OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA’S GEOTHERMAL POWER PROJECTS

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PRESENTED AT
THE ASIA BUSINESS FORUM ON
INDONESIA POWER
JAKARTA, 27-28 AUGUST 2008
PRESENTATION AGENDA

- What is Geothermal
- Typical Geothermal Power Project Development
- Indonesia Geothermal Resources
- 1st Generation of Indonesia Geothermal Power Projects
- Legal Framework (law, regulations and key issues)
- Geothermal Development Blue Print 2004 -2020 and National Energy Policy
  Energy Mix Target 2025
- Geothermal Power Project Opportunities in Indonesia – Upstream
- Geothermal Power Project Opportunities in Indonesia – Downstream
- Geothermal Power Project Upside Potential
WHAT IS GEOTHERMAL
OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
GEOTHERMAL POWER PLANT CARICATURE

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
TYPICAL GEOTHERMAL POWER PLANT

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
GEOTHERMAL POWER PLANT

Dry Steam Power Plant
Steam is piped directly from wells to turbine
Turbine turns generator
Steam is condensed & injected back into reservoir

Flash Steam Power Plant
For Hot water > 360° F
Hot water flashes into steam
Separated steam is piped into turbine to turn generators
Condensed steam and water is re-injected

Binary Cycle Power Plant
For low enthalpy water 220° F
Heat water boils working fluid (low boiling point)
Working fluid is vaporized in heat exchanger & vapor turns turbine to turn generator
Water is re-injected

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
ENHANCING GEOTHERMAL SYSTEM

- **Drill Injection Well**
  A production injection well is drilled in hot rock that has limited permeability and fluid content.

- **Inject Water**
  Water is injected at sufficient pressure to induce fracturing or open existing fractures within the rock mass.
**ENHANCING GEOTHERMAL SYSTEM**

- **Hydro Fracture**
  Pumping of water is continued to extend fractures some distance from injection well bore.

- **Doublet**
  A second production well is drilled with the intent to intersect the stimulated fracture system and circulate water to extract the heat from the rock.

- **Multiple Injection Wells**
  Additional production-injection couplets are drilled to extract heat from large volume of rock to meet power generation requirement.

**OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS**
UNIQUE ASPECTS OF GEOTHERMAL

- Site specific and must be converted to a more user friendly energy (electricity) in the vicinity of where it is found.
- Exploration and resource commercialization is a costly process and there is not an open or competitive market for the resource other than in the form of electricity.
- Exploration and commercialization of geothermal resources can be thought of as two major projects:
  - The upstream discovery and commercialization; and
  - Down steam power development project.
UNIQUE ASPECTS OF GEOTHERMAL

- Development in relatively small increments, yet exploration & infrastructure costs can make the first prohibitively expensive:
  - Contracts should be made as large as possible to cover the maximum infrastructure costs to be spread over a larger generation base.
  - Easier fit with the utility growth curve as opposed to the system having to instantaneously absorb large blocks of power or having to maintain large quantities of standby reserve power in the event of large unit failures.

- Geothermal Development should be thought of in terms of long-term capacity planning, allowing:
  - Sufficient time to discover and confirm the commercial feasibility of resources;
  - To be fitted into the system as needed.
  - Flexibility to accommodate failed resources without causing capacity short fall.

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
UNIQUE ASPECTS OF GEOTHERMAL

- The longer term approach with large multiple contracts may allow more flexibility for both, the utility and the developer, so that a consistent program can be maintained with minimal mobilization and demobilization of equipment and manpower.

- Start and stop programs negatively impact safety, necessitate the requirement for a great deal of training, are inefficient, expensive and thereby deprive the consumer of the most economical power.
OIL & GAS VERSUS GEOTHERMAL

**Oil & Gas Project**
- **Exploration:**
  - Geological Mapping
  - Gravity and Seismic survey
  - Full size hole
  - Sand & Limestone
- **Development:**
  - Development wells
  - Production Facilities

**Geothermal Project**
- **Exploration:**
  - Geological Mapping
  - Gravity, Geochemistry & Temperature Survey
  - Slim & Full Size hole
  - Fractured rock
- **Field Development:**
  - Development wells
  - Steam above ground facilities
- **Power Plant**
OIL & GAS VERSUS GEOTHERMAL

Oil & Gas Project
- Reserves Estimate:
  » Volumetric
  » Material Balance
  » Decline Analysis (exponential/hyperbolic)
  » Reservoir Modeling
- Reservoir Management:
  » Water production
  » Improve sweep efficiency
  » Enhanced Oil Recovery for improved recovery
- Major drilling hazard:
  » Blowout

