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

Studies for Project Development and Organization

Introducing Energy Efficiency Technologies for integrated Steel Works in India

New Energy and Industrial Technology Development Organization (NEDO)
JFE Steel Corporation
JFE Techno-Research Corporation
## Outline of JFE Steel and JFE Techno research’s FS Project

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Introducing Energy Efficiency Technologies for integrated Steel Works in India</th>
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<tr>
<td><strong>Overview</strong></td>
<td>Energy efficiency improvement and CO2 emission reductions through various superior Japanese technologies were assessed for integrated steel works in India.</td>
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</tbody>
</table>
| **Study site and Schedule** | The Vijayanagar works, KA: 1000MTPA  
The Dolvi works, MH: 300MTPA  
Project term: July 7, 2011 to February 29, 2012 |
| **Survey Items** | 1) Basic energy balance survey and field study, and potential estimation in the Dolvi works, JSW ISPAT in MH  
2) Basic engineering activity for waste heat recovery equipment in the Vijayanagar works, JSW Steel in KA  
3) Appropriate MRV methodology study in the Bilateral Offset Credit Mechanism (BOCM)  
4) Economic and financial feasibility assessment |

### Background

Steel production in India was almost 70MT, but per capita steel demand is still quite low in 2010 and is expected to grow rapidly in next decades because of its huge population and emerging economy. Average energy efficiency in Indian steel industry, however, is about 30% worse than that of Japan. Therefore various technologies for better energy efficiency developed by Japan’s steel industry will contribute energy saving and CO2 emission reduction in India.

### Possible technologies to improve energy efficiency in steel industry

- Better TRT operation
- Revamping of heat recovery (Hot Stove)
- Advanced Ignition burner
- Product Cooler heat recovery and Flue gas recovery from Main
- Heat recovery from CONARC flame
- Ladle preheating with regenerative burner
- Better operation of air compressors
- Inverters for large motors
- Power Generation using flaring BFG
- Total Energy Management and Control
- Better operation for O2
- Air and Steam balance
- Increase heat recovery
- Usage of COG

### Steel industry in Japan can provide excellent and proven technologies to improve energy efficiency that have been already identified in the SOACT handbook developed through APP Steel Task Force. Experts in JFE studied applicability of these technologies and their potential effects to save energy consumption and to reduce CO2 emission in Indian integrated steel works. Economic and financial feasibility were also assessed.
Per Capita Steel consumption

![Bar chart showing steel consumption per capita for Japan, India, China, Thailand, and the US. The world average is 211 kg.]

Energy Efficiency in steel production

![Bar chart showing energy efficiency relative values for Japan, Korea, US, China, and India. Japan has a value of 100, Korea 107, US 125, China 129, and India 132.]
Reference 1. History of Energy Saving Law (Japan)

History of the Law Regarding the Rationalization of Energy Use (Energy Saving Law) in Japan

| Enactment 1979 | ● Enacted for the purpose of promoting comprehensive energy conservation in all sectors, replacing the former Heat Management Act of 1951, which focused narrowly on heat use in the industrial sector. The new law expanded the application of the law to include the consumer, commercial, and transportation sectors, and also added electricity as an object type of energy.  
● Preconditioned on voluntary efforts by businesses using energy, this was a “guidance” type law which relied by guidance/advice that those concerned should follow the guidelines established by the national government. |
| Revision No. 1 1983 | 1) Transferred authority for testing of Qualified Energy Managers to the Energy Conservation Center, Japan (ECCJ). |
| Revision No. 2 1993 | ● A basic policy for energy conservation was established in response to the Rio Earth Summit of 1992, and calls were made for wide-ranging energy conservation efforts.  
1) Periodic reporting of the amount of use was made mandatory for Designated Energy Management Factories. |
| Revision No. 3 1998 | ● Energy conservation efforts were further strengthened in response to the Kyoto Protocol adopted by COP3 in 1997.  
1) In order to promote energy conservation at small-scale factories, a category of Type 2 Designated Energy Management Factory (1,500kl or more or 6GW or more) was created, and selection of an Energy Manager and record-keeping regarding the condition of energy use was made mandatory for those factories.  
2) Submission of mid- and long-term plans was made mandatory for Type 1 Designated Energy Management Factories.  
3) The top-runner system for automobiles and home electrical appliances, etc. was introduced. |
| Revision No. 4 2002 | ● Increasing energy consumption in the consumer and commercial sectors was viewed as a problem.  
1) Designation of types of industries subject to Type 1 Designated Energy Management Factory requirements was abolished (had been limited 5 types of industry including manufacturing, etc. in the past), extending application to the commercial, consumer, and other sectors.  
2) Periodic reporting of amount of energy use was made mandatory for Type 2 Designated Factories.  
3) Reporting of energy conservation measures was made mandatory for owners of designated buildings (non-residential buildings with floor area of 2,000m2 or more). |
With the Kyoto Protocol taking effect in February 2005, regulations on the transportation and residential sectors were strengthened.

