and keep government subsidies to the power off-taker (PLN) at an affordable level. Further details regarding the financial analysis that was carried out to evaluate the project are available in Annex 7.

Table A8.2 – Financial Rates of Return and Net Present Values of Project

	Financial metrics	Ulubelu	Lahendong (Tompaso)	Combined Project
Project Scenario - with IBRD and CTF financing *(@ PPA tariff rates 7.53/kWh for Ulubelu and 8.25/kWh for Lahendong (Tompaso))*	Nominal FIRR	17.4%	14.6%	16.5%
	NPV (US$ million)	46.8	4.0	51.4
	Probability of negative return			20%
	Present value of additional PSO subsidy (US$ million)			114

13. In addition to the two proposed fields, the CTF/World Bank engagement will also continue to assist with the preparation of the Lumut Balai field by providing technical assistance for undertaking the feasibility, safeguards and other necessary studies to meet good industry practice. Once the preparation work supported by the World Bank is completed, the Japanese International Cooperation Agency (JICA) has agreed to finance the additional development of the Lumut Balai field at terms similar to that of the CTF loan. As a result, the World Bank's technical assistance to PGE for preparation of the Lumut Balai geothermal field along with the JICA loan to finance its implementation will contribute to the development of an additional 110 MW of power generation capacity. The World Bank's engagement with PGE will therefore lead to the development of a total 260 MW of geothermal capacity. Furthermore, the technical assistance provided by the World Bank will help further strengthen PGE's capacity to meet industry and international standards, improving the company's prospects for progressively developing the more than 1,000 MW of potential that are a part of its expansion plan under the *Second Fast Track Program.*

III. Assessment of Proposed Project with CTF Investment Criteria

A. Potential for GHG Emissions Savings

14. **Emissions Reduction Potential of Investment:** The avoided emissions from geothermal development are due to the direct displacement of a comparable capacity of coal-based power since they are both base-load substitutes. The first *Fast Track Program* in Indonesia confirms that additional coal-fired power stations will be developed to substitute for the base-load power generation needs if the geothermal targets were to fall short. Therefore, to achieve the GoI agenda to mitigate the negative impacts of climate change, it is imperative that there is timely and continued development of the sector in line with the GoI's targets.

15. The proposed project, by immediately developing a total of 150 MW of capacity in the Ulubelu and Lahendong (Tompaso) geothermal fields will avoid estimated annual emissions of about 1.1 million tonnes of CO_2 annually. Over the 30 year lifetime of the project, the cumulative emissions reduction is an estimated 33 million tonnes of CO_2. If the additional project at Lumut Balai that is still under preparation with technical assistance from the World Bank and will be financed by JICA is included, then the resulting total capacity of 260 MW will avoid 1.9 million tonnes of CO_2 annually and about 57 million tonnes of CO_2 on a lifetime basis. The transformational impact when PGE fully develops its 1,000 MW investment target and the GoI longer term goal of scaling up towards 9,500 MW, on avoided emissions is estimated in Table A8.3.

Table A8.3 – Avoided CO_2 Emissions through the Transformation of the Geothermal Sector

New Geothermal Capacity	Avoided tCO_2 per year	Avoided tCO_2 on life-cycle basis
150 MW	1,109,296	33,278,880
260 MW	1,922,780	57,683,400
1000 MW	7,395,308	221,859,240
4000 MW	29,581,233	887,436,990
9500 MW	70,255,428	2,107,662,840

16. **Technology Development Status:** Geothermal technology is well proven and commercially available. The proposed flash steam technology is applied in a number of countries throughout the world including in Indonesia. Although the total global geothermal capacity is only 10 GW and is dwarfed in terms of scale by other conventional forms of power generation, there are a number of internationally reputable firms that specialize in the technology. Indonesia itself has successfully developed a tenth of this global capacity. Furthermore, the multi-directional drilling technology that is employed for developing the upstream geothermal steam fields is similar to that applied in the much larger and mature oil and gas sectors; and the risks in well development is related more to the nature of developing geothermal resources (resource risks) rather than to the drilling technology.

B. Cost Effectiveness

17. CTF investment per ton of CO_2-equiavalent reduced: The avoided emissions that will directly result when 150 MW of geothermal capacity is fully commissioned is about 1.1 million tonnes of CO_2 annually which translates to 33 million tonnes of CO_2 on a 30 year lifetime basis. On this basis, the CTF intervention of US$125 million will result in a cost effectiveness of US$3.80 per tonne of CO_2 avoided. If a total of 260 MW including the Lumut Balai field is considered, then the cumulative avoided emissions is 57 million tonnes of CO_2, which would result in a cost effectiveness of US$2.19 per avoided tonnes of CO_2 for a CTF intervention of US$125 million.