Geothermal Project
- Reserves Estimate:
  » Mass Deterministic
  » Stored Heat Analysis
  » Decline Analysis (hyperbolic/harmonic)
  » Reservoir Modeling
- Reservoir Management:
  » Quality & Fluid Chemistry
  » Well productivity
  » Re-injection of water for steam regeneration
- Major drilling hazard:
  » Lost circulation

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
GEOTHERMAL VS COAL/GAS POWER PLANT

- Geothermal Power Plant:
  - High upfront investment to provide fuel (for ± 30 years operations);
  - Lower annual operating cost
  - Longer time to develop project
  - Stabilized annual revenue
  - Renewable resources (with prudent reservoir management)

- Coal/Gas Power Plant:
  - Higher annual operating cost
  - Sensitive to fluctuation in fuel price
LAND USE

Source: Petrominer No.02 / Feb 15, 1998 (page 56)

 OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
TYPICAL GEOTHERMAL POWER PROJECT DEVELOPMENT
GEOTHERMAL PROJECT

- Sign JOC / ESC
- Resource Feasibility Study Approved
- Submit Notice of Intention To Develop
- Commercial Operations

Resource Development
- Construction Starts
  - Roads
  - Land Purchase
  - Drill Wells
- At least 3 Yrs

EPC Bids
- Financing Plans
- Finalizing Costs
  - Confirm Resource
  - Financing Plans
- ~ 2 Yrs

Project Construction
- Complete Construction
- Close Financing
  - On Final Phase - PGF
- Close Financing
- Commercial Operations

COAL/GAS POWER PROJECT

- Sign PPA
- EPC Bids
  - Financing Plans
- Conditions Precedent
- Construction Starts
- Commercial Operations

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
BUSINESS DEVELOPMENT

Separate Project

Steam

Resource Developer → Power Plant → Power Market

Electricity

BOT Operation (Leyte Philippines)

Steam

Resource Develop PNOC-EDC → Power Market NAPOCOR

Electricity

Power Plant (Private)

Total Project

Steam

Resource Developer → Power Plant → Power Market

Electricity

Private Sector Developer

Host Utility (Sponsor)

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
## PROJECT SCHEDULE – 110 MW

<table>
<thead>
<tr>
<th>ID</th>
<th>TASK NAME</th>
<th>Year 1</th>
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<th>Year 3</th>
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<td>Unit 2 Erection</td>
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**OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS**
# PROJECT COST – 110 MW

## Investment

<table>
<thead>
<tr>
<th></th>
<th>Million USD</th>
<th>Percent</th>
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<tr>
<td><strong>STEAM FIELD:</strong></td>
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<td></td>
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<tr>
<td>Study &amp; Survey</td>
<td>3 – 5</td>
<td>3</td>
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<tr>
<td>Road &amp; Location</td>
<td>5 – 10</td>
<td>6</td>
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<tr>
<td>Exploration Drilling</td>
<td>12 – 20</td>
<td>12</td>
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<tr>
<td>Development Drilling</td>
<td>60 – 70</td>
<td>53</td>
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<tr>
<td>Production Facilities</td>
<td>30 – 35</td>
<td>26</td>
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<tr>
<td>Total Steam field</td>
<td>110 – 140</td>
<td>USD 1,000 -1,300/kW</td>
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<tr>
<td><strong>POWER PLANT:</strong></td>
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</tr>
<tr>
<td>Design &amp; Tender</td>
<td>15 – 20</td>
<td>17</td>
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<tr>
<td>Manufacturing</td>
<td>60 – 70</td>
<td>47</td>
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<tr>
<td>Civil Work</td>
<td>20 – 30</td>
<td>22</td>
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<tr>
<td>Installation</td>
<td>15 – 25</td>
<td>14</td>
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<tr>
<td>Commissioning</td>
<td></td>
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<tr>
<td>Total Power Plant</td>
<td>110 – 145</td>
<td>USD 1,000 – 1,300/kW</td>
</tr>
<tr>
<td>Grand Total</td>
<td>220 – 285</td>
<td>USD 2,000 – 2,600/kW</td>
</tr>
<tr>
<td>Operating &amp; Maintenance</td>
<td></td>
<td>USD 0.08 – 0.12/kWh</td>
</tr>
</tbody>
</table>

## OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
SENSITIVITY ANALYSIS

Net Present Value

<table>
<thead>
<tr>
<th>Price</th>
<th>Investment</th>
<th>Power Factor</th>
<th>O &amp; M &amp; I</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.5 c$/kwh</td>
<td>USD 220 m</td>
<td>95%</td>
<td>95%</td>
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</table>

