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

Studies for Project Exploration and Planning

Gas turbine cogeneration system for factories in Republic of South Africa

New Energy and Industrial Technology Development Organization (NEDO) Hitachi, Ltd.
Feasibility Studies with the Aim of Developing a Bilateral Offset Credit Mechanism

Gas turbine cogeneration system for factories in Republic of South Africa

February, 2012

New Energy and Industrial Technology Development Organization
Hitachi, Ltd.
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- CO₂ reduction potential
- Cogeneration system
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Outline

- Install high efficiency gas turbine cogeneration systems to the automotive industry in South Africa
- Contribute to the green house gas reduction by saving energy at factories
System Image

Outline
CO₂ reduction potential

Specification of the facilities in automobile factory

- Image of Ovens and ASU (Air Supply Unit)
CO₂ reduction potential

Natural Gas Demand

Gas consumption per hour

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CO₂ reduction potential

Electricity Demand

Year

Maximum demand (KVA)

1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011
Cogeneration System

Gas Turbine Image

Inside Cut Model

Completion Image
### Project outline and eligibility for MRV

#### “Installation of cogeneration system”

<table>
<thead>
<tr>
<th>Project outline</th>
<th>The project is CO₂ reduction project with installing or replacing of cogeneration system operation and satisfied all eligibility.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eligibility</td>
<td>Condition1: Install cogeneration equipment and replace heat supply from existing heat supply equipment.</td>
</tr>
<tr>
<td></td>
<td>Condition2: Heats (exclude unutilized energy) from cogeneration system such as exhaust heat, steam, etc. should be used own facility or supplied nearby facilities.</td>
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<td></td>
<td>Condition3: Generated electricity should be used for own facility. However, surplus electricity can be sold to the grid.</td>
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<tr>
<td></td>
<td>Condition4: Demonstrate additional by investment analysis or common practice analysis</td>
</tr>
</tbody>
</table>
MRV boundary

- **Power Plant**
  - Power selling
  - CO\textsubscript{2} emission

- **Gas company**
  - Natural gas

- **Factory**
  - Burner
  - Power for the facility
  - Drying system
  - ASU
  - Surplus heat

- **Electricity**
- **Heat**

- **Original amounts**

- **CO\textsubscript{2} Reduction**
Calculation of CO$_2$ emission reduction

<Emission reductions>

$$ER_y = BE_y - PE_y$$

- $ER_y$: Emission reductions during the year $y$ [t-CO$_2$/year]
- $BE_y$: Baseline emissions during the year $y$ [t-CO$_2$/year]
- $PE_y$: Project emissions during the year $y$ [t-CO$_2$/year]

<Project emissions>

$$PE_{PJ,y} = FC_{PJ,y} \times CV_{PJ,y} \times EF_{PJ,y}$$

- $PE_{PJ,y}$: Project emissions during the year $y$ [t-CO$_2$/year]
- $FC_{PJ,y}$: Quantity of project flue combusted during the year $y$ [m$^3$/year]
- $CV_{PJ,y}$: Net calorific value of the project fuel combusted during the year $y$ [GJ/m$^3$]
- $EF_{PJ,y}$: CO$_2$ emission factor of the project flue combusted in the year $y$ [t-CO$_2$/GJ]

<Base line emissions>

$$BE_y = BE_{heat,y} + BE_{elec,y}$$

- $BE_y$: Baseline emissions during the year $y$ [t-CO$_2$/year]
- $BE_{heat,y}$: Baseline heat emissions during the year $y$ [t-CO$_2$/year]
- $BE_{elec,y}$: Baseline emissions from electricity generation during the year $y$ [t-CO$_2$/year]
Calculation of $\text{CO}_2$ emission reduction

(a) Baseline heat emissions

(i) Calculation from the efficiency of the equipment

\[
BE_{\text{heat},y} = HG_{\text{PJ},y} \times \frac{100}{\eta_{\text{BL}}} \times EF_{\text{BL},y}
\]

$BE_{\text{heat},y}$ Baseline heat emissions during the year y [t-$\text{CO}_2$/year]
$HG_{\text{PJ},y}$ Utilized waste heat amounts which supplied from cogeneration equipment during the year y [GJ/year]
$\eta_{\text{BL}}$ Energy efficiency of heat supply equipment in the baseline [%]
$EF_{\text{BL},y}$ $\text{CO}_2$ emission factor of a fuel which is used for the equipment in the baseline [t-$\text{CO}_2$/GJ]

(ii) Calculation from Quantity of production (if heats are used all over the plant)

\[
BE_{\text{heat},y} = PD_{\text{PJ},y} \times FC_{\text{BL/Pr},y} \times FC_{\text{BL},y} \times EF_{\text{BL},y}
\]

$BE_{\text{heat},y}$ Baseline heat emissions during the year y [t-$\text{CO}_2$/year]
$PD_{\text{PJ},y}$ Quantity of production in the project activity during the year y [units/year, t/year]
$FC_{\text{BL/Pr},y}$ Unit fuel consumption of a product in the baseline [m$^3$/t or unit]
$FC_{\text{BL},y}$ Net calorific value of the fuel in the baseline [GJ/m$^3$]
$EF_{\text{BL},y}$ $\text{CO}_2$ emission factor of a fuel which is used for the equipment in the baseline [t-$\text{CO}_2$/GJ]
Calculation of CO$_2$ emission reduction

(b) Baseline electricity emissions

$$BE_{elec,y} = EL_{PJ,y} + EF_{BL,y}$$

- $BE_{elec,y}$: Baseline emissions from electricity generation during the year y [t-CO$_2$/year]
- $EL_{PJ,y}$: Baseline emissions during the year y [t-CO$_2$/year]
- $EF_{BL,y}$: Baseline emissions from electricity generation during the year y [t-CO$_2$/year]
## Monitoring data / parameter (Reference)

### <Activity amounts>

<table>
<thead>
<tr>
<th>Data/Parameter</th>
<th>HG_{Pj,y}: Utilized waste heat amounts which supplied from cogeneration equipment during the year y [GJ/year]</th>
</tr>
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</table>
| Measurement Procedures | ・ measure heat use by measuring instruments (e.g. flow meter, thermometer)  
・ Calculate from measured data (exhaust gas flow rate, temperature, etc.)  
・ Calculate from waste heat recovery efficiency of cogeneration equipment |
| Monitoring frequency | Continuously (during operation) |

### <Fossil fuel consumption>

<table>
<thead>
<tr>
<th>Data/Parameter</th>
<th>FC_{Pj,y}: Quantity of project flue combusted during the year y [m³/year]</th>
</tr>
</thead>
</table>
| Measurement procedures | Measure by measuring instruments.  
Use purchase slip |
| Monitoring frequency | On a voluntary basis |
Project evaluation

- Electricity tariff and gas tariff is highly affected to the IRR
- Carbon credits would contribute to the project IRR

Electricity tariff: 1.1 ZAR/kWh
Gas tariff: 3.0 ZAR/Nm³
Initial cost: 409 MZAR
Reference

<Project evaluation with or without carbon credits>

Electricity tariff: 1.1 ZAR/kWh
Gas tariff: 3.0 ZAR/Nm3
Initial cost: 409 MZAR
Conclusion

- Installation image of cogeneration plant is designed in car factory
- \( \text{CO}_2 \) reduction is calculated 86,000 t/year for installation of cogeneration plant
- Electricity tariff and fuel price are strong impact parameter for feasibility of the project
- Bilateral offset credit can support the realization of the project