18. ***Expected cost reduction of technologies.*** Financially, geothermal power costs more than coal-fired power (i.e. when environmental externalities are not internalized in electricity prices).[104] As a result, there are structural incremental costs and associated risks to developing geothermal when compared with fossil fuel alternatives such as coal. In addition to the structural incremental costs, there are also costs associated with low efficiency due to public sector culture and sub-standard project development practices, as PGE's capacity is stretched by the program under development. Assistance provided to help develop the initial phase of the greenfields in the proposed project will enhance the understanding of field characteristics and reduce the risks for future expansion of these fields. The experience gained through the proposed developments will also lead to greater knowledge and access to international best practices (i.e. field characteristics, drilling techniques) that will improve PGE's performance in future operations. Finally, the revival of international geothermal programs and Indonesia's announced target will contribute greatly to extending the market scope, increasing equipment manufacturing, and contribute to cost reduction.

[104] This is confirmed through an analysis that was carried out for the geothermal sector in Indonesia, as illustrated in the World Bank Project Appraisal Document for the *Geothermal Power Generation Development Project*, in 2008.

C. Demonstration Potential at Scale

19. ***Scope of avoided GHG emissions through replication:*** Indonesia has the world's largest geothermal potential, with estimated prospects of about 27 GW. Through the second *Fast Track Program*, the GoI is looking to develop a globally unprecedented 4,000 MW in the medium term. The proposed project will directly contribute towards this target and jump-start its development. This scale-up would result in avoided emissions through the displacement of coal estimated at a cumulative 887 million tonnes of CO_2 over thirty years. Analysis suggests that about 10,000 MW of geothermal capacity in Indonesia can be economically justified at present when local and global environmental benefits are considered. This is consistent with the longer term target of GoI to develop 9,500 MW by 2025. If Indonesia were to achieve its longer term objectives, then the annual emission reductions are estimated at over 70 million tonnes of CO_2 with a cumulative impact of about 2.1 billion tonnes of CO_2 over a thirty year period.

20. ***Transformation potential:*** The proposed project will have important direct and indirect transformation potential because it is assisting PGE in achieving its goal to become a world class geothermal developer. The direct potential stems from the optimal development of all PGE's concession fields leading to the addition of at least 1000 MW of geothermal capacity, which will double the current geothermal capacity in the country and represents about 10 percent of the total global installed geothermal capacity. The indirect potential is difficult to quantify but it is envisaged in the company's strategic planning to compete for tendered green fields in association with strategic private partner and/or listing on stock markets and/or securitization of assets to raise investment funds. A credible PGE will be attractive to private developers to share the risks associated with geothermal. If successful such an approach could lead to a market penetration well beyond PGE's existing concessions.

21. Tapping this important potential is contingent upon the successful transformation of PGE into a company with a clear and focused vision, incorporating climate change into its long-range plans.[105] In order to do so, PGE will need to have its decision making framework adapted to dealing with the uncertainties related to geothermal development by designing its investments to be robust to handle risks rather than focus on optimal solutions that may quickly succumb to change.[106] This would result in PGE being able to take risks with built in measures to deal with uncertainties as they arise, improve efficiency through best practice procedures throughout the geothermal development chain (especially the downstream power generation aspect, which is relatively new to PGE) and provide credible benchmarks of field development that could contribute to the government efforts to develop a comprehensive pricing and compensation policy attractive to private developers.

22. *Focusing on Core Business*. The spinoff of Pertamina's geothermal department into an autonomous company and the strategic plan prepared by reputable international and local consultants clearly indicate a new paradigm for geothermal development. PGE is quickly becoming a business and profit oriented company accountable for developing the resources under its control in an efficient way. Its stated objective is to become a world class developer with access to the most advanced scientific knowledge, tools, and technologies to contribute efficiently to the development of Indonesia's substantial geothermal resources.

[105] Lempert Robert J. and Myles T. Collins, (2007). "Managing the Risk of Uncertain Threshold Response: Comparison of Robust, Optimum, and Precautionary Approaches" Risk Analysis 27 (4).
[106] Ibid

23. *Pushing the Business Boundary*. PGE, as a fully owned subsidiary of Pertamina, is responsible for its profits and losses and allowed for government subsidies if it is mandated to undertake loss making public interest projects. However, Pertamina decided for these early projects and to jumpstart its geothermal business to seek a reduced return of 14 percent on equity (compared with no less than 20 percent that would be expected by private sector developers) and to take higher resource risks in Ulubelu than private developers would commonly take (60 percent probability of full resource availability compared to no less than 90 percent certainty that is commonly needed to secure commercial financing) because the government guaranteed IBRD loan and the CTF concessional financing would allow PGE to maintain an acceptable financial standing nevertheless. These decisions, although not optimal (i.e. delay development awaiting commercial financing), are robust because PGE could alter course and sustain the investment in the face of potential changes. For example, in the less likely event that total resource capacity in the field is discovered to be available for less than the 30 year life-cycle of the power plant, PGE could change course by (a) developing the power plant at the originally envisaged capacity and operated for a shorter period (i.e. 22 years) if the project would remain financially viable despite the lost revenues; or (b) reducing the installed capacity at Ulubelu and redirect released funds to further expand the development of a field with higher confirmed resource potential (as with the Lahendong (Tompaso[107])). *Testing this approach which allows developing fields that would have been otherwise disregarded would not have been possible without the benefit of CTF funding.*