<table>
<thead>
<tr>
<th>$2.7 m</th>
<th>$12.9 m</th>
<th>$23.1 m</th>
<th>$33.3 m</th>
<th>$43.5 m</th>
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<tbody>
<tr>
<td>-10%</td>
<td></td>
<td></td>
<td></td>
<td>+10%</td>
</tr>
<tr>
<td>+10%</td>
<td></td>
<td></td>
<td></td>
<td>-10%</td>
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</tbody>
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OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
## Sensitivity Analysis

### Internal Rate of Return

<table>
<thead>
<tr>
<th>Price</th>
<th>5.5 c$/kwh</th>
<th>+10% Investment</th>
<th>+10% USD 220 m</th>
<th>Power Factor</th>
<th>+10% O &amp; M &amp; I</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10%</td>
<td>10.2%</td>
<td>10.8%</td>
<td>11.4%</td>
<td>12.0%</td>
<td>12.6%</td>
</tr>
<tr>
<td>+10%</td>
<td>10.2%</td>
<td>10.8%</td>
<td>11.4%</td>
<td>12.0%</td>
<td>12.6%</td>
</tr>
</tbody>
</table>

**Opportunities & Challenges for Participating in Indonesia Geothermal Power Projects**
TYPICAL GENERATION COSTS

- Nuclear
- Hydro
- Coal
- Geothermal
- Oil (steam)
- Gas Combined Cycle
- Gas Turbine
- Internal Combustion

Capacity & O&M costs for various energy sources.

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
Assumptions:
- Steam Field = USD 110 million
- Power Plant = USD 110 million
- Electricity Price = USD 0.055/kwh
- Price Escalation = 2%/yr

Economic Parameters:
- Undiscounted CF = USD 827.4 million
- 10 % NPV = USD 23.1 million
- IRR = 11.4%
PLANNING PROCESS

- Project delays and failures are not unique to geothermal.
  - Lack of Resource
  - Environmental and Permits
  - Land Acquisition
  - Financing
  - Transmission

- Prudent project management is essential for preserving the value of the resource.

- Sufficient flexibility should be built into contracts to allow completion of all elements of a project within a reasonable time:
  - Work programs and expenditure schedules.
  - Comparison of plans versus actual
PROJECT RISK

TAXES

- VAT
- Corporate Tax
- Customs/Duties

PRICE & Conditions

Terms

REWARD

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
## RISK MANAGEMENT

<table>
<thead>
<tr>
<th>RISK</th>
<th>MITIGATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completion (delays, cost overruns and under-performance)</td>
<td>Hiring reputable contractor to design, build and commission the plant under a fixed price, turn-key contract.</td>
</tr>
<tr>
<td>Availability</td>
<td>Employment of an efficient operation and maintenance contractor.</td>
</tr>
<tr>
<td>Steam Supply</td>
<td>Steam Sales Contract with &quot;right to assist in remedial work&quot;.</td>
</tr>
<tr>
<td>Market</td>
<td>Energy Sales Contract with “take-if- tendered (80%)&quot; clause.</td>
</tr>
<tr>
<td>Steam/Power Cost</td>
<td>Steam/Energy Sales Contract with &quot;escalation&quot;.</td>
</tr>
</tbody>
</table>

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
# RISK MANAGEMENT

<table>
<thead>
<tr>
<th>RISK</th>
<th>MITIGATION</th>
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<tbody>
<tr>
<td>Inflation</td>
<td>Energy Sales Contract with &quot;price escalation&quot; formula</td>
</tr>
<tr>
<td>Interest Rates</td>
<td>Loan Agreement with hedging</td>
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<tr>
<td>Law Changes</td>
<td>Steam Sales Contract and Energy Sales Contract with price adjustment</td>
</tr>
<tr>
<td>Rupiah Convertibility</td>
<td>ESC with tariff equations to adjust the revenue stream to reflect fluctuations in the exchange rate</td>
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</table>
PROJECT DEVELOPMENT RISKS

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
GEOTHERMAL DISTRIBUTION & POTENTIAL IN INDONESIA

- Geothermal locations in Indonesia are mainly distributed along the Indonesian Volcanic Belts, however some are in association with non volcanic environments (intrusive, tectonics).

- By 2008, there are 256 geothermal locations discovered with the total energy potential of about 28 GWe. From these, 203 locations (80%) associate to volcanic environments and 53 locations (20%) are non volcanic geothermal association such as in the larger part of Sulawesi, West Kalimantan, and Papua.

- The geothermal locations are mainly (137 locations or 53.52%) in stage of early preliminary Survey, 23 locations (8.98%) in stage of preliminary Survey, 81 locations (31.6 %) of detailed with or without core hole temperature survey, 8 locations (3.1 %) of exploration drilling/ready to develop, and 7 locations (2.7 %) of installed.