1) Unified management of heat and electricity was introduced, and the factories subject to mandatory requirements were expanded.

2) Reporting of the condition of use and establishment of energy conservation plans was made mandatory for transportation contractors and cargo owners of a certain scale and larger.

3) Designated buildings required to report energy conservation measures (floor area of 2,000m² or more) were expanded to include residential buildings.

Increasing use of energy in the commercial and household sectors was viewed as a problem.

1) Control by factory/place of business units was changed to control by company unit, and franchise chains, etc. were defined as companies subject to mandatory requirements.

2) Sectoral benchmarks were introduced (5 industry categories in 2008, 3 in 2009).

3) Residential top runner standards were introduced.

### Main Energy Conservation Countermeasures by Sector

#### Industrial sector

- For Designated Energy Management Factories, mandatory selection of Qualified Energy Manager, periodic reporting of condition of use and submission of mid- and long-term plans.

- In response to reports and site survey results, guidance and advice based on objective standards.

- Private companies’ active efforts and implementation of Voluntary Environmental Action Plans under the leadership of Keidanren (Federation of Economic Organizations).


- Following the Oil Crises, unit energy consumption in the Mining and Manufacturing Production Index showed an improving trend.

#### Consumer sector

- Establishment of the top-runner system for passenger automobiles and main household electrical appliances (initially applied to 13 items, expanded to 23 in 2006).

- Energy conservation labels for products (18 items), and Excellent Energy Saving Product Promotion Store Mark.

- Residence/Building Energy Conservation Countermeasures Support System.

- Support for ESCO projects.

#### Transportation sector

- For transportation contractors and cargo owners, mandatory reporting of condition of use and mid- and long-term plans.

- Improvement of fuel efficiency of passenger automobiles and trucks by the top-runner system.

- Japan’s comprehensive energy conservation law for transportation contractors is without precedent in the world.

**Targets and achievement of Top runner programme: 1st stage**
<table>
<thead>
<tr>
<th>Equipment</th>
<th>Base year</th>
<th>Improvement</th>
<th>Achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Target (%)</td>
<td>Year</td>
</tr>
<tr>
<td>1 TV sets</td>
<td>1997</td>
<td>16.4</td>
<td>2003</td>
</tr>
<tr>
<td>2 VCR</td>
<td>1997</td>
<td>58.7</td>
<td>2003</td>
</tr>
<tr>
<td>3 Air conditioners</td>
<td>1997</td>
<td>66.1</td>
<td>2004</td>
</tr>
<tr>
<td>4 Refrigerators</td>
<td>1998</td>
<td>30.5</td>
<td>2004</td>
</tr>
<tr>
<td>5 Freezers</td>
<td>1998</td>
<td>22.9</td>
<td>2004</td>
</tr>
<tr>
<td>6 Passenger vehicles</td>
<td>1995</td>
<td>22.8</td>
<td>2005</td>
</tr>
<tr>
<td>7 Trucks</td>
<td>1995</td>
<td>6.5</td>
<td>2005</td>
</tr>
<tr>
<td>8 Vending machines</td>
<td>2000</td>
<td>33.9</td>
<td>2005</td>
</tr>
<tr>
<td>9 Lighting equipment</td>
<td>1997</td>
<td>16.6</td>
<td>2005</td>
</tr>
<tr>
<td>10 Copy machines</td>
<td>1997</td>
<td>30.8</td>
<td>2006</td>
</tr>
<tr>
<td>11 Computers</td>
<td>2001</td>
<td>69.2</td>
<td>2007</td>
</tr>
<tr>
<td>12 Magnetic disk equipment</td>
<td>2001</td>
<td>71.4</td>
<td>2007</td>
</tr>
<tr>
<td>13 Warm lavatory basin</td>
<td>2000</td>
<td>10.0</td>
<td>2006</td>
</tr>
</tbody>
</table>

Targeted equipment for Top runner programme 2nd stage started in 2006

<table>
<thead>
<tr>
<th>1 Passenger vitals</th>
<th>9 Magnetic disk equipment</th>
<th>17 Vending machines</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Turks</td>
<td>10 Refrigerators</td>
<td>18 Electrical Transformer</td>
</tr>
<tr>
<td>3 Air conditioners</td>
<td>11 Freezers</td>
<td>19 Rice cookers</td>
</tr>
<tr>
<td>4 TV sets</td>
<td>12 Gas stove</td>
<td>20 Kitchen microwaves</td>
</tr>
<tr>
<td>5 VCRs</td>
<td>13 Gas ovens</td>
<td>21 DVD recorders</td>
</tr>
<tr>
<td>6 Lighting equipment</td>
<td>14 Gas water heaters</td>
<td>22 Rutting equipment</td>
</tr>
<tr>
<td>7 Copy machines</td>
<td>15 Oil water heaters</td>
<td>23 Switching equipment</td>
</tr>
<tr>
<td>8 Computers</td>
<td>16 Warm lavatory basin</td>
<td></td>
</tr>
</tbody>
</table>