24. *Improving Efficiency and Industry Practices.* One of the achievements of the proposed project was to bring PGE's development practices to industry technical, environmental and social standards through a preparation grant provided by the Government of The Netherlands. The on-the-job capacity building during project preparation will not only benefit the proposed specific project, but will necessarily contribute to the development of other fields by PGE; to improve its efficiency that will reduce costs and contribute to the sustainability of geothermal development. An example would be the knowledge sharing with international experts on drilling and well testing strategies; information that is sure to be utilized in replicate in future projects. More environmentally sustainable development is another example. The focus on environmental and social standards and consultation of local communities is essential to the acceptance of the technology and building its reputation as a reliable and clean energy source. The H_2S emission modeling carried out for the proposed project triggered a discussion in Indonesia about odor and concentration issues and the use of abatement measures, and will shape development of the specific fields financed by the World Bank as well as other upcoming developments where such issues are prevalent.

25. *Benchmarking as input to policy.* The GoI is developing its geothermal pricing policies on a piecemeal basis and trying to find the right balance between public and private sector interests. One of the concerns in this regard is to rush the decision and devise a policy that would hand windfall profits to developers (public and private) at the expense of electricity consumers. On the other hand, there is also concern that prices would be established below what developers require to secure a return commensurate with their costs and risks, which will deter investments. The preparation of this project up to industry standards with open and competitive bidding procedures will provide cost benchmarks that will enables the formulation of policies on a sound analytical basis. All concerned Indonesian agencies are aware that a transparent and fair

[107] The confirmed resource estimate in Lahendong (Tompaso) is more than 80 MW although the planned development is only 40 MW.

pricing policy needs to be developed so that geothermal development takes off and becomes sustainable and the country can achieve its ambitious targets.

26. *Establishing PGE as a Credible Partner.* PGE has plans to associate with strategic partners or to access equity markets to finance its future development. These plans will materialize only if PGE would be regarded as a sound, efficient company by private developers and with assets built to industry standards that could be securitized and used as a hedge against risks associated with development of new fields.

D. Development Impact

27. The main development objective of the proposed project will be to generate electricity from renewable geothermal resources to meet growing demand – as measured by the 150 MW expansion of power generation capacity. This is particularly significant in Sumatra and Sulawesi where the projects are located, as these areas experience common power shortages and long wait lists to get connections. According to PLN, in Sumatra over sixty percent of the residential applicants for new connections are placed on the waitlist while in Sulawesi nearly eighty percent face a similar plight. With average household consumption ranging between 95 kWh per month and 110 kWh per month, the proposed project will generate sufficient electricity to provide electricity access for up to about 675,000 new residential customers in Sumatra and provide upwards of 280,000 new connections in Sulawesi; leading to improvements in the quality of life of Indonesians residing in the project areas.