- The total installed capacity is 1052 MWe or about 30% of the proven reserve or less than 4% from the total energy potential. These include 375 MWe in G. Salak, 200 MWe in Kamojang, 255 MWe in Darajat, 110 MWe in Wayang Windu, 60 MWe in Dieng, 40 MWe in Lahendong, and 12 MWe in Sibayak.
INDONESIA GEOTHERMAL RESOURCES

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
DISTRIBUTION OF GEOTHERMAL LOCATIONS IN INDONESIA

Total Location : 256
Total Potential : 28 GWe

Non Volcanic
Location : 53 Lcs
Potential : 1.15 GWe

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
GEOTHERMAL EXPLORATION STATUS - 2007

- Total Locations: 256
- 31.64% Detail ± Gradient Temp (81 locs)
- 8.98% Preliminary (23 locs)
- 3.13% Exploration Drilling Ready to Developed (8 locs)
- 53.52% Early Preliminary (137 locs)
- 2.73% Installed (7 locs)

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
# Geothermal Energy Potential of Indonesia

## Status on April 2008

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<tr>
<th>Island</th>
<th>Speculative (MWe)</th>
<th>Hypothetical (MWe)</th>
<th>Possible (MWe)</th>
<th>Probable (MWe)</th>
<th>Proven (MWe)</th>
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<td>2,267</td>
<td>5,745</td>
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<td>Jawa</td>
<td>2,360</td>
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<td>359</td>
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<td>Kalimantan</td>
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<td>Sulawesi</td>
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<td>865</td>
<td>150</td>
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<td>Papua</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>9,415</strong></td>
<td><strong>4,201</strong></td>
<td><strong>11,135</strong></td>
<td><strong>1,050</strong></td>
<td><strong>2,288</strong></td>
<td><strong>1,052</strong></td>
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<td><strong>256 Locations</strong></td>
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<td><strong>28,089</strong></td>
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OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOThERMAl POWER PROJECTS
### GEOTHERMAL LOCATIONS & WORKING AREAS

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<th>Geothermal Location and WKP</th>
<th>Number of Location</th>
<th>Number of WKP</th>
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<tbody>
<tr>
<td>Locations within existing WKP (Pertamina &amp; JOC)</td>
<td>27</td>
<td>16 WKP</td>
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<tr>
<td>Locations within new issued WKP</td>
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<td>7 WKP (to bid)</td>
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<td>Locations being evaluated for new WKP</td>
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<td>15 new proposed WKP</td>
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<td>Locations would be evaluated for future new WKP</td>
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<td>Locations in stage of preliminary surveys</td>
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<td>Total</td>
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<td>23 WKP</td>
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SOURCE: INDONESIA GEOTHERMAL AGENCY – 2008
1ST GENERATION OF GEOTHERMAL POWER PROJECT DEVELOPMENT IN INDONESIA
GEOTHERMAL RESOURCE DEVELOPMENT

- Geothermal energy for electricity generation began in the early 1980’s spearheaded by Kamojang Field and the issuance of Presidential Decree No. 22/1981.
- PD 22/1981 authorizes Pertamina the right to explore and exploit geothermal energy for generating electricity and to sell the energy/electricity to PLN.
- Pertamina may cooperate with investor under the Joint Operation Contract (JOC).
- Presidential Decree No. 23, dated 3 June 1981 stipulates:
  - Corporate tax and taxes on interests, dividends and royalty.
  - 46% of Pertamina’s net operating income from the geothermal business to the Government.
GEOTHERMAL RESOURCE DEVELOPMENT

- Presidential Decree No. 22/1981:
  - Contractor & Pertamina conduct exploration and development under JOC.
  - Pertamina and the Contractor sells the energy to PLN under the ESC.
  - PLN build the power plant and sells electricity to public
  - Unocal Gunung Salak Unit #1 and Amoseas Darajat Unit #1.

  - Integrated Project:
    » Pertamina and Contractor conduct exploration and steam development and build power plant.
    » PLN purchase the electricity under the ESC.
  - Net Revenue to Contractor = Gross revenue minus:
    » Operating Cost
    » 34% Income Tax (incl. VAT and other levies)
    » 4% Pertamina’s allowance (net operating income after tax).
GEOTHERMAL RESOURCE DEVELOPMENT

- Pertamina own operation:
  - Kamojang – 200 MW
  - Lahendong – 40 MW
  - Sibayak – 12 MW

- Joint Operating Contract Generation I (steam only):
  - Salak 1 (Unocal) – 165 MW
  - Darajat I (Amoseas) – 55 MW