*Italic shows newly targeted items in the 2nd stage.*
Moonlight Plan

Japan established the Sunshine Plan for new energy development in the summer of 1973, just before the 1st Oil Crisis, and then launched the Moonlight Plan in fiscal year 1978 as an energy conservation technology development project. Japan continued vigorous promotion of these technical development projects even in the mid-1980s, when oil supply-and-demand was slack and prices remained low. In FY 1993, the two plans were consolidated into one under the New Sunshine Plan, which was continued until FY 2000. The following is an outline of the Moonlight Plan.

| A. Large-scale energy conservation technologies | 1) Waste heat utilization technology system: 1978-82, total, ¥3.4 billion  
2) Magneto hydrodynamic generation: 1978-83, total, ¥3.8 billion  
3) High efficiency gas turbine: 1978-87, total, ¥27.7 billion  
4) New type battery power storage system: 1978-91, total, ¥16.2 billion  
5) Fuel cell generation technology: 1981-95, total, ¥21.3 billion  
6) General-purpose Stirling engine: 1982-87, total, ¥7.0 billion  
7) Super heat pump: 1984-92, total, ¥6.6 billion  
8) Superconducting power application technology: 1988-99, total, ¥27.5 billion  
9) Ceramic gas turbine: 1988-98, total, ¥14.9 billion  
10) Distributed battery power storage technology: 1992-2001, total, ¥17.5 billion |
| Others | B. Advanced basic energy conservation technologies:  
C. International research cooperation project: Participation in IEA Implementing Agreement for Heating Pump Technology; Japan-US MHD cooperation  
D. Survey of establishment of energy conservation technologies  
E. Support for private-sector energy conservation technology development: Securing an energy conservation technology framework in the subsidy system  
F. Standardization of energy conservation  
G. Survey of energy conservation software technologies |
Policy measures to address climate change

The Kyoto Protocol became effective in 2005 decided 6% from 1990 level as Japan’s national mitigation target. The government of Japan established “the KP goal achievement plan” in 2005 and has been promoting various policy measures. Before the 1st commitment period of the Kyoto Protocol started in April 2008, the plan was fully revised in March 2008.

After big earthquake and the Fukushima on 311, 2011, the government has started to review its whole energy policy, which has close relation with addressing climate change measures. The followings are current major policies to reduce energy related CO2 emissions and CO2 emission in Japan has already peaked out.

<table>
<thead>
<tr>
<th>Fiscal year</th>
<th>1990</th>
<th>Goal</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHG emission</td>
<td>1,261</td>
<td>1,221</td>
<td>1,280</td>
<td>1,209</td>
<td>1,244</td>
</tr>
<tr>
<td>Energy related CO2</td>
<td>1,059</td>
<td></td>
<td>1,153</td>
<td>1,090</td>
<td>1,124</td>
</tr>
</tbody>
</table>

Major policy measures to reduce CO2 emission

- **“Voluntary action plan” by business association**
  - “Keidanren” (strong business association in Japan) promoted to formulate action plans to reduce CO2 and other GHG for its members, 50 sub-sectors in industry, 32 in commercial, 17 in transportation and 4 in energy conversion. They quantitatively assess and publish their progress and achievement every year. It covers 80% of GHG emission from industry sector and 50% of national emission.
  - The governmental committee evaluates and verifies their report; therefore the action plan is likely mandatory, not voluntarily.

- **Promoting energy efficiency equipment**
  - Top runner system for vehicles and major home appliances
  - Official support to introduce energy efficient facilities in industry and commercial sectors
  - “Eco-point system” for house hold: TV sets, AC, Refrigerators

- **Enhanced Energy management**
  - Expanded Energy Efficiency Law target sector of transport and commercial
  - Enterprise base regulation was introduced substituted from site base regulation in 2008 revision to cover franchise chain retailers
  - Common benchmark for some energy intensive industry sub-sectors such as power, iron & steel, cement

- **SMEs**
  - Joint Implementation system to improve energy efficiency in small and medium companies using large companies’ resource
  - Various official support and “Domestic emission credit system”

- **Purchasing CER**
  - 100 million ton by the government
  - About 300 million ton by power utilities and iron & steel companies

Reference 2. Pollution control and regulations in Japan