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

Studies for Project Development and Organization

Operation Optimization Technology for Utility Facilities

New Energy and Industrial Technology Development Organization (NEDO)
Yamatake Corporation
Feasibility Studies with the Aim of Developing a Bilateral Offset Credit Mechanism

Operation Optimization Technology for Utility Facilities

Feb. 2012
Yamatake Corporation
Application of “Utility Facility Operation Optimization Technology” by Yamatake Corp.

The technology can be applied to the existing utility system in the factory of various industries and is high return-on-investment (ROI) technology, since it works on simple computer systems, without high-performance hardware or other expensive equipment. It has great amount of CO2 reduction potential for various industries in Indonesia such as refinery plant, chemical plant, district heating and cooling and so on.

Investigation Outline

Application of “Utility Facility Operation Optimization Technology” in Indonesia, which were successfully applied to many industries in Japan, will contribute the reduction of CO2 emission in Indonesia. Feasibility study will investigate the contribution of this technology to “New offset Mechanism”

Investigation Items

Feasibility study of this technology in Indonesia as below.

1. Applicable finance and ESCO scheme to be investigated.
2. Measure, report and verification method to be specified.
3. Market potential of this technology to be investigated.

Counter part in Indonesia

Pulp & Paper company
Textile company

Expected CO2 Reduction

Estimated reduction %: around 4% of total emission
Target reduction 300,000 ton CO2/ year in Indonesia
Feasibility Study for New Offset Mechanism
Country: Indonesia

Outline of Applied Technology

Equipment Selection

Load Allocation

Primary Energy
- Elec. Power
- Fuel Oil
- Gas
- Cogeneration
- MP Steam

Utility Facility
- Compressor
- Heat Storage
- Chiller
- Turbine
- Turbine
- Turbine

Utility Distribution
- Elec. Power
- Substation
- Air
- Cooling Water / Hot Water

Production Area
- Stable supply for utilities
- Consideration for trouble in utility plant
- Consideration for demand change

Minimize CO2 & Energy Cost

U-OPT
Outline of Applied Technology

Utility Facility Operation Optimization Technology can greatly improve energy conservation when applied to an existing utility facility consisting of equipment such as boilers, steam turbine generators, co-generation systems, refrigerators, and hot/cold water heat exchangers. With the use of this optimization and control technology, the operation of various pieces of equipment that previously worked independently can be coordinated in an optimal way, with the aim of eliminating energy loss and increasing total facility efficiency throughout the entire utility facility.

This technology can achieve conservation of energy in existing utility equipment by the use of software (optimization and control technology) running on simple computer systems, it is not necessary to invest in high-performance hardware or other expensive equipment.

Thus it can be truly said that this technology is high return-on-investment (ROI) technology. In actual results in Japan, an energy cost reduction of 2–5 % and the same amount of CO2 reduction was achieved.
This methodology referred Small-Scale CDM Methodology AMS Type II.B. “Supply side energy efficiency improvements-generation”. This also referred to AM0018 “Baseline methodology for steam optimization system”.

“Specific $\text{CO}_2$ Emission Ratio (SCER)”, is determined to calculate baseline emission.

\[
\text{SCER} = \frac{(\text{consumption of fuel oil} \times \text{EF of fuel oil}) + (\text{consumption of fuel gas} \times \text{EF of fuel gas})}{\text{Steam output}}
\]

Baseline emission for CO2 = Steam output * SCER

EF: Emission Factor of CO2
Feasibility Study for New Offset Mechanism  Country: Indonesia

MRV method (Case 1)

**Step 1:** Gathering data for the baseline consumption of fuel oil
**Step 2:** Gathering data for the baseline consumption of fuel gas
**Step 3:** Gathering data for the baseline steam generation by boilers
**Step 4:** Benchmarking the baseline specific \( \text{CO}_2 \) emission ratio (SCER) Calculating the average baseline SCER for each steam demand range by using historical data
**Step 5:** Measure Steam generation and multiply SCER

Baseline emission for \( \text{CO}_2 \) = Steam generation \( \times \) SCER
Project emission for \( \text{CO}_2 \) = Fuel Consumption \( \times \) EF for Fuel

Range for SCER

The steam demand are not constant. Because of this, the load of the boilers has to be changed. And boiler efficiency is affected by boiler load.

In order to take this into account, multiple SCERs are set with respect to each range of total steam demand in this methodology (Figure 2).
Boiler total efficiency will be affected by
⇒ Steam demand
⇒ Individual boiler efficiency
⇒ Boilers selection
To have more accurate baseline it is better to consider those effect factors.
This simulation approach is including all these effect factors to calculate baseline emission.

