Feasibility Studies with the Aim of Developing a Bilateral Offset Credit Mechanism FY2011

Studies for Project Exploration and Planning


New Energy and Industrial Technology Development Organization (NEDO)
Sumitomo Corporation
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Outline of this Feasibility Study and reduction process

- Outline of this Feasibility Study (FS)

  In this FS, we investigated two types of projects. One is flash geothermal power projects. The other is projects that added a binary geothermal power system to an existing/future flash geothermal power system. Especially for the binary geothermal power system, brine that is emitted with the steam can be effectively used by adding it to the existing flash geothermal power plant.

  Flash system is the most popular geothermal power generation technology in the world. High-temperature steam and brine are extracted from the geothermal reservoir that is present deep underground (1,000-3,000 m), and the steam and brine are divided in a separator, with the steam sent to a turbine, so that the steam turbine is rotated using the power of the steam pressure and electricity is generated by a generator.

  Binary cycle power systems are used with hot water that is at a lower temperature (100° –300° F). The hot water is passed through a heat exchanger in conjunction with a secondary fluid with a lower boiling point (typically a hydrocarbon such as isobutane or isopentane, or other working fluids). The secondary fluid vaporizes, which turns the turbines to drive the generators. The remaining secondary fluid is simply recycled through the heat exchanger. The geothermal fluid is condensed and returned to the reservoir.
## Emission reductions (1/2)
- flash steam generation -

<table>
<thead>
<tr>
<th>Location</th>
<th>Grid name</th>
<th>Reference</th>
<th>Fiscal 2020 Emission reduction (t-CO2)</th>
<th>Fiscal 2025 Emission reduction (t-CO2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Java, Bali</td>
<td>JAMALI</td>
<td>0.713</td>
<td>13,393,025</td>
<td>21,205,624</td>
</tr>
<tr>
<td>Sumatera</td>
<td>Sumatera</td>
<td>0.743</td>
<td>16,303,947</td>
<td>25,814,583</td>
</tr>
<tr>
<td>Kalimantan</td>
<td>East Kalimantan</td>
<td>0.927</td>
<td>87,111</td>
<td>137,926</td>
</tr>
<tr>
<td></td>
<td>West Kalimantan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>South and Central Kalimantan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulawesi</td>
<td>North, Central Sulawesi and Gorontalo (Sulutenggo)</td>
<td>0.194</td>
<td>603,360</td>
<td>955,320</td>
</tr>
<tr>
<td></td>
<td>South, West and Southeast Sulawesi (Sulselrabar)</td>
<td>0.194</td>
<td>603,360</td>
<td>955,320</td>
</tr>
<tr>
<td>Others</td>
<td>-</td>
<td>0.661*</td>
<td>1,125,012</td>
<td>1,781,269</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>31,512,456</td>
<td>49,894,722</td>
</tr>
</tbody>
</table>
Emission reductions (2/2)

- binary cycle generation -

**Binary System Potential (use brine for flash system)**

Indonesia geothermal resource potential: 29,000 MW  
Steam consumption rate for electric power generation: 7.0 t/h/MW  
Equivalent steam flow rate: estimated as 203,000 t/h  
applying the average ratio of the produced steam and brine; 1:3)  
Brine flow rate produced together with the steam: estimated as 609,000 t/h  
Brine consumption rate for electric power generation of binary system: 70 t/h/MW

=> Binary resource potential can be calculated to be 8,700 MW

**GHG reduction**

Generating capacity (8,700 MW) x Availability factor (94%) x 24 (h) x 365 (days) x (baseline emission factor: 0.661 t-CO2/MWh – project emission factor: 0.00012 t-CO2/MWh) = 47.3 million t-CO2
Examination of draft MRV methods (1/3)

- **Examination policy**
  1. The CDM methodologies that relate to geothermal power generation project are specified.
  2. We will investigate and arrange how the methodologies concerning the "Calculation of baseline emissions", "Calculation/monitoring of project emissions" and "Demonstration and assessment of additionality“ specified in step 1 are applied to the existing CDM projects.
  3. The problems of the methodologies concerning the "Calculation of baseline emissions", "Calculation/monitoring of project emissions" and "Demonstration and assessment of additionality“ are identified through the examination in step 2 and the review of previous studies, and the points of improvements are specified.
  4. In Indonesia, we will conduct interviews concerning the points for improvement in step 3 and confirm their validity (the interviewees are 4 CDM consultants from two companies as project participants).
  5. Based on the results of step 4, the ideas for improvements in the CDM methodologies will be examined and settled on.
Examination of draft MRV methods (2/3)