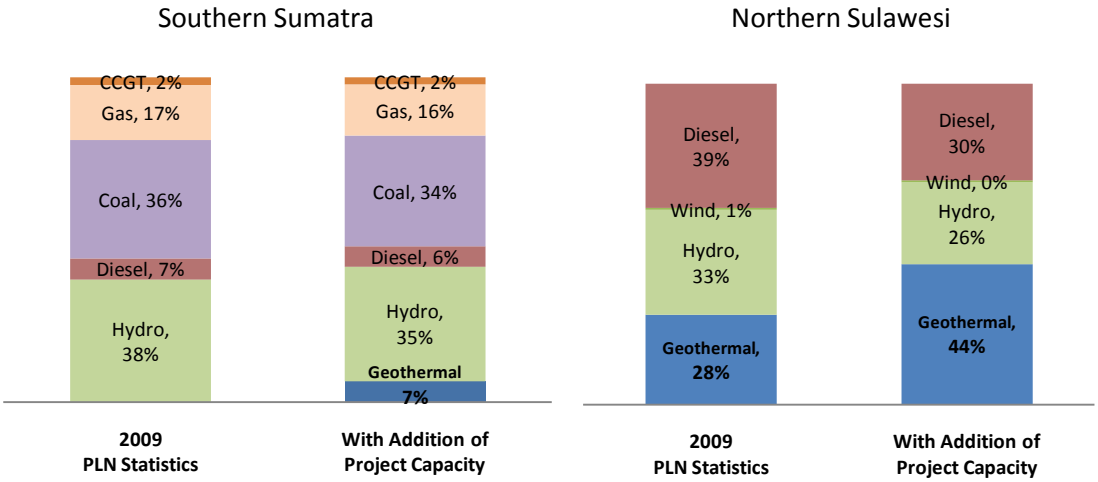
28. In addition to the global climate change impacts of the proposed project, it will also have local development impacts. As a result of the proposed geothermal developments, the project areas would be spared considerable local pollution that would have otherwise occurred. If the geothermal plants were substituted with equivalent coal-based capacity, then there would be considerable emissions of nitrogen oxide (NOx), sulfur dioxide (SO_2), and total suspended particulates (TSP). These pollutants are only known to cause respiratory and other illnesses in surrounding areas. The proposed geothermal project will help avoid up to 5,400 tonnes of SO_2, 3,000 tonnes of NOx, and 2,500 tonnes of TSP annually. Based on the economic analysis carried out for the project and summarized in Annex 7, the costs savings that would result due to the health and other benefits are estimated at US$45 million in present value terms at an economic discount rate of 10 percent on a project life-cycle basis. This estimate assumes that an alternative coal-fired power plant will fully comply with the existing emissions regulations and undertake the required abatement measures. If this were not to be the case in practice, then the local health benefits of the proposed geothermal project would be even higher.

29. Those living in the project area also stand to gain from business and other opportunities that will arise as a result of the proposed project. It is common for PGE to employ local workers for carrying out some of the construction, security and other similar work. Local businesses also stand to secure construction and other contracts including the development of access roads, preparation of well pads etc., which in turn will also employ additional local labor. There are also long-term prospects for local villagers to work in the facilities on an on-going basis. Finally, the community outreach activities of PGE where they provide general services as a member of the community (maintain access roads, scholarships to local school children etc.) will also benefit those in proximity to the project.

30. A key development benefit of power generation from renewable sources such as geothermal is that the resources are indigenous and non-tradable, and therefore, will remain for the exclusive use in Indonesia. In contrast, the most likely alternative, which would be coal-based power, will face competition from international sources and convey its price volatility to

local markets. The proposed project, which is expected to produce nearly 890 million additional kWh per year for the Sumatra electricity grid and generate more than 320 million kWh per year in the North Sulawesi system from indigenous resources, will diversify the power generation mix in the respective regions and enhance energy security. In the Southern Sumatra grid, the addition of 110 MW at Ulubelu would increase the geothermal power capacity to comprise seven percent of the energy mix where there is none in operation at present. This would result in an 18 percent increase in the renewable energy capacity in South Sumatra, which also includes hydro power. In North Sulawesi, the current generation mix already includes 28 percent geothermal, which would increase to 44 percent with the Lahendong (Tompaso) 40 MW development under the proposed project. This implies a 46 percent increase in renewable energy based power generation capacity; and the total renewable energy in the generation mix would increase to a significant 70 percent.

Figure A8.1 – Potential Improvement in Power Generation Mix
(based on PLN available capacity)



E. Environmental Co-Benefits

31. As previously mentioned, one of the key environmental co-benefits of the proposed project is the avoidance of local pollution that would have resulted from equivalent coal-based power plants. The following table estimates the positive local environmental impacts from the proposed project to the outcome when the GoI long-term target is achieved.

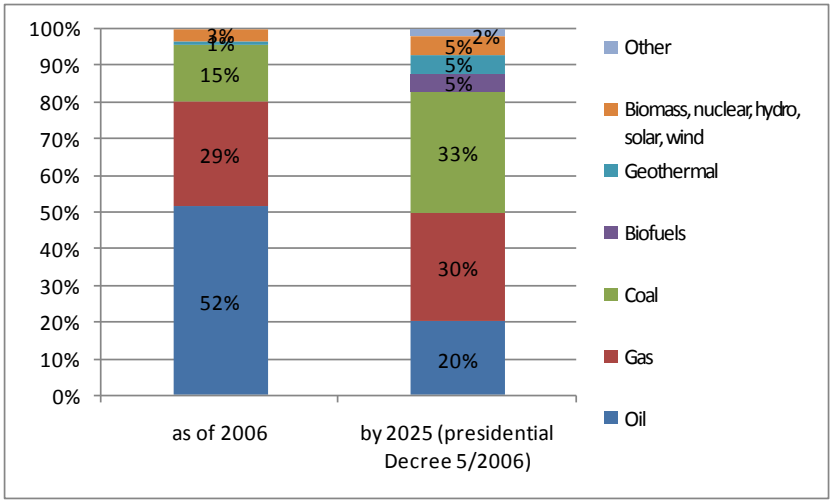
Table A8.4 – Avoided Local Pollution from the Geothermal Development Program

