GEOTHERMAL DEVELOPMENT IN THE PHILIPPINES

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Assistant Director, Renewable Energy Management Bureau
Philippines Department of Energy
• Historical Geothermal Development in the Philippines
• Geothermal Energy Situation
• Republic Act No. 9513 (RE Law)
• Roadmap and Geothermal Targets 2013 - 2014
• Awarded (New Geothermal Contracts)
• Roadmap 2013 - 2014
• Barriers and Challenges in Geothermal Development
• The Way Forward
Pre-Geothermal Development (prior to 1977)

The Commission on Volcanology laid the foundation for the commercial utilization of geothermal energy between 1952 to late 1960’s when it studied and inventoried geothermal activity at a number of localities.

Historic lighting of several electric bulbs on April 12, 1967 in Barrio Cale, Tiwi, Albay.

Service Contract Systems signed in 1971 between the National Power Corporation (NPC) and Union Oil of California for the development of Tiwi and Makban.

Philippine Government entered into bilateral energy cooperation with New Zealand Government that led to the commencement of exploratory drilling at Tongonan and Palinpinon in 1973 in conjunction with NPC.

The first 2.5 kilowatt geothermal pilot plant at Barangay Cale, Tiwi.
RP harnessed its first geothermal power in 1967 after Dr. Alcaraz and his team lit up an electric bulb in Tiwi, a town at the foot step of Mt. Mayon.
First commercial power generation in the Philippines in 1977

PNOC-EDC was created in 1976 to undertake accelerated development of indigenous energy sources. Likewise, PNOE assumed NPC’s interest at Tongonan and Palinpinon in the late 1976’s.

In July 1977, the first commercial geothermal power generation in the Philippines commenced at PNOE’s 3-MW power plant in Palinpinon.

The 1.5 Mw Pilot Plant at Negros Occidental installed in 1977
### HISTORY OF PHILIPPINE GEOTHERMAL DEVELOPMENT

