Power Generation by Waste Heat Recovery in Cement Industry

Seminar on the Joint Crediting Mechanism (JCM) Project Implementation in Indonesia

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## JCM Model Project Summary

<table>
<thead>
<tr>
<th>Counterpart</th>
<th>PT Semen Indonesia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site</td>
<td>Tuban Plant, East Jawa</td>
</tr>
<tr>
<td>Power Generation</td>
<td>28MW</td>
</tr>
<tr>
<td>GHG Emission Reduction</td>
<td>122,000t-CO2/year</td>
</tr>
</tbody>
</table>

**Maps:**
- PJ Site
- Tuban: approx 100km from Surabaya
- Jakarta
- Surabaya
All Critical Equipment Component Installed
The System under Commissioning

No.1 SP Boiler Area

No.1 AQC Boiler Area
Recent Project Photos -2

- No.5 AQC Boiler Area
- Air Cooled Condenser
- STG Building
- Steam Turbine & Generator
JCM Project Scheme

Indonesian Government

Japanese Government

JCM Agreement

GHG Reductions

Semen Indonesia’s Budget

JCM Subsidy from Japan

International Consortium

✓ Construction
✓ Operation
✓ Maintenance
✓ MRV

✓ Engineering
✓ Equipment Supply

DISCUSSION PURPOSE ONLY

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## Eligibility Criteria - Approved Methodology ID_AM001

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criterion 1</td>
<td>The project utilizes waste heat from a cement production facility by waste heat recovery (WHR) system to generate electricity</td>
</tr>
<tr>
<td>Criterion 2</td>
<td>WHR system consists of a Suspension Preheater boiler (SP boiler) and/or Air Quenching Cooler boiler (AQC boiler), turbine generator and cooling tower</td>
</tr>
<tr>
<td>Criterion 3</td>
<td>WHR system utilizes only waste heat and does not utilize fossil fuels as a heat source to generate steam for power generation</td>
</tr>
<tr>
<td>Criterion 4</td>
<td>WHR system has not been introduced to a corresponding cement kiln of the project prior to its implementation</td>
</tr>
</tbody>
</table>
| Criterion 5 | The cement factory where the project is implemented is connected to a grid system and the theoretical maximum electricity output of the WHR system, which is calculated by multiplying maximum electricity output of the WHR system by the maximum hours per year (24*365=8,760 hours), is not greater than the total amount of the electricity imported to the cement factory from the grid system:  
  > During the previous year before the validation, if the validation of the project is conducted before the operation of the project, or  
  > During the previous year before the operation of the project, if the validation of the project is conducted after the operation of the project |
| Criterion 6 | The WHR system is designed to be connected only to an internal power grid of the cement factory |
Calculation of Reference Emissions

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E(A<em>B</em>C*D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity of Electricity Generation</td>
<td></td>
<td>Generation Capacity (MW)</td>
<td>Operating day per year (days/y)</td>
<td>Time (hrs/day)</td>
<td>Operating Rate</td>
</tr>
<tr>
<td>Dry Season</td>
<td>28</td>
<td>182.5</td>
<td>24</td>
<td>0.85</td>
<td>104,244</td>
</tr>
<tr>
<td>Rainy Season</td>
<td>22</td>
<td>182.5</td>
<td>24</td>
<td>0.85</td>
<td>81,906</td>
</tr>
<tr>
<td>The quantity of electricity consumption</td>
<td>2.4</td>
<td>365</td>
<td>24</td>
<td>1</td>
<td>21,024</td>
</tr>
<tr>
<td>The quantity of net electricity generation by the WHR system which replaced grid electricity import</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>165,126</td>
</tr>
</tbody>
</table>

$$RE_y = EG_y \times EF_{grid}$$

$$= 165,126 \text{ MWh/y} \times 0.741 \text{ tCO}_2 \text{e/MWh}$$

$$= 122,358 \text{ tCO}_2 \text{e/y}$$
**Reference Emissions**

**Reference**

Reference is the situation where WHR system has not been introduced. Diffusion rate of WHR system is very low in Indonesian Cement Industry 1 plant installed / 25 plants total

**Conservativeness**

Electricity consumption of WHR system is calculated by the theoretically maximum load of auxiliary equipment

=> Rated capacity of installed equipment \((\text{EG}_{\text{CAP}})\) related to WHR system and max. hours/period

\[
\text{EG}_{\text{AUX,y}} : 2.4 \text{MW}(\text{EG}_{\text{CAP}}) \times 24\text{h/d} \times 365\text{days} \\
1.9 \text{MW}(\text{Designed capacity}) \times 24\text{h/d} \times 365\text{days}
\]

The quantity of gross electricity generation by waste heat
Emission Reduction / Monitoring

Emission Reductions = Reference Emissions

Replacement of Grid Electricity Generation

- Calculation of reference/project emissions
  Emissions to be calculated in the methodology are those replaced by power generation of WHR system

- Emission Reductions = Reference Emissions - Project Emissions

- No additional fuel
  Project Emissions = 0

Monitoring

- $EG_{GEN,y}$: Quantity of gross electricity generation

Watt meter log data are saved:
every one minute in both electronic data in a server and on printed paper
After WHR System Installation

Reduction of grid power supply = Reduction of CO₂

- 20%
- 80%

Cement Production Process

- SP Boiler
- AQC Boiler
- Turbine Generator
- Electricity
- Steam
- Hot Exhaust Gas
- Suspension Preheater
- Rotary Kiln
- Clinker Cooler
- Stack
- Raw Mill

Coal-fired Power Plant

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## Waste Heat Recovery Benefits

<table>
<thead>
<tr>
<th>CO₂ Emission Reduction</th>
<th>Electricity Reserve for the Community</th>
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<tbody>
<tr>
<td>No Additional Fuel Required</td>
<td>Savings on Production Costs</td>
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</tbody>
</table>

- **WHR System to other cement factory in Indonesia**
- More opportunities in further reduction of GHG emission
## Reference: JCM WTE Project for Yangon City

- **First WTE Project with JCM**
- **First WTE Project in Myanmar**

### Counterpart
- Yangon City Development Committee

### Technology
- **Waste to Energy (WTE)**
  - Incinerator: 60ton/day
  - Generator: 0.7MW

### GHG Emission Reduction
- 4,700t-CO$_2$/year

### EPC Budget
- Yangon City’s Budget + JCM Subsidy from Japan

### Schedule
- **EPC**: FY2015-2016 (approx. 1.5 years)
- **MRV**: FY2017-2032 (15 years)

Facility Opening Ceremony on April 7th
Proposing Timeline for 2 Phase Project

Small Scale WTE As JCM Model Project

Capacity Building, Regulation Setting, Training of WTE Operation, Finance Arranging, etc.

Install WTEs in another Areas

Larger Scale WTE

JCM Application
Thank you

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