Development of District Energy Supply Business by Introducing Co-generation
(FY2015 JCM Feasibility Study, Ministry of Environment, Japan)

February, 2016
1. Overview of JCM FS

a. Project Location
   - Central Jakarta

b. Description of the technology

- Gas Engine
  - 2,000 kW \times 2 \text{ unit}

- Abs. Chiller
  - 1,884 kW \times 2 \text{ unit}

- Gas fired chiller
  - 3,869 kW \times 1 \text{ unit}

- City Gas

- Cooling Tower

- Electricity: 35 GWh/yr

- Cold water: 27 GWh/yr

- (Difference between Supply and Return)

- Clean Water

- Grid Electricity

- Water

- Complex Buildings

- Local Real Estate Developer (A Company)

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1. Overview of JCM FS

d. Project Detail

Project Scope

Complex Buildings
(Office, Apartment, Hotel)

Electricity (PLN)
Gas (PGN)
Water (PALYJA)

Elec. Meter
Gas Meter
Water Meter

PIP, DB

Facility Building

Gas Engine
Chiller

Gas Engine
Chiller

Hot Water
Cold Water

Header

PFP, DB

FCU: Fan Coil Unit
DB: Distribution Board
PFP: Power Feeder Panel
PIP: Power Incoming Panel

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d. Project Detail

**Electricity Demand**

<table>
<thead>
<tr>
<th>Hourly Electricity Demand (weekday)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
</tr>
<tr>
<td>Sky Bridge</td>
</tr>
<tr>
<td>Hotel</td>
</tr>
<tr>
<td>Apartment</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

**Heat Demand**

<table>
<thead>
<tr>
<th>Building/Facility</th>
<th>Floor Area [m²]</th>
<th>Annual Demand [TJ/year]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
<td>26,464</td>
<td>33</td>
</tr>
<tr>
<td>Sky Bridge</td>
<td>7,110</td>
<td>16</td>
</tr>
<tr>
<td>Hotel</td>
<td>11,880</td>
<td>11</td>
</tr>
<tr>
<td>Apartment</td>
<td>37,584</td>
<td>37</td>
</tr>
<tr>
<td>Total</td>
<td>83,038</td>
<td>98</td>
</tr>
</tbody>
</table>

**Input / output condition**

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INPUT</strong></td>
<td></td>
</tr>
<tr>
<td>Electricity Consumption</td>
<td>6.5 [GWh/year]</td>
</tr>
<tr>
<td>Gas Consumption</td>
<td>6.9×10^6 [m³/year] (73 [GWh/year])</td>
</tr>
<tr>
<td>Water Consumption</td>
<td>1.4×10^5 [m³/year]</td>
</tr>
<tr>
<td><strong>OUTPUT</strong></td>
<td></td>
</tr>
<tr>
<td>Electricity Sale</td>
<td>35 [GWh/year]</td>
</tr>
<tr>
<td>Cold Heat Sale</td>
<td>98 [TJ/year] (27 [GWh])</td>
</tr>
</tbody>
</table>
d. Project Detail

Current Situation of Electricity and Gas Supply in Jakarta

<table>
<thead>
<tr>
<th>Frequency of Blackout</th>
<th>Office Building A</th>
<th>Office Building B</th>
<th>Hotel</th>
<th>Commercial Building</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Once/Month</td>
<td>3 to 4 times/year</td>
<td>Once/Month</td>
<td>—</td>
</tr>
<tr>
<td>(Max two hours)</td>
<td></td>
<td>(2 hours/time)</td>
<td>(Mainly voltage drop)</td>
<td>(N.A.)</td>
</tr>
<tr>
<td>Frequency of Gas Supply Stop</td>
<td>Twice/year</td>
<td>(N.A.)</td>
<td>Once</td>
<td>Once/5 years</td>
</tr>
</tbody>
</table>

Gas Engine Example in Jakarta

- Plaza Indonesia is a large shopping mall in Jakarta (Started since 2009, net floor area: aprox 62,747 m2).
- Electricity from gas engine make up 75% of total demand (as long as we know). No use for wasted heat.

- Co-generation system is still unpopular in Jakarta especially commercial market.
- Spread of energy saving system also contributes to sustainable society in addition to power plant expansion.
1. Overview of JCM FS

d. Project Detail

 Perspective of Government and State-owned Companies

| ESDM | • ESDM anticipates private sector's investment on electricity business as the electricity generation capacity is not sufficient in Indonesia.  
• Basically one electricity company shall be in one business area for public electricity supply under the current electricity regulation.  
• If current electricity company's supply is not enough, other company is able to obtain business area. |
| PLN  | • PLN supposes the electricity capacity is sufficient in Jakarta.  
• Business area may be given to private company where it is difficult for PLN to supply. |
| PGN  | • PGN is supportive for installing cogeneration system. |