New Geothermal Capacity		Avoided TSP tonnes	Avoided NOx tonnes	Avoided SO_2 tonnes
150 MW	Annual	2,551	3,022	5,404
	Cumulative	76,522	90,666	162,111
260 MW	Annual	4,421	5,238	9,366
	Cumulative	132,638	157,154	280,992
1000 MW	Annual	17,005	20,148	36,025
	Cumulative	510,147	604,440	1,080,739
4000 MW	Annual	68,020	80,592	144,098
	Cumulative	2,040,589	2,417,760	4,322,955
9500 MW	Annual	161,547	191,406	342,234
	Cumulative	4,846,400	5,742,180	10,267,018

F. Implementation Potential

32. ***Public Policies and Institutions:*** Indonesia's broader energy strategy calls for increasing capacity and access to meet the demands of a burgeoning economy, but doing so in a sustainable and balanced manner by diversifying its energy mix. The Presidential Decree No. 5 of 2006 on National Energy Management maps out a path that emphasizes energy security by making a dramatic shift away from the country's substantial reliance on oil that is increasingly imported, into greater utilization of other indigenous resources that are available in greater abundance. One part of this diversification strategy is to increase the utilization of relatively cheap and widely available coal resources in Indonesia, represented by the first *Fast-Track Program* that is already under implementation. However, the GoI recognizes the environmental implications of such an expansion and plans to balance it with an increase in the utilization of its abundant renewable energy options from about 4 percent at present to 17 percent by 2025, as illustrated in Figure A8.2. The substantial geothermal expansion, included as a part of the second *Fast-Track Program* as well as the GoI's longer terms target of developing 9,500 MW of capacity, is an integral part of its overall strategy to diversify its energy mix. However, in order to meet these targets, the GoI has requested international assistance; and especially with efforts related to climate change assistance, they have stipulated that financial assistance should go beyond commitments already made, and that it should help achieve its development objectives without undue burden on the poor.

Figure A8.2 - Targeted Diversification of Indonesia's Energy Mix (Prediential Decree 5/2006)



Source: Ministry of Energy and Mineral Resources; Presidential Decree 5/2006

33. The GoI has recognized the need to improve the policy and regulatory framework if it is to achieve the ambitious scale at which they expect to expand its geothermal capacity. A number of significant reforms have been implemented in this regard over the past several years. In 2003, the GoI issued a Geothermal Law,[108] making it the only renewable energy that is government by its own law. The Law, among other things, shifted regulatory authority of the sector that was previously delegated to the national oil company back to the GoI (Ministry of Energy and Mineral Resources - MEMR); mandated that geothermal fields that are not already allocated under the regulatory decree that was in effect previously (Presidential Decree 45/1991) be transparently and competitively tendered for development; and, to be consistent with the decentralization law, enhanced the role of local governments in developing the geothermal

[108] Law No. 27 of 2003

resources within their respective jurisdictions. The GoI also issued in 2010 a Presidential Decree[109] to promote the development and off-take of the second *Fast-Track Program* that focuses on renewable energy including the proposed 4,000 MW of additional geothermal capacity. One of the key polices that the GoI is attempting to implement is a pricing and compensation mechanism that is essential for addressing the fact that geothermal electricity is more costly on a financial basis than coal-based power when environmental and other benefits are not internalized. A successful policy would enable developers to secure a return on their investments that is commensurate with the cost of geothermal and its associated risks. International experience suggests that such a policy should include provisions for mandate the off-take electricity from geothermal generators, a simple and efficient price setting approach, and a mechanism to compensate either the off-taker or the developer for the associated incremental costs. Presently, Indonesia does not have a comprehensive pricing and compensation mechanism for geothermal, as the attempts to address this barrier has been done through a piecemeal approach by the GoI. Some progress has been made, including recognition by the Government that the environmental benefits of geothermal are not reflected in the financial prices; and that generators should be paid a (premium) price internalizing these benefits. However, the latest pricing decree[110] does not provide a clear directive to pay a premium to compensate developers, and instead establishes a ceiling price of 9.7 USc/kWh. As a result, developers must rely on long, drawn out negotiations to reach agreement on a power purchase price with PLN, which undermine any efforts to scale-up geothermal development. Even developers who are awarded concessions through competitive tenders have to resort to follow-up negotiations with PLN before reaching a price agreement. Paramount to the pricing issue is the lack of a clear compensation mechanism, which is essential to underwrite the policy. Although the PSO subsidy, which is stipulated by law,[111] can be applied as a source for compensation, the funding requirements for the full-scale geothermal expansion will be substantial. Therefore, PLN, which is already under pressure to reduce its operating costs, is reluctant to off-take more expensive electricity without clear direction from the GoI. The World Bank is supporting this effort through the GEF funded *Geothermal Power Generation Development Project.* The GoI has now mobilized international consultants to help them refine the existing policy framework and develop a comprehensive pricing and compensation mechanism that is adequate to the task. These efforts are also supported through the series of *Climate Change Development Policy Loans*, collectively provided by the World Bank, Japanese International Cooperation Agency (JICA), and Agence Française de Développement (AfD). However, it will take some time to develop consensus, design the mechanism, identify the resources, and implement the policy; and for investor confidence to be gradually enhanced. The proposed project will contribute to the development of the pricing policy by providing valuable cost and other benchmarks, which will enable the GoI to design an effective instrument that will more accurately reflect the incremental costs of geothermal.

