Energy Saving Practices
A Japanese Steel Industry Case

March 29, 2017

Hiroyuki Tezuka
Chair, Energy Technology Committee
Japan Iron & Steel Federation
&
JFE Steel Corporation
Japanese steel industry - Overview

- Second largest steel-making country
- Contribute to manufacturing sectors in Japan by supplying high grade steel

Crude steel production in 2016
Total production: 1,629 Mt

Source: worldsteel

Automobile
\(52\ trillion\)
811,000 workers

Construction
\(28\ trillion\)
499,000 workers

Information and Electronics
\(36\ trillion\)
1,035,000 workers

Producers
¥18 trillion
220,000 workers

Distributors
¥24 trillion
90,000 workers

Source: Ministry, Economy and Trade, Japan
Crude Steel Production in Japan

- Japan’s crude steel production increased rapidly as demand for steel rose during Japan’s period of strong economic growth in the postwar years.
- Steel demand in Japan stopped growing when the first oil crisis occurred in 1973. Since then, annual crude steel production has remained at an average of about 100 million tons.
Japanese steel industry – Energy consumption

- Steel industry is one of the energy-consuming industries in Japan and accounts for 14% of energy consumption in Japan in FY2014.
- Energy consumption is regulated by the *Energy Conservation Act* since 1970s and Japanese steel industry has been engaging in several energy saving actions.

### Energy consumption in Japan (FY2014)

- **Total consumption**: 13,558PJ

Source: Ministry, Economy and Trade, Japan
Energy Saving Activities of Japanese Steel Industry

- **Eco Process**
  - Efficiency improvement of production process

- **Eco Product**
  - Contribution from use of high-grade steel in finished products

- **Eco Solution**
  - Global contribution from the use of energy conservation technologies and equipment

Activities to develop innovative technologies:
- Technology for separating and capturing CO2 in blast furnace gas
- Iron ore reduction technology using hydrogen in reformed coke oven gas

<table>
<thead>
<tr>
<th>Period</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008~2012</td>
<td>Voluntary Action Plan</td>
</tr>
<tr>
<td>2013~2020</td>
<td>JISF’s <strong>Commitment to a Low Carbon Society</strong> – Phase I</td>
</tr>
<tr>
<td>2021~2030</td>
<td>JISF’s <strong>Commitment to a Low Carbon Society</strong> – Phase II</td>
</tr>
</tbody>
</table>
Steel Production Processes and Development and Use of Energy Conservation Technologies

- Coal moisture control equipment
- Coke dry quenching equipment
- SCOPE21
- Reuse of waste plastics
- Pulverized coal input
  - Top pressure recovery turbine HS (Dry/low-pressure loss furnace top pressure recovery turbine (TRT))
  - Exhaust heat recovery
- Reuse of waste plastics
- COG boiler
- Kalina cycle power generation
- Oxygen
- LDG
- LD converter gas
  - Recovery of latent heat
  - and sensible heat
- Oxygen
- Pellet plant
- Prevention of air leakage
- More efficient main exhaust blowers
- Suitable size for dust collection blowers
- Control of electric motor speed
- Burst furnace
- Prevention of air leakage
- Prevention of pressure loss for input/exhaust
- Thermal insulation for blower pipes
- Construction of high recovery rate plants
- More efficient raw material air compressors
  - (For entire steel mill)
- Start using CDCM
  - Cut use of power for auxiliary machinery (control no. of compressors, etc.)
  - Suitable volume for cooling pumps (smaller and lower lifting power)
- Continuous electroplating equipment
  - Efficient continuous annealing
- Torpedo car
  - Oxygen
- LD converter
- Continuous casting line
- Bloom
- Slab
  - Efficiency continuous annealing
  - Cold rolling mill
  - More efficient cooling water system
    - Use plunger pumps, smaller and lower lifting power, control speed of heating oven blowers and cooling water pumps, less power for auxiliary machinery (less power for wasted mill motor operation, auto stop for table rolls, etc.)
  - Slab yard temperature retention measures
    - More efficient recuperator
    - Modify ovens (increase length, use partitions to improve heat transmission, increase oven thermal insulation, better seals for input/output doors)
    - Improve thermal insulation for skid pipes
    - Improve heat pattern
    - Measures for low-temperature billet output (temperature retention on transport table, etc.)
- Hot rolling mill
- Heating furnace
  - Heating furnace with regenerative burner
- Electric power plant
  - High-efficiency power generation ACC USC
  - More LDG recovery by expanding sources
    - Control of OG-IDF rotation speed
    - Temperature retention on billet transport line
    - Cut electricity consumption by dust collectors
    - Suitable volume for cooling pumps (smaller and lower lifting)
- Fuel
  - Heavy oil
  - Fuel light oil
  - Byproduct gas
  - LDG
  - COG

Efficient use of energy conservation technologies is crucial for reducing costs and environmental impacts in steel production.
Utilization of energy saving technologies

- Japanese steel industry reduced gross consumption by **process improvements**
- **Energy recovery** is contributing to reduce net consumption in recent years

---

**Process improvements and innovation**
- continuous casting, PCI, coal moisture control, optimization of logistics, SCOPE21