**Commercial Installations from 1979 to 2014**

<table>
<thead>
<tr>
<th>PLANT</th>
<th>2014 INSTALLED CAPACITY, MW</th>
<th>CURRENT OWNER</th>
<th>ORIGINAL YEAR COMMISSIONED</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LUZON</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mak-Ban 1</td>
<td>63.20</td>
<td>AP Renewables Inc. (APRI)</td>
<td>April 26, 1979</td>
</tr>
<tr>
<td>Mak-Ban 2</td>
<td>63.20</td>
<td>APRI</td>
<td>July 25, 1979</td>
</tr>
<tr>
<td>Mak-Ban 3</td>
<td>63.20</td>
<td>APRI</td>
<td>April 22, 1980</td>
</tr>
<tr>
<td>Mak-Ban 4</td>
<td>63.20</td>
<td>APRI</td>
<td>June 25, 1980</td>
</tr>
<tr>
<td>Mak-Ban 5</td>
<td>55.00</td>
<td>APRI</td>
<td>June 5, 1984</td>
</tr>
<tr>
<td>Mak-Ban 6</td>
<td>55.00</td>
<td>APRI</td>
<td>September 10, 1984</td>
</tr>
<tr>
<td>Mak-Ban 7 (D)</td>
<td>20.00</td>
<td>APRI</td>
<td>October 16, 1995</td>
</tr>
<tr>
<td>Mak-Ban 8 (D)</td>
<td>20.00</td>
<td>APRI</td>
<td>November 12, 1995</td>
</tr>
<tr>
<td>Mak-Ban 9 (E)</td>
<td>20.00</td>
<td>APRI</td>
<td>May 22, 1996</td>
</tr>
<tr>
<td>Mak-Ban 10 (E)</td>
<td>20.00</td>
<td>APRI</td>
<td>May 27, 1996</td>
</tr>
<tr>
<td>Mak-Ban Binary</td>
<td>15.73</td>
<td>APRI</td>
<td>February 28, 1994</td>
</tr>
<tr>
<td>Maibarara</td>
<td>20.00</td>
<td>Maibarara Geothermal Inc.</td>
<td>February 08, 2014</td>
</tr>
<tr>
<td>Bac-Man I - Unit 1</td>
<td>55.00</td>
<td>Bacman Geothermal Inc. (BGI)</td>
<td>September 10, 1993</td>
</tr>
<tr>
<td>Bac-Man I - Unit 2</td>
<td>55.00</td>
<td>BGI</td>
<td>December 12, 1993</td>
</tr>
<tr>
<td>Bac-Man II - Cawayan</td>
<td>20.00</td>
<td>BGI</td>
<td>March 15, 1994</td>
</tr>
<tr>
<td>Bac-Man II - Botong*</td>
<td>0.00</td>
<td>BGI</td>
<td>March 17, 1998</td>
</tr>
<tr>
<td>Manito Lowland**</td>
<td>0.00</td>
<td>Energy Development Corp. (EDC)</td>
<td>October 1, 1998</td>
</tr>
<tr>
<td>Tiwi 1</td>
<td>60.00</td>
<td>APRI</td>
<td>January 11, 1979</td>
</tr>
<tr>
<td>Tiwi 2</td>
<td>60.00</td>
<td>APRI</td>
<td>May 25, 1979</td>
</tr>
<tr>
<td>Tiwi 3***</td>
<td>0.00</td>
<td>APRI</td>
<td>January 8, 1980</td>
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<tr>
<td>Tiwi 4***</td>
<td>0.00</td>
<td>APRI</td>
<td>April 1, 1980</td>
</tr>
<tr>
<td>Tiwi 5</td>
<td>57.00</td>
<td>APRI</td>
<td>December 20, 1981</td>
</tr>
<tr>
<td>Tiwi 6</td>
<td>57.00</td>
<td>APRI</td>
<td>March 16, 1984</td>
</tr>
<tr>
<td><strong>VISAYAS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palinpinon I</td>
<td>112.50</td>
<td>Green Core Geothermal Inc. (GCGI)</td>
<td>May / July / August 1983</td>
</tr>
<tr>
<td>Palinpinon II</td>
<td>80</td>
<td>GCGI</td>
<td>January 1, 1994 / May 5, 1995</td>
</tr>
<tr>
<td>Northern Negros***</td>
<td>0</td>
<td>EDC</td>
<td>February 2, 2007</td>
</tr>
<tr>
<td>Tongonan I</td>
<td>112.5</td>
<td>GCGI</td>
<td>March 10, 1983 / June 18, 1983</td>
</tr>
<tr>
<td>Unified Leyte</td>
<td>610.18</td>
<td>EDC</td>
<td>July 1996 / 1997</td>
</tr>
<tr>
<td><strong>MINDANAO</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mindanao I</td>
<td>54.24</td>
<td>EDC</td>
<td>December 15, 1996</td>
</tr>
<tr>
<td>Mindanao II</td>
<td>54.24</td>
<td>EDC</td>
<td>June 17, 1999</td>
</tr>
<tr>
<td><strong>TOTAL (Luzon, Visayas and Mindanao)</strong></td>
<td>1,866.19</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:**
- * Bac-man II Botong was decommissioned
- ** Manito Lowland was officially decommissioned by EDC on 11 July 2014, although the plant is not operating since July 2001.
- ** Tiwi 4 was decommissioned on 13 October 2003. Tiwi 3 was decommissioned
- ** Northern Negros was on shutdown since July 2011.
Geothermal Energy Situation

Newly Commissioned Geothermal Power Plant

20 MW Maibarara Geothermal Power Project commissioned on February 08, 2014
# Geothermal Energy Situation

## Geothermal Energy Potential

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed Capacity</td>
<td>1,972 MW</td>
<td>1,902.69 MW</td>
<td>1,848 MW</td>
</tr>
<tr>
<td>Generation</td>
<td>10,279 GWh</td>
<td>10,494 GWh</td>
<td>10,249.99 GWh</td>
</tr>
<tr>
<td>Fuel Oil Displacement (MMBFOE)</td>
<td>17.13</td>
<td>17.49</td>
<td>17.08</td>
</tr>
<tr>
<td>Foreign Savings in MM US$</td>
<td>1,349.31</td>
<td>1,377.51</td>
<td>1,861.74</td>
</tr>
</tbody>
</table>

NOTE: no official data yet for 2013
Geothermal Energy Situation

POWER GENERATION MIX

2011
- Natural Gas: 30%
- Oil-Based: 4%
- Hydro: 14%
- Geothermal: 15%
- Coal: 37%