34. In order to better handle its increased oversight responsibilities for sector development, the GoI, through its various ministries and state-owned enterprises, is also strengthening the institutional structure and capacity in the geothermal sector. The MEMR has now established a dedicated directorate for geothermal given the prominence of the sector in the development agenda under a specialized Director General responsible for renewable energy development. The directorate has led the way in revising the sector *Master Plan*, establishing the geothermal

[109] Presidential Decree No. 4 of 2010
[110] Ministerial Decree No. 32 of 2009
[111] Law No. 19 of 2003 on State-Owned Enterprises

development targets and selecting the projects that were included in the second *Fast-Track Program*. It has also spearheaded the policy reforms including the issuance of regulations to support the Geothermal Law. The Ministries of Planning (Bappenas) and Finance are playing an instrumental role in promoting the development of the geothermal sector, including facilitating financing to support the state-owned enterprises expand the resources under their control.

35. With GoI support, several state-owned enterprises are leading the first phase of the scale-up to meet the initial targets in the second *Fast-Track Program*, since the bulk of the unexploited resources that are already allocated rest with them. Leading among them is, PGE, which is responsible for a majority of the public sector developments. PGE has experience developing and operating geothermal fields as well as some power plants. They currently operate 272 MW of steam production or power generation capacity. However, given the unprecedented scale-up that is being implemented, PGE will need to further strengthen its capacity. In this regard, the World Bank is already providing technical assistance to help prepare the proposed projects to industry as well as international standards. PGE has also undertaken comprehensive human resource assessment, identified key skill gaps, and begun an extensive recruitment drive and training program to strengthen its capacity. In order to complement this initiative, PGE has worked with the World Bank to develop an additional capacity building proposal as a follow-up to the ongoing technical assistance support. It is designed to complement the ongoing initiative by PGE to further enhance its technical, financial, and managerial capabilities. This proposed parallel activity is subject to securing funding from donors who have shown interest. The proposed technical assistance for capacity building is further detailed in Annex 2. These past and proposed capacity upgrades being undertaken by PGE are expected to strengthen the capabilities of the company so that it is well placed to rapidly carry out the scale-up of over 1,000 additional MW of capacity.

36. ***Sustainability of Transformation.*** Many of the policies that have been implemented thus far to enhance investor confidence in the sector will require time to take hold. Furthermore, additional reforms or revision of existing ones are necessary in order to sufficiently address the barriers and attract the necessary investments into the sector, as developers still face critical barriers. They include the inadequacy of the present pricing and compensation policy needed to address incremental costs, risks associated with developing greenfields in particular, and the lack of a credible and transparent process for tendering new geothermal developments. Successfully addressing these barriers is vital if Indonesia is to achieve the unprecedented scale-up that is being attempted. Therefore, the GoI is continuing its reforms to address these unresolved issues, and it is being strongly supported by IFIs and key bilateral donors. The MEMR is leading a continued effort to implement new policies as well as refine existing ones in order to further improve the policy and institutional framework in the sector. The World Bank, through its *Geothermal Power Generation Development Project*, is helping the MEMR Directorate for Geothermal with its key reforms. Furthermore, the World Bank is assisting MEMR with technical assistance so that the geothermal sector can access greater levels of carbon revenues. Through trust funding support from the Public-Private Infrastructure Advisory Facility and Asia Sustainable and Alternative Energy program, the World Bank has also helped improve the understanding of geothermal resource risks in Indonesia. Finally, the World Bank supported the GoI in hosting the *2010 World Geothermal Congress*, a definitive global event that was also intended to promote the sector amongst potential investors. This is being followed up with efforts by the World Bank and IFC in providing advisory services to GoI for carrying out credible geothermal tenders for the development of new fields beyond the immediate scale-up. The first batch of CTF supported investments, which will be implemented in parallel, are also of critical importance to jump start the scale-up program and undertake some breakthrough

investments. It will also help with the development of policy by providing vital cost and other benchmarks. Furthermore, the public institutions whose capacities would be strengthened through the proposed projects will also be more credible and better placed to partner with suitable private developers to undertake future investments.