- Joint Operating Contract Generation II (Total Project):
  - Salak (Unocal) – 165 MW
  - Darajat (Amoseas) – 200 MW
  - Dieng – 60 MW
  - Wayang Windu – 110 MW
  - Bedugul *)
  - Patuha *)
  - Karaha Bodas *)
  - Cibuni *)
  - Sarulla *)

*) Not in Operation

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
## GEOTHERMAL POWER PROJECTS

### Presidential Decree 39/1997

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<tr>
<th>Continued</th>
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<th>Rescheduled</th>
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<td>Salak</td>
<td>165</td>
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<td>Bedugul</td>
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<td>Patuha 1</td>
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<td>10</td>
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<td>330</td>
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<tr>
<td>Darajat</td>
<td>70</td>
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<td>Karaha</td>
<td>110</td>
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<td>Patuha (165 MW)</td>
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<td>Sibayak</td>
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**Opportunities & Challenges for Participating in Indonesia Geothermal Power Projects**
OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS

GEOTHERMAL LAW AND REGULATIONS
REGULATORY REFORM

PRES. DECREE 15/2001
PRES. DECREE 39/1997
PRES. DECREE 37/1992
PRES. DECREE 49/1991
PRES. DECREE 45/1991
MIN. DECR. 667K/2002
LAW NO. 27/2003
PRES. DECREE 23/1981
PRES. DECREE 22/1981
PRES. DECREE 22/1981
PRES. DECREE 76/2000


LAW NO. 44/1960 & LAW NO. 8/1971
LAW NO. 22/2001
GOV. REG. 31/2003
GOV. REG NO. 3/2005
GOV. REG NO. 26/2006
LAW No. 27/2003 - GEOTHERMAL (1)

- Enacted in April 2003.
- Geothermal utilization:
  - Direct use of produced steam or hot fluid; and
  - Indirect use to generate electricity
- Geothermal energy utilization business is based on Geothermal Business Permit (IUP) issued by Minister of Energy & Mineral Resources, Provincial or Regional Government depending on the extent of the geothermal reservoirs.
- The geothermal power project can be conducted as a separate project between upstream and downstream activities or as an integrated project. For the electricity generation business a separate permit is required in accordance with the electricity law.
- IUP is valid for 30 years beginning the exploitation phase. Exploration phase is limited for 6 years and can be extended for two years.
LAW No. 27/2003 - GEOTHERMAL (2)

- Maximum acreage of Mine Working Area:
  - For exploration = 200,000 ha.
  - For exploitation = 10,000 ha.
- Relinquishment of Work Area in stages (partly or all subject to Government Regulation).
- Geothermal Business Mining activities may not be conducted in certain areas (natural reserves areas), except with prior approvals from the Government and of relevant community/individuals.
- One Business Entity may have only one WKP for geothermal undertaking (no tax consolidation or Ring Fencing)
- IUP may be transferred to an affiliated Business Entity with prior approval of the respective approving authority.
- IUP holders has the right to obtain tax facilities in accordance with the provisions of applicable tax laws and regulations.
IUP holders are obliged to pay state revenues in the form of taxes and Non-Tax State Revenues in accordance with provisions of applicable tax laws and regulations.

Provisions regarding the types and rates of Non-Tax State Revenues to be stipulated in the Government Regulation.

Minister of Energy & Mineral Resources determine the base tariff for steam/electricity from geothermal

All cooperation contracts for Geothermal energy business already in existence before this law became effective are declared remain in effect until the end of the terms of the contracts
NEW LAW vs OLD PRESIDENTIAL DECREE


- BUSINESS STRUCTURE: Based on Joint Operating Contract (EPC) with Pertamina and Energy Services Contract (ESC) with PLN.
- GOVERNMENT “SPLIT”: 34% of net income – included all tax payments
- MANAGEMENT: Under Pertamina (JOC) and PLN (ESC)
- PROJECT EXECUTION: Integrated from exploration to generating electricity
- ENERGY PRICE: US dollar
- OTHERS: Does not regulate direct use

LAW NO. 27/2003 ON GEOTHERMAL

- BUSINESS STRUCTURE: Based on IUP (Geothermal Business Permit) issued by Minister or Regional Government and IUKU (Electricity Business Permit for Public Use) issued by Central or Regional Government
- GOVERNMENT “SPLIT”: Non tax levy and general tax law. Est. net 47%
- MANAGEMENT: Under the Central or Regional Government
- PROJECT EXECUTION: Survey and exploration by Gov, Exploitation by Business Entity
- ENERGY PRICE: Rupiah
- OTHERS: Regulates direct use/mineral