**Byproduct gas use**
- gas holder, high-efficiency gas turbine combined cycle generation, hydrogen amplification, CO₂ recovery

**Exhaust heat recovery**
- TRT, CDQ, regenerative burners, mid-low temp. heat recovery

**Waste material use**
- waste plastics and tires

---

Source: The Japan Iron and Steel Federation
Energy saving since 1970s

- After the two oil crises in the 1970’s, Japanese steel industry improved the energy efficiency by **promoting investment for R&D and implementation of energy saving technologies**

**1971~1989**
- Energy Saving: 20%
- Investment: \3 trillion

**1990~2012**
- Energy Saving: 12%
- Investment: \1.8 trillion

Source: Ministry, Economy and Trade, Japan
Japanese steel industry achieves the **lowest energy intensity** (unit energy consumption per ton of crude steel) among the world’s major steel producing countries.

Source: Research Institute of Innovative Technology for the Earth (RITE)
## Emission Reductions with Japanese Energy Saving Technologies

- CDQ, TRT and other major types of equipment, which were commercialized and sold by Japanese engineering companies, are already lowering annual aggregate CO$_2$ emissions in China, Korea, India, Russia, Ukraine, Brazil and other countries by approximately **50 million tons**.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Units</th>
<th>CO$_2$ Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coke dry quenching (CDQ)</td>
<td>90</td>
<td>16.71Mt</td>
</tr>
<tr>
<td>Top-pressure recovery turbines (TRT)</td>
<td>59</td>
<td>10.71Mt</td>
</tr>
<tr>
<td>Byproduct gas combustion (GTCC)</td>
<td>47</td>
<td>16.34Mt</td>
</tr>
<tr>
<td>Basic oxygen furnace OG gas recovery</td>
<td>21</td>
<td>7.92Mt</td>
</tr>
<tr>
<td>Basic oxygen furnace sensible heat recovery</td>
<td>7</td>
<td>0.85Mt</td>
</tr>
<tr>
<td>Sintering exhaust heat recovery</td>
<td>6</td>
<td>0.88Mt</td>
</tr>
<tr>
<td><strong>Total emission reduction</strong></td>
<td></td>
<td><strong>53.4Mt</strong></td>
</tr>
</tbody>
</table>

GTCC: Gas Turbine Combined Cycle system
The public and private collaborative meeting between Indian & Japanese iron & steel industry

Meetings – since 2011

<table>
<thead>
<tr>
<th>Year</th>
<th>Meeting</th>
<th>Date</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>1st</td>
<td>Nov. 2011</td>
<td>New Delhi</td>
</tr>
<tr>
<td>2012</td>
<td>2nd</td>
<td>Nov. 2012</td>
<td>New Delhi</td>
</tr>
<tr>
<td>2013</td>
<td>3rd</td>
<td>Feb. 2013</td>
<td>Tokyo</td>
</tr>
<tr>
<td>2014</td>
<td>4th</td>
<td>Feb. 2014</td>
<td>Tokyo</td>
</tr>
<tr>
<td>2015</td>
<td>5th</td>
<td>Mar. 2015</td>
<td>New Delhi</td>
</tr>
<tr>
<td>2016</td>
<td>6th</td>
<td>Feb. 2016</td>
<td>Tokyo</td>
</tr>
</tbody>
</table>

Three pillars of the energy management in the steel plant

ISO14404

Steel Plant Diagnosis using ISO14404 (2013-2016)

Technologies Customized List

Technology reference of energy saving technologies suitable for each country/region

Energy Management System

Plan
- Review past/current energy use by using ISO14404
- Implement the energy saving technologies from the Technologies Customized List

Check
- Specify the next chance to improve energy efficiency
- Review the effect of technology introduction by using ISO14404
- Cause analysis

Act
- Self-improvement by the steel plant

Do
- Help steel plants to establish a framework to plan, do, check and act for the energy saving activities
Energy Management: PDCA Cycle

- Energy saving/GHG reduction actions of Japanese steel industry is based on **PDCA (Plan, Do, Check and Act) cycle** with the aim to improve the energy performance, which complies with **ISO50001**.*

*ISO50001 is an international standard for energy management systems that was issued in June 2011.

**Keidanren: Japan Business Federation**

---

**Plan**
- JISF establishes the highest possible goals based on best available technologies

**Do**
- Member companies take actions for conserving energy and cutting CO₂ emissions based on the JISF targets

**Check**
- Performance is evaluated every year by a government advisory council (steel working group) and Keidanren third-party evaluation committee

**Act**
- The plan is revised as needed based on assessments and instructions from the government advisory council and Keidanren** third-party evaluation committee
Emission Reduction by Technology Transfer to Indian Steel Industry

10 CDQs have been installed by Japanese engineering companies to India triggered by NEDO model project.

5 TRTs have been installed by Japanese engineering companies to India.

With Japanese energy saving technologies, Indian steel industry will be able to reduce CO2 emission by 13 Mt per year.
Thank you
Kaya Identity

Technological Solution
**COURSE50 ~ Breakthrough Technology**

(COURSE50: **CO2 Ultimate Reduction in Steelmaking process by Innovative technology for cool Earth 50**)

- **CO2 Reduction by 30%**
- **Develop by 2030**