37. The GoI is also taking measures that will immediately impact investments. This includes having state-owned enterprises lead the first phase of investments that is being supported directly through the CTF funds. This initial scale-up of investments is critical to maintain momentum especially since a significant scale-up of private investments will likely take time until further reforms are in place to sufficiently bolster investor confidence. In addition to channeling international financing, the GoI is also facilitating negotiations at the project level between state-owned geothermal developers such as PGE with the power off-taker, PLN, to expeditiously reach agreement on the power and steam purchase prices. This is critical to sustaining the immediate scale-up until the GoI is able to implement a comprehensive pricing and compensation policy. PGE in turn have also already made a significant financial commitment through its own funds for exploratory drilling to confirm the resources in a number of geothermal fields, including those in the proposed project. As a result, they have been able to effectively utilize the World Bank/GoTN approximately US$2.5 million project preparation grant to complete feasibility studies and other preparation work to be able to begin full-scale implementation. The proposed project is now fully ready to be implemented. In this regard, PGE has committed additional funds to continue with production drilling as a part of project implementation to develop the upstream steamfields with the expectation that the World Bank/CTF loan would be forthcoming to complete remaining steam gathering systems and power plants; They are looking to the World Bank and CTF to compensate them for the substantial risks they have taken by investing their own-funds in the upfront development that carry the bulk of the uncertainty. PGE also would like for the capacity building efforts that were initiated through the project preparation grant to continue through the proposed scaled-up follow-on technical assistance activity that will be implemented in parallel with the World Bank/CTF loan, subject to securing grant funding from donors. This will help complement the significant initiatives that PGE is already taking to further strengthen its capacity to be better able to implement its larger investment program that is vital to the success of the GoI second *Fast Track Program*.

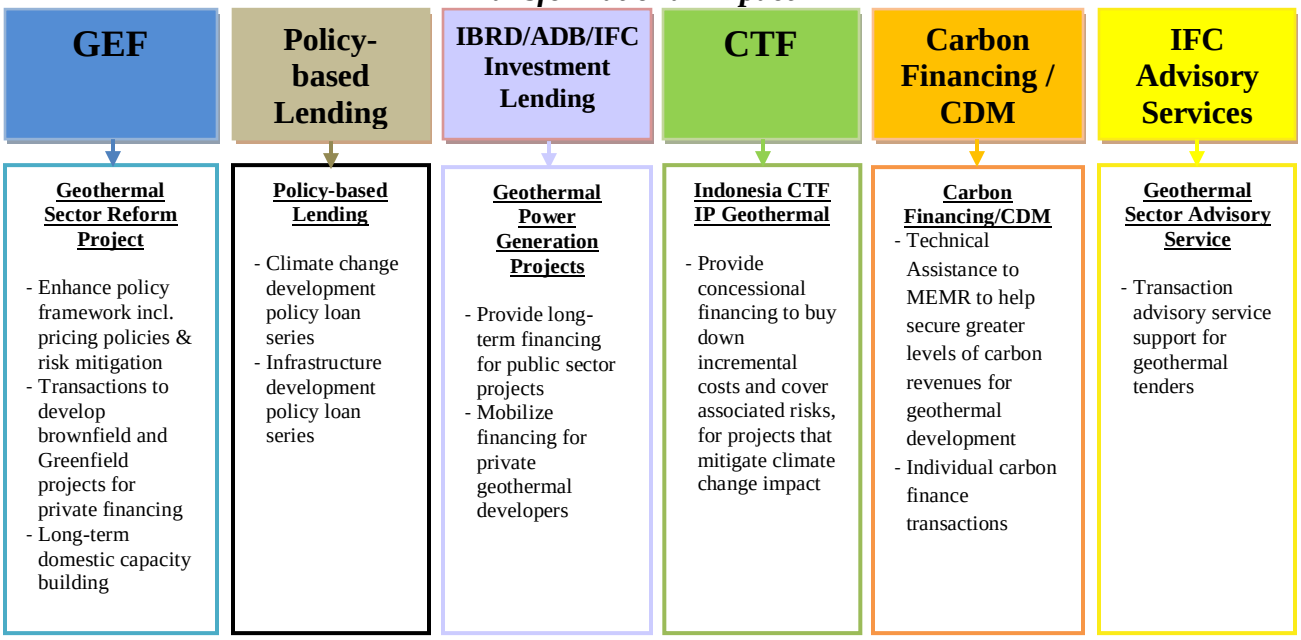
38. There are considerable prospects for sustaining the transformation since the GoI, with the support of the CTF, World Bank and other development partners, are integrating the various financing sources both at the policy as well as project level to develop the geothermal sector. This weaving of financing sources towards reforms is illustrated in Figure A8.3, where CTF along with World Bank and other IFI financing are a critical component. In particular, by supporting the leading public sector geothermal developer in Indonesia, the World Bank and CTF funds will be contributing to the success of PGE. This is synonymous with sustaining the transformation since it will help PGE achieve its full scale-up, which would double the present geothermal capacity in the country and represent a ten percent increase in the geothermal capacity that is presently developed in the entire world.