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
FLOW PROCESS

GOV/REGION/GOV/PRIVATE GOVERNMENT/BU MN, BUMID, PRIVATE, COOPERATIVES

TENDER WA TENDER WA

DATA AND INFORMATION

SINERGY

GEOTHERMAL ENERGY POTENTIAL

PRELIMINARY SURVEY

EXPLORATION

FEASIBILITY STUDY

EXPLOITATION

DIRECT MINERAL CARRY OVER ELECTRICITY

GEOTHERMAL ENERGY UTILIZATION

3 yrs 2 yrs 30 yrs

HR, TECHNOLOGY, LAWS & REGULATIONS

APPOINTMENT BUSINESS LICENCE FOR GEOTHERMAL MINING (IUP)

REGIONAL REGULATION

OPERATING LICENSE IUPTL

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
MINISTRY REGULATION

- Under the Ministry Regulation Nr. 667 K/11/MEM/2002:
  - Director General of Electricity will be responsible for making regulation and supervision in the development of geothermal power plant.
  - Director General of Mineral, Coal and Geothermal will be responsible for making regulation and supervision in the exploration, exploitation, and development activities of geothermal resources.
Izin Usaha Pertambangan (Geothermal Mining Business License - IUP):

- Exploration:
  » Terms = 3 years (extendable 2 x 1 year);
  » Area = 200,000 ha (maximum)

- Feasibility Study:
  » Terms = 2 years

- Exploitation:
  » Terms = 30 years (extendible 1 x 20 years)
  » Area = 10,000 ha (maximum)

Utilization:

- IUP holder has a right to utilize the steam directly and indirectly (electricity);

- Government may request the Authority Holder of Electricity or Pemegang Kuasa Usaha Ketenagalistrikan (PKUK) or License Holder for Public Electricity (PIUKU) to purchase steam or electricity from geothermal.
RIGHT & OBLIGATION OF IUP HOLDER

Right:
- Conducting geothermal undertaking in its WKP;
- Use the data until IUP expires;
- May obtain tax facility;
- May utilize the resource for direct use;
- Sell the geothermal steam;
- May obtain extension for the IUP

Obligation:
- Observe the HSE requirements and standard;
- Managing the environment;
- Pay to the Government the tax and non-tax revenue;
- Give priorities to the utilization of domestic goods, technology services and engineering and procurement.
- Support the research and development of science and technology (IPTEK);
- Support the development of competency and manpower;
- Perform community development activities.

OPPORTUINITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
GEOTHERMAL UNDERTAKING

- Preliminary Survey
- Tendering process of Working Area
- Exploration
- Feasibility Study
- Exploitation
PRELIMINARY SURVEY

- Performed by:
  - Government (Ministry)
  - Regional Government (Governor and Bupati)
  - Other (business entity) that obtains permit from the Minister

- Costs:
  - Government: State Budget
  - Regional Government (Regional Budget)
  - Business entity

- Results of survey will be used to determine the Mine Working Area (Wilayah Kerja Pertambangan or WKP):
  - Consultation with relevant department
  - Minister determine the basic price of data and data compensation.
TENDERING OF MINE WORKING AREA

- Geothermal Mine Working Area (WKP):
  - Maximum Area for Exploration = 200.000 ha
  - Maximum Area for Exploitation = 10.000 ha
  - One Business Entity may have one WKP for geothermal undertaking;
  - Ring Fencing for tax purposes.

- Minister of Energy & Mineral Resources determine the base tariff for steam/electricity from geothermal

- Minister, Governor or Bupati/Major in accordance with their respective authority will:
  - Announce the WKP to be tendered
  - Establish Tendering Committee
  - Decide and approve the result of tendering.

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
TENDERING PROCESS

- **Document Presentation:**
  - **Stage One:**
    - The participant submits administration requirement document, among others the financial capability to pay the basic data or data compensation (except those who has conducted the preliminary survey)
  - **Stage Two:**
    - The participant who passes the Stage One must submit the offer.

- **Decision of the Winner:**
  - Offer the lowest tariff for steam/electricity;
  - Business entity who has conducted preliminary survey has first right of refusal to match the offer Minister ERM Regulation No. 5/2007)
The highest reference selling price / tariff for geothermal electricity at the time of bidding for the Geothermal Working Area (WKP) shall be calculated based on percentage of the published Basic Electricity Production Cost (BPP) of PLN*) as the Holder of Electricity Business Authority or of the Holder of Integrated Electricity Business License as follows:

- 85% BPP at High Voltage (BPP-TT) or 85% BPP at Medium Voltage (BPP-TM) of the local electricity system for unit capacities above 10 MW through 55 MW, in accordance with its inter-connection plan.

- 80% BPP at High Voltage (BPP-TT) of the local electricity system for unit capacities bigger that 55 MW.