- If the business area license were open to private company, more business opportunity born and energy efficient technology could be adopted.
1. Overview of JCM FS

d. Project Detail

Considerable Business Scheme

- PLN
- PGN
- PALYJA

Real Estate Development Company

Energy Service Operator

Manufacturer

Area for Rent
- Tenant of Rental Office
- Resident of Rental Apartment

Area for Sale
- Tenant of strata Office
- Resident of Strata Apartment

Elec. City Gas Water

Selling of Elec and Heat Operation of Cogeneration

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2. Reference Scenario

• Characteristics of the Project
  – Produce electricity by gas engine, which is operated by natural gas, to supply electricity to the complex buildings
  – Produce cold-heat by absorption chiller, which is operated by waste heat out of the gas engine, to supply air-conditioning service to the complex facility

• Reference Scenario
  – Electricity from the national power grid
  – Cold-heat from electric chiller operated by electricity from the national power grid
### 3. Monitoring Methods

#### Double Check / Feasibility Check / Monitor Accuracy Check

<table>
<thead>
<tr>
<th>Category</th>
<th>Check Item</th>
<th>Technical manager·Staff</th>
<th>Financial manager</th>
<th>Calibration Staff</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>Supply status / Amount</td>
<td>☑</td>
<td>-</td>
<td>☑ (International standards)</td>
<td>Gas meter Invoices</td>
</tr>
<tr>
<td></td>
<td>Price / Amount</td>
<td>-</td>
<td>☑</td>
<td>-</td>
<td>Invoices</td>
</tr>
<tr>
<td>Electricity</td>
<td>Supply status / Amount</td>
<td>☑</td>
<td>-</td>
<td>☑ (International standards)</td>
<td>Electricity meter</td>
</tr>
<tr>
<td></td>
<td>Price/ Amount</td>
<td>-</td>
<td>☑</td>
<td>-</td>
<td>Invoices</td>
</tr>
<tr>
<td>CO2 Emissions</td>
<td></td>
<td>☑</td>
<td>☑</td>
<td>-</td>
<td>MRV report</td>
</tr>
<tr>
<td>Maintenance Cost</td>
<td>(Operation cost)</td>
<td>☑</td>
<td>☑ (maintenance cost)</td>
<td>-</td>
<td>Invoices Working records</td>
</tr>
<tr>
<td>Feasibility check</td>
<td></td>
<td>-</td>
<td>☑</td>
<td>-</td>
<td>Reference electricity price check</td>
</tr>
</tbody>
</table>
4. Quantification of GHG Emissions and their reductions

- **Condition**
  - Electricity demand of the complex facility: 35 GWh/year
  - Cold-heat demand of the complex facility: 98 TJ/year
  - Natural gas consumption for gas engine: 243 TJ/year
  - Natural gas consumption for gas-fired absorption chiller: 21 TJ/year
  - Electricity received from power grid: 6.5 GWh/year

- **Reference Emission**
  - 33,313 tCO₂/year
    - CO₂ emission factor of the grid: 0.843 tCO₂/MWh (Latest Emission Factor, JAMALI, Ex-ante)
    - COP of centrifugal chiller: 5.94 (ID_AM002 “Energy Saving by Introduction of High Efficiency Centrifugal Chiller”)

- **Project Emission**
  - 20,321 tCO₂/year
    - CO₂ emission factor of the grid: 0.843 tCO₂/MWh (Latest Emission Factor, JAMALI, Ex-ante)

- **GHG Emission Reductions**
  - GHG Emission Reductions = Reference Emission – Project Emission
  - = 33,313 tCO₂/year – 20,321 tCO₂/year = 12,992 tCO₂/year

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5. MRV Methods

- **Financial Division Manager**
  - Collecting invoices
  - Reference data

- **Technical Division Manager**
  - Checking data
  - Managing monitoring equipment

- **Monitoring Staff**
  - Collecting data
  - Natural Gas, Electricity

- **Calibration Staff**
  - Daily Check
  - Calibrating monitoring equipment

- **Co-Generation Operator**
  - Reporting

- **General Manager**
  - CO2 Emissions
  - Feasibility Check

- **Developer**

- **JCM Secretariat**
  - Reporting

- **Natural Gas, Electricity, Maintenance**

- **Double Check**

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6. Capacity Building Plan

- Co-generation system design and Operation knowhow will transferred.

7. Others

<table>
<thead>
<tr>
<th>Investment</th>
<th>Category</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Equipment [billion Rp]</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>Building [billion Rp]</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Total [billion Rp]</td>
<td>69</td>
</tr>
</tbody>
</table>

Condition

- Corporate Income Tax: 25%
- Depreciation Period (20 yrs for building, 16 yrs for facilities)
- Exchange Rate: Rp. 13,333/US$, Rp. 110/JPY
- Operation Period: 17 years (2 yrs for construction, 15 yrs for operation)

Pay Back periods

- 11 years

If there are any opportunity adopting co-generation system in Indonesia, please contact to JGC!