39. ***IFI and Donor Coordination.*** Given the importance of geothermal in Indonesia's development agenda and its significance to mitigating climate change, a number of IFIs and donors are assisting the GoI implement its geothermal development program.[112] There is already considerable coordination as well as collaboration of these efforts. This is exemplified by the

[112] Indonesia CTF Country Investment Plan, Government of Indonesia, 2010.

GoTN support to PGE in conjunction with the World Bank/CTF loan and the World Bank preparation support for a geothermal field that is expected to be financed by JICA. A policy level example would be the collaboration between JICA, Agence Française de Développement (AfD), and the World Bank in preparing and implementing a series of *Climate Change Development Policy Loans*, where geothermal reforms are a key component. The CTF IP has already played an important role in promoting such coordination during its preparation phase when several stakeholder meetings were held to share information and obtain feedback. Such coordination has continued during the preparation of the proposed project, and the GoI expects these efforts to continue throughout the implementation of the CTF geothermal program.

Figure A8.3 – Utilizing Different World Bank Group Instruments Together to Make a Transformational Impact



40. ***Leverage.*** The CTF co-financing will directly lead to the development of 150 MW of geothermal power capacity that is estimated to cost about US$574.7 million in investments. The US$125 million allocation from the CTF will leverage US$175 million in IBRD funds and US$274.7 million from PGE (for a leverage ratio of 4.6). If the additional project at Lumut Balai is considered, then an additional US$400 million will be leveraged from PGE and JICA (for a leveraged ratio of nearly 8).

G. Additional Cost/Risk Premium

41. The CTF and the IBRD loans are critical to enhancing the financial viability of the project, as detailed in Annex 7. In its absence, PGE will not be able to secure a return commensurate with project costs and the risks they face. In the absence of the CTF funds, the resulting cost increase would place pressure on fiscal subsidies or burden electricity consumers. Furthermore, the CTF funds will also enable PGE to take greater calculated risks and look to achieving breakthroughs, as in the case of the Ulubelu field where boundaries are being pushed in terms of development that go beyond what many private companies would be willing to undertake. In short, this project could not be realized in the absence of both IBRD and CTF loans. The project, however, will have an impact beyond the immediate geothermal fields it is helping develop, since the World Bank engagement is helping strengthen PGE's capacity to meet industry and international standards for developing geothermal, which PGE will continue to

apply in its other investments. This impact is already evident in the knowledge gained and support received by PGE as a result of the support of project preparation grant, which will enhance their ability to achieve its 1,000 MW expansion program. At the same time, if these investments contribute to the GoI's effort to prepare a comprehensive pricing and compensation mechanism, it would begin to attract greater private sector financing towards the geothermal sector as well. As new private developers enter the geothermal market in Indonesia, they will look to experienced domestic developers with local knowledge to partner in their efforts. Given the substantial domestic market position it will have at the time, PGE is likely to be viewed as a credible partner by private developers who are interested in investing in Indonesia's geothermal sector. With the world's largest prospects, the geothermal sector in Indonesia could thrive in time to come driven by a substantial scale-up in both public and private investments. As a result, the prospect of reaching the GoI's long term geothermal development target of 9,500 MW by 2025 will be significantly enhanced.

H. Implementation Readiness

42. The project preparation at Ulubelu and Lahendong (Tompaso) geothermal sites are well advanced, and ready for full scale development. PGE has completed the exploratory drilling and confirmed the resources in each field. With the support of the World Bank facilitated preparation grant of approximately US$2.5 million, PGE has also completed feasibility studies, the environmental and social impact assessments, and other related documentation, for each site. The safeguard documents have been publicly disclosed at the World Bank InfoShop as well as the project affected areas and PGE offices in Jakarta. PGE has also acquired a majority of the land necessary for the project and begun production drilling in each of the fields. Anticipating the completion of the drilling program in 2011, PGE has also begun advanced procurement of the EPC contracts that are expected to be financed by the World Bank and CTF loans, so that the manufacture and construction of the SAGS and the power plant can be timed to begin towards the completion of production drilling. In this regard, PGE has already issued a General Procurement Notice (GPN) for the project on July 20, 2010, and is now in the process of prequalifying potential bidders. The readiness of the project for full-scale implementation has been confirmed by World Bank management as well as independent geothermal experts, including the external technical expert reviewer. Therefore, the expeditious processing of the loan is of utmost importance in order to maintain the commissioning schedule for the geothermal power plants.