*) Minister of Energy & Mineral Resources Regulation No. 269/2008 describes PLN basic electricity production cost (BPP) 2008 for each system & corresponding reference price of geothermal electricity tariff
FLOW PROCESS

Department

Institution

Coordination

Minister

Determine:
- Price for data
- Data Compensation
- Reference tariff steam/power

Tender Committee

Governor

Bupati/Major

Consultation Supervision

Tender

Committee

Determine

Govern

ment

Survey

Pay Basic Data except who has conducted survey

Government Survey

Pay Basic Data except who has conducted survey

Winner of Tender

IUP

Exploration Feasibility Exploitation

Private

First Right

Refusal

Two stages

Government

State Budget

Regional

Reg. Budget

Private

Own Fund

WKP Maximum:
- Exploration = 200,000 ha
- Exploitation = 10,000 ha

Geothermal Potential

Preliminary Survey

Mine Working Area WKP

Tendering WKP

Private First Right Refusal

Government Data except who has conducted survey

Lowest Steam/power tariff

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
INDONESIA GEOTHERMAL DEVELOPMENT
BLUEPRINT 2004-2020 AND
NATIONAL ENERGY POLICY TARGET 2025

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
PRESENT SITUATION

- **Power system:**
  - Java – Bali: interconnected;
  - Sumatra: partly interconnected
  - Other Islands: not interconnected

- **Electricity Demand:**
  - Annual increase = 7.1%/yr (forecasted through 2026)

- **Installed Capacity:**
  - PLN: 21.768 MW (78,5%);
  - IPP: 5.270 MW (19,0%);
  - PPU: 700 MW (2,5%) (province).

- **Electrification Ratio**: 56%

- **Energy Mix:**
  - Oil: 24%
  - Coal: 42%
  - Gas: 19%
  - Hydro: 9%
  - Geothermal: 5%
  - Renewable: 1%

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
TARGETED ENERGY MIX

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
GEOTHERMAL ROAD MAP TOWARD 2025

- 2004: 822 MW (production)
  - Existing WKP: 1193 MW

- 2008: 2000 MW
  - Existing WKP: 1442 MW

- 2012: 3442 MW
  - Existing WKP: 1158 MW
  + New WKP: 2844 MW

- 2016: 4600 MW
  - New WKP: 1400 MW

- 2020: 6000 MW (target)
  - Existing WKP: 1158 MW

- 2025: 9500 MW (target)

Geothermal Road Map

(GSDM, 2004; 2005)

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS

- 1000 MWe for 30 years
- 465 Million Barrel oil
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<td>220</td>
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<td>9 Kawah Cibuni Gunung Patuha Wayang Windu</td>
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<td>10</td>
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**OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS**
# GEOTHERMAL EXISTING PROJECTS

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<td>11 Dieng*</td>
<td>Geodipa</td>
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<td>400</td>
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<td>16 Tulehu</td>
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<td>5,491</td>
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# RESOURCES TO BE DEVELOPED

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GEOTHERMAL POWER PROJECT OPPORTUNITIES IN INDONESIA

UP - STREAM

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
GEOTHERMAL POWER BUSINESS ENTRY

- Farm – into existing, commercially operated areas
- Participate in the development of existing fields which have already been in operation
- Business partnership with Pertamina for the exploration and exploitation of 15 geothermal working areas
- Participate in bid process of area(s) of interest among the 7 areas which have been open for tender among 14 areas which have been studied by GOI
- Participate in the tendering process – on remaining 14 areas on the basis of usage for non PLN consumers
- Offer Preliminary Survey for good potential green fields

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
EXISTING GEOTHERMAL POWER PLANTS

SIBAYAK capacity (12 MWe)

G. SALAK capacity (380 MWe)

DIENG capacity (60 MWe)

LAHENDONG capacity (40 MWe)

WAYANG WINDU capacity (110 MWe)

KAMOJANG capacity (200 MWe)

DARAJAT capacity (255 MWe)

TOTAL: 1057 MWe

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
GEOTHERMAL WORKING AREA MAP OF PERTAMINA

15 WKP : 2349.59 hectares

1. Sibayak-Sinabung
2. Sibualbuali
3. Sungaipenuh
4. T.Sawah-Hululais
5. Lumutbalai
6. Waypanas Ulubelu
7. Cibereum-Parabakti
8. Pengalengan
9. Kamojang-Darajat
10. Karaha
11. Dieng
12. Iyang-Argopuro
13. Tabanan / Bedugul
14. Lahendong
15. Kotamobagu

References:
- Keppres RI No. 22 / 1981
- Keppres RI No. 45 / 1991
- Keppres RI No 49 / 1991
- Keppres RI No. 76 / 2000
- UU Panasbumi No 27/2003
- Kepmen ESDM No 0980 K/40/MEM/2004

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
PROFILE OF GEOTHERMAL FIELDS

KETERANGAN
- Badan Geologi
- WKP Pertamina

Batas Provinsi
- GL Geologi
- GF Geofisika
- LS Landaian Suhu

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
GEOTHERMAL WORKING AREAS – IN OPERATION, UNDER EXPLORATION & DEVELOPMENT, AND BIDDING PROCESS

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
GEOTHERMAL POWER PROJECT OPPORTUNITIES IN INDONESIA

DOWN - STREAM
Electricity will be provided by the state through state owned company (PLN).