Key Parameters
☞ CO₂ Minimum Emission (simulation value)
Operation emitting the least CO₂
(theoretical maximum efficiency)
☞ CO₂ Maximum Emission (simulation value)
Operation emitting the most CO₂
(theoretical minimum efficiency)
☞ Deviation ratio (%)
Deviation from CO₂ Minimum Emission, which demonstrates how far the actual boiler operation allows emitting CO₂, compared to theoretical maximum efficiency
Procedure for calculation of CO₂ emission reduction

Before installation

After installation

U-OPT installation

CO₂ emission [ton]

Actual CO₂ emission

Baseline emission (after optimisation)

Average deviation ratio (%)

CO₂ emission reduction

CO₂ Maximum Emission (simulated value by U-OPT)

CO₂ Minimum Emission (simulated value by U-OPT)

Before installation

After installation

U-OPT installation

CO₂ Maximum Emission (simulated value by U-OPT)

CO₂ Minimum Emission (simulated value by U-OPT)

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Indonesian energy use in 2007

<table>
<thead>
<tr>
<th>Industrial Section</th>
<th>Energy usage (ktoe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Ceramic</td>
<td>5,008</td>
</tr>
<tr>
<td>2 Pulp &amp; Paper</td>
<td>1,436</td>
</tr>
<tr>
<td>3 Textile</td>
<td>1,047</td>
</tr>
<tr>
<td>4 Mining</td>
<td>920</td>
</tr>
<tr>
<td>5 Metal &amp; Steel</td>
<td>906</td>
</tr>
<tr>
<td>6 Chemical &amp; Petrochemical</td>
<td>707</td>
</tr>
<tr>
<td>7 Food</td>
<td>603</td>
</tr>
<tr>
<td>8 Consutaraaction</td>
<td>296</td>
</tr>
<tr>
<td>9 Non-ferrous Metal</td>
<td>174</td>
</tr>
<tr>
<td>10 Machine</td>
<td>62</td>
</tr>
<tr>
<td>Others</td>
<td>25,990</td>
</tr>
<tr>
<td>Total</td>
<td>47,242</td>
</tr>
</tbody>
</table>

**Expected CO2 Reduction**

- **Textile and Pulp & Paper industry**
  - In those 2 section, 30% of energy use company apply U-OPT technology.
  - Estimated reduction is around 2% of total emission.
  - Then, the target reduction in Indonesia P&P and Textile industry is 50,000 ton-CO2/ year.

- **Industrial Total**
  - In the total industrial section, 10% of energy use company apply U-OPT technology.
  - Estimated reduction is around 2% of total emission.
  - Then, the target reduction in Indonesia industry is 300,000 ton-CO2/ year.
(1) Target factory  
This factory produces pulp and paper. The total amount of pulp and paper produced is 700,000 tons per year.

(2) Economic viability evaluation  
We received equipment data and operation data from the site. We calculated the benefit (energy cost reduction) of applying U-OPT to the site. The result was that an energy cost reduction of around 2.2 % (US $506,000/year) and a CO2 reduction of around 2.3 % (3,869 tons/year of CO2) can be expected.

<table>
<thead>
<tr>
<th>Economic indicators without CO2 credits</th>
<th>assumptions:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NPV (Net Present Value)</strong></td>
<td>USD 1,668,408</td>
</tr>
<tr>
<td><strong>IRR (Internal Rate of Return)</strong></td>
<td>77%</td>
</tr>
<tr>
<td><strong>PI (Profitability Index)</strong></td>
<td>3.88</td>
</tr>
<tr>
<td>Equipment life = 10 years</td>
<td></td>
</tr>
<tr>
<td>Discount rate = 15 %</td>
<td></td>
</tr>
<tr>
<td>Carbon credit price: USD 14.28/ CO2-t</td>
<td></td>
</tr>
<tr>
<td>Total investment value = USD 580,000</td>
<td></td>
</tr>
<tr>
<td>TSA (technical service assistance) = 10 % of initial investment per year</td>
<td></td>
</tr>
</tbody>
</table>
(1) Target factory
   The factory produces viscose staple fibers and sodium sulfate. The total amount of
viscose staple fibers produced is 238,000 tons per year, and the total amount of sodium
sulfate is 120,000 tons per year.

(2) Economic viability evaluation
   We received equipment data and operations data from the site. We then calculated the
benefit (energy cost reduction) of applying U-OPT to the site.
   The result was that an energy cost reduction of around 3.4 % (US $950,000/year) and
a CO2 reduction of around 3.5 % (8,900 tons/year of CO2) can be expected.

**Economic indicators without CO2 credits**

<table>
<thead>
<tr>
<th></th>
<th>USD 3,896,742</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPV (Net Present Value)</td>
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</tr>
<tr>
<td>IRR (Internal Rate of Return)</td>
<td>154%</td>
</tr>
<tr>
<td>PI (Profitability Index)</td>
<td>7.72</td>
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</table>

**assumptions:**
- Equipment life = 10 years
- Discount rate = 15 %
- Carbon credit price: USD 14.28/ CO2-t
- Total investment value = USD 580,000
- TSA (technical service assistance) = 10 % of initial investment per year

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A shift from controlling equipment
to fulfilling people's satisfaction ——
azbil is a new symbol of the Yamatake Group