- **The directions for improvements in the CDM methodologies**
  - **Calculation of the baseline emissions**
    1. Indication of the latest baseline emissions factors for each grid from the secretariats of the Bilateral Offset Credit Mechanism and the use of these by the project participant.
    2. Simplification of the baseline emissions calculation methodology (the option of the OM calculation method is limited to the one that the local participant can calculate and be simplified).
    3. Improvement of OM calculation methods (The improvement: The emissions factor adopted, whether the proportion of Low-cost/Must-run power supplies to the grid exceed 50% for the Simple OM and the Average OM calculation technique might differ greatly, and this might significantly affect the amount of the acquisition of the exhaust reduction amount/credits).
    4. The setting of the option of the BM calculation method (Especially for projects in the Least Development Countries is assumed. It is considered that there is no major problem in Indonesia).
    5. Improvement of the baseline emissions calculation methodology that lies behind equipment replacement and reinforcement projects (e.g. Review the period for obtaining the basic data).
  - **Calculation/monitoring of project emissions**
    1. Improvement of the methodologies concerning project emissions calculation/monitoring to meet local circumstances (the simplification of the monitoring method for CH4 contained in non-condensable gas, which requires work additional to the normal operation).
  - **Demonstration and assessment of additionality**
    1. The geothermal power generation project has the additional risks of drilling risks, etc., and because the rate of diffusion is also low, it obviously has additional issues compared with other forms of power generation. Making a positive list (list of the project types automatically considered as a bilateral mechanism) public is hoped to be avoided as long as the entrepreneur can depend on huge costs in relation to proof of the additionality.
Examination of draft MRV methods (3/3)

- Differences in the methodology between flash steam generation and binary cycle generation
  It is considered that a methodology for each of these is unnecessary. However, there may be two patterns for the spread of binary cycle generation, and it is thus hoped to supplement the methodology with the operational rules applied to each of them. These patterns and draft operational rules are provided below.

- Project that adds a binary geothermal power system to an existing flash geothermal power system
  The quantity of CH4 and CO2 emissions from non-condensable gas are calculated as emissions from an existing flash geothermal power system. Therefore, it is unnecessary to calculate them in this project.

- Project that introduces binary geothermal power system into a greenfield site
  The quantity of CH4 and CO2 emissions from non-condensable gas are calculated. However, there is room for improvement concerning the monitoring methodology for CH4 as shown in P.10.
**Potential of emission reductions and other benefit**

- **Calculation process of the potential GHG emissions reductions**
  - Calculation of the potential GHG emissions reductions in each area
    - Development Plan for each area (MW) × availability factor (%) × 24 (h) × 365 (day) × (baseline emissions factor - project emissions factor)
  - Estimation of the potential GHG emissions reductions in Indonesia
    - Add up the potential for each area, as calculated above.

- **Results**
  - The potential GHG emissions reductions in FY2020: About 31.5 million t-CO2
  - The potential GHG emissions reductions in FY2025: About 49.9 million t-CO2
  - Additional potential according to the addition of a binary power generation system to a flash steam generation system (where 8,700MW): About 47.3 million t-CO2

- (Ref.) Co-benefits (Nox, SOx and PM emissions reductions in FY2025 based on the introduction of geothermal power generation)

<table>
<thead>
<tr>
<th>NOx emissions (t)</th>
<th>SOx emissions (t)</th>
<th>PM emissions (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline emissions</td>
<td>49,698</td>
<td>56,488</td>
</tr>
<tr>
<td>Project emissions</td>
<td>462</td>
<td>38</td>
</tr>
<tr>
<td>Potential emissions reductions</td>
<td>49,236</td>
<td>56,450</td>
</tr>
</tbody>
</table>

*1 This is estimated provisionally from the development planned value of the Indonesian Geothermal Road -map and the geothermal resources potential of Indonesia.
*2 and 4 The mean value of CDM projects in Indonesia, which have dealt with geothermal power generation and are registered, is used.
*3 The emissions factor of each grid (Indicate this in the website of DNA)
Summary

- The potential for the spreading of geothermal power generation in Indonesia is high.
- The reduction potential and co-benefits due to the introduction of geothermal power generation are substantial.
- In particular, it is considered that binary cycle generation is a usage of new geothermal resources that can effectively use the brine that has not been used up to now. Therefore, its importance will increase in the future.
- For the promotion of its introduction, solving the technical problems identified in this FS is essential.
- There is room for improvement in the related CDM methodologies concerning the MRV methods for geothermal power generation. It is necessary to continuously discuss the MRV methods to meet the local circumstances, based on the points for improvement revealed in this FS.