Other entities (cooperation, private and regional owned company) will be given opportunities to participate in supply through:
- Independent Power producer (IPP);
- Regional Business Entity (PPU).

PLN and PPU have obligations to guarantee supply of electricity in its area.

Electricity tariff is controlled by the Government.
OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
PROJECTED DEMAND & SUPPLY

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
ROADMAP GEOTHERMAL DEVELOPMENT 2006-2025 AND PLN ELECTRICITY SUPPLY GENERAL PLAN

- 2006: 852 MW
- 2010: 2000 MW
- 2012: 3442 MW
- 2016: 4600 MW
- 2020: 6000 MW
- 2025: 9500 MW (Target)

Existing WKP:
- 2006: 1148 MW
- 2010: 1442 MW
- 2012: 1158 MW
- 2016: 1400 MW
- 2020: 3500 MW

New WKP:
- 2010: 590 MW
- 2012: 1945 MW
- 2016: 3050 MW
- 2020: 4890 MW
- 2025: 5800 MW

CUMULATIVE ADDITION:
- 2006: 590 MW
- 2010: 1522 MW
- 2012: 2877 MW
- 2016: 3982 MW
- 2020: 5822 MW
- 2025: 6732 MW

TOTAL INST.:
- 2006: 932 MW
- 2010: 1522 MW
- 2012: 2877 MW
- 2016: 3982 MW
- 2020: 5822 MW
- 2025: 6732 MW

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
## Indonesia Geothermal Development

**PLN General Electricity Supply General Plan 2008**

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Java Bali System</td>
<td>3122</td>
<td>70</td>
<td>720</td>
<td>1190</td>
<td>2970</td>
<td>2970</td>
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<tr>
<td>Outside Jawa Bali</td>
<td>5838</td>
<td>520</td>
<td>1225</td>
<td>1860</td>
<td>1920</td>
<td>2830</td>
</tr>
<tr>
<td><strong>TOTAL INDONESIA</strong></td>
<td><strong>8960</strong></td>
<td><strong>590</strong></td>
<td><strong>1945</strong></td>
<td><strong>3050</strong></td>
<td><strong>4890</strong></td>
<td><strong>5800</strong></td>
</tr>
</tbody>
</table>

Source: PLN – Revised RUPTL June 2008
GEOTHERMAL POWER PROJECT
UPSITE POTENTIAL

CARBON CREDIT – CLEAN DEVELOPMENT MECHANISM

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
POTENTIAL CO2 REDUCTION

CO2 (Kg/MWh)

- Coal: 950
- Diesel: 950
- Oil/Steam: 809
- NG/CCGT: 375
- Geothermal: 850

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS

VALUE CREATED BY CO2 CREDITS

Carbon Credit Value ($/tonne CO2) vs. Reduction in Price (cents/KWh)

-3.0 -2.5 -2.0 -1.5 -1.0 -0.5 0.0

$0 $5 $10 $15 $20 $25 $30

(0.42)
CONCLUSIONS

- Business Opportunities in Indonesia Geothermal Power Projects:
  - Cooperation with Pertamina in Pertamina’s Operated Area (Ulubelu, Tompaso, Hulu Lais, Lumut Balai, Sei Penuh, Argopuro, etc).
  - Acquiring License for exploration, feasibility study and exploitation:
    » Participate in open tender
    » Conduct preliminary survey
  - Farm-in existing JOC and ESC Contracts (Dieng, Patuha, Cibuni, Karaha Bodas, Lahendong, Kamojang, Gn Salak, Darajat, Wayang Windu, Sarulla)

- Challenges:

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS
FOR MORE DETAILS

- PT Pranata Energi Nusantara (PENConsulting), an energy development process consultant – antonw@penconsulting.com

- PT Paramartha Energi Nusantara (PEN Alliance), your partner of choice in the energy business over the value chain spectrum – antonws@penalliance.com

OPPORTUNITIES & CHALLENGES FOR PARTICIPATING IN INDONESIA GEOTHERMAL POWER PROJECTS