2012
- Natural Gas: 27%
- Oil-Based: 5%
- Hydro: 15%
- Geothermal: 14%
- Coal: 39%
LANDMARK LAWS

Republic Acts No. 9513
An act promoting the Development, Utilization and Commercialization of Renewable Energy Resources

Provides for additional incentives in geothermal development aside from establishing incentives for other RE development. Geothermal resource is the banner resource in the campaign for the Act
<table>
<thead>
<tr>
<th></th>
<th>P. D. No. 1442</th>
<th>R. A. 9513</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contract Term</strong></td>
<td>5 years exploration period + 2 years exploration period extension + 25 years production period + 18 years production period extension</td>
<td>2 yrs explo + extendible for two (2) years, + further extendible for one (1) year (pre-development stage) 25 years, maximum of 50 years (Development/commercial stage)</td>
</tr>
<tr>
<td><strong>Ownership</strong></td>
<td>60% Filipino, 40% Foreign</td>
<td>Can be 100% foreign, provided the President sign the contract</td>
</tr>
<tr>
<td><strong>Annual Cost Recovery</strong></td>
<td>Maximum 90%</td>
<td>1.5% from the sale of electric power for geothermal energy</td>
</tr>
<tr>
<td>(% of Gross Proceeds)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Share of Net Proceeds</strong></td>
<td>National 60%</td>
<td>-do-</td>
</tr>
<tr>
<td></td>
<td>LGU 40%</td>
<td></td>
</tr>
<tr>
<td><strong>Depreciation of Capital</strong></td>
<td>10 Years straight line</td>
<td>Accelerated depreciation</td>
</tr>
<tr>
<td><strong>Equipment Exemption from payment of Taxes</strong></td>
<td>All taxes except income tax 1.5% Special Realty Tax Rates on Equipment and Machinery 7 years Net Operating Loss Carry-Over (NOLCO) 10% Corporate Tax Rate after seven (7) years of ITH Zero Percent Value-Added Tax Rate Tax Exemption of Carbon Credits 100% Tax Credit on Domestic Capital Equipment and Services</td>
<td>7 years Income Tax Holiday (ITH)</td>
</tr>
<tr>
<td><strong>Importation</strong></td>
<td>Exemption from payment of tariff duties and compensating tax on the importation of machinery, equipment, spare parts and all materials for geothermal operations during contract duration</td>
<td>10 year Duty-free Importation of RE Machinery, Equipment and Materials</td>
</tr>
<tr>
<td><strong>Other incentives</strong></td>
<td>Cash inventive of Renewable Energy Developers for Missionary Elecrification Exemption from the Universal Charge Payment of Transmission Charge Hybrid and Cogeneration Systems</td>
<td></td>
</tr>
</tbody>
</table>
Geothermal

A total of nine GRESCs under Open and Competitive Selection Process (OCSP), five GREOCs/GOCs and 20 GRESCs/GSCs under Direct Negotiation for frontier areas and seven conversions of Geothermal Service Contracts under P.D. 1442 into GRESCs under R.A. 9513 were signed.

To date, the country has 41 GRESCs/GSCs, seven (7) of which are producing fields with total installed capacity of 1,866 MW, while the remaining are under pre-development/exploration. Among the major islands, Visayas has the highest installed capacity with 915 MW. Luzon has 843 MW and Mindanao has 108 MW of geothermal energy.

Note:
GRESC – Geothermal RE Service Contract/
GSC – Geothermal Service Contract
GREOC – Geothermal RE Operating Contract/
GOC – Geothermal Operating Contract
Geothermal Service Contracts (Pre-Development Stage)

1. Sal-Lapadan-Bolinao-Bucloc-Tubo, Abra
   Potential Capacity to be determined
   GSREC No. 2011-12-029

2. Mainit-Sadanga, Mt. Province (80 MW)
   GSREC No. 2010-03-023

3. Kalinga, Kalinga Province (60 MW)
   GSREC No. 2010-01-024

4. Cagayan-Baua, Cagayan (40 MW)
   GSREC No. 2011-12-026

5. Buguias-Tinoc, Benguet/Iligao (60 MW)
   GSREC No. 2010-03-022

6. Cervantes, Ilocos Sur/Mt. Province/Benguet
   Potential Capacity to be determined
   GSREC No. 2011-12-030

7. East-Mankayan, Iligan/Benguet/Mt. Province
   Potential Capacity to be determined
   GSREC No. 2013-11-041

8. Daklan, Benguet/Nueva Ecija (60 MW)
   GSREC No. 2010-02-017

9. Negren-Cuartado, Zamboales/Pampanga
   Potential Capacity to be determined
   GSREC No. 2013-02-040

10. Mariveles, Bataan
    Potential Capacity to be determined
    GSREC No. 2013-03-032

11. Natib, Bataan (40 MW)
    GSREC No. 2010-02-016

12. San Juan, Batangas (20 MW)
    GSNC No. 2011-12-031

13. Mabini, Batangas (20 MW)
    GSNC No. 08

14. Puting Lupa, Laguna (40 MW)
    Potential Capacity to be determined
    GSNC No. 2014-01-034

15. Montelago, Oriental Mindoro (40 MW)
    GSNC No. 2010-02-013

16. Tayabas-Lucban, Tayabas/Quezon
    Potential Capacity to be determined
    GSNC No. 2011-12-032

17. Tiaong, Laguna/Quezon/Batangas
    Potential Capacity to be determined
    GSNC No. 2011-12-033

18. Labo, Quezon/Camarines Norte and Sur
    (65 MW)
    GSNC No. 2010-02-020

19. Southern Bicol, Sorsogon (40 MW)
    GSREC No. 2010-02-015

20. West Bulusan, Sorsogon
    Potential Capacity to be determined
    GSNC No. 2013-11-048

21. Iriga, Albay and Sorsogon
    Potential Capacity to be determined
    GSNC No. 2013-02-043

22. Mandaog, Negros Occidental (20 MW)
    GSNC No. 2012-01-036

23. Biliran, Biliran (50 MW)
    GSREC No. 2010-02-010

24. Mainit, Surigao del Norte (30 MW)
    GSREC No. 2010-02-021

25. Lakewood, Zamboanga del Sur/Zamboanga del Norte/Zamboanga Sibugay (40 MW)
    GSNC No. 2012-01-038

26. Ampiro, Misamis Occ./Zamboanga del Norte/Zamboanga del Sur (30 MW)
    GSNC No. 2012-01-025

27. Balibasag, Misamis Or./Bukidnon (20 MW)
    GSNC No. 2012-01-039

28. Mt. Zion, North Cotabato/Davao del Sur (20 MW)
    GSNC No. 2012-01-037

29. Mt. Talomo-Tico, North Cotabato/Davao del Sur
    Potential Capacity to be determined
    GSNC No. 2013-11-046

30. Mt. Sibulan-Kapatagan, Davao del Sur
    Potential Capacity to be determined
    GSNC No. 2013-11-047

LEGEND
- GSREC - Geothermal RE Service Contract
- GSNC - Geothermal Service Contract under RA 9513
- GSNC under PD 1442

Date as of August 2014
Source: Geothermal Energy Management Division
# Major Differences of Geothermal Service Contract under PD 1442 and RA9513

<table>
<thead>
<tr>
<th></th>
<th>Presidential Decree No. 1442 and other Service Agreement</th>
<th>Republic Act No. 9513</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Contract Awarded</td>
<td>13</td>
<td>41</td>
</tr>
<tr>
<td>Company</td>
<td>5*</td>
<td>19**</td>
</tr>
</tbody>
</table>

**Key Players under PD 1442***
1. Energy Development Corp.
2. Basic Energy Corp.
5. Philippine Geothermal Inc. (now PGPC)

**Key Players under RA 9513**
1. Energy Development Corp.
2. AP Renewables Inc.
4. Maibarara Geothermal Inc.
5. Basic Energy Corp.
7. Negron Cuadrado Geopower Inc.
9. PRC-Magma Energy Resources Inc.
10. Aragorn Power and Energy Corp.
12. Green Core Geothermal Inc.
14. Philippine Geothermal Production Company, Inc. (PGPC)
15. SKI Construction Group Inc.
17. Tayabas Geothermal Power Inc.
18. San Juan Geothermal Power Inc.
19. Filtech Energy Drilling Corp.
ROADMAP for the EXPLORATION, DEVELOPMENT and UTILIZATION of GEOTHERMAL RESOURCES IN THE PHILIPPINES (2013-2030)

**Establishment of RPS and FIT**

**2013**
- Installation of additional 50 MW
  - New Areas - 20 MW
  - Expansion - 30 MW
  - Generation - 350.4 GWh
  - Employment - 85 (full time)
  - Investment - ~PhP11,250 MM

**2015**
- Installation of additional 1,180 MW
  - New Areas - 1,050 MW
  - Expansion - 130 MW
  - Generation - 8,269.44 GWh
  - Employment - 2,006 (full time)
  - Investment - ~PhP265,500MM

**2020**
- Installation of additional 155 MW
  - New Areas - 90 MW
  - Expansion - 65 MW
  - Generation - 1,086.24 GWh
  - Employment - 263 (full time)
  - Investment - ~PhP34,875 MM

**2025**
- Installation of additional 80 MW
  - New Areas - 20 MW
  - Expansion - 60 MW
  - Generation - 526.6 GWh
  - Employment - 136 (full time)
  - Investment - ~PhP 18,000MM

**2030**

**VISION:**
Increase of 75% in geothermal capacity by 2030

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**1. Installed Capacity 1,848 MW**
- Implementation of Detailed Assessment of Low-Enthalpy Geothermal Resources Project
- Drafting of policy/guidelines for the direct use of small-scale geothermal energy
- Feasibility of Small-Scale Geothermal Energy

**2. Research/study on the steam/electricity pricing of geothermal resource to determine true cost of steam production**
- Research/Study on Enhanced Geothermal System (EGS) and Geothermal Heat Pump
- Feasibility Study of Enhanced Geothermal System (EGS), Binary Technology, Utilization of Acidic Reservoir and Geothermal Heat Pump
- Optimization and Improvement of Geothermal Power Plant Efficiency and Energy Conversion
- Establishment of Geothermal Training Center

**3. Encourage Service Contractors to undertake expansion and full utilization or optimization of the geothermal projects**
- Study and promotion of nonpower application/cascaded use of geothermal energy for development
- IEC campaign to address the following issues: environmental permits and approval of SLUP, FLAG, TCP; protected areas; LGUs and NCIP/IPs; social acceptability and harmonization with other government agencies' policies

**Continued improvement of database and networking for better data access of both internal and external clients**

**Continued exploration in identified, underexplored, unexplored resource assessment of geothermal areas (high and low temperature/enthalpy)**
<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>LUZON</td>
<td>20</td>
<td>800</td>
<td>65</td>
<td>-</td>
</tr>
<tr>
<td>VISAYAS</td>
<td>30</td>
<td>150</td>
<td>-</td>
<td>60</td>
</tr>
<tr>
<td>MINDANAO</td>
<td>-</td>
<td>230</td>
<td>90</td>
<td>20</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>50</strong></td>
<td><strong>1,180</strong></td>
<td><strong>155</strong></td>
<td><strong>80</strong></td>
</tr>
</tbody>
</table>

BARRIERS AND CHALLENGES IN GEOTHERMAL DEVELOPMENT

Technology
- Development technology that can tap acidic or young geothermal systems
- Lack of permeability in prospect areas
- Optimization of geothermal resource utilization through cascade use and development of low enthalpy geothermal systems
- Enhanced Geothermal System (EGS)

Environmental
- Utilization of geothermal resources located inside protected areas

Social Acceptability
- IPs Consent
- LGU Concerns

Policy
- FIT for emerging technology on geothermal energy
- RPS approval
BARRIERS AND CHALLENGES IN GEOTHERMAL DEVELOPMENT

- Capacity building and enhancement of geothermal technical expertise
- Continuous Inventory of geothermal resources
- Development and utilization of geothermal energy in off-grid and missionary areas
- Integration of climate change mitigation to energy policies, plans and programs
THE WAY FORWARD

• Formulation of guidelines for the direct use of small-scale geothermal energy
• Continued Resource Inventory and continued improvement of Geothermal RE Database
• Capacity Building / Information, Education and Communication Campaigns
• Establishment of Geothermal Training Center in coordination with RE Stakeholders
• Ongoing study on the exploration, development and market of low enthalpy, acidic reservoir and enhance geothermal system
THANK YOU !!!

www.doe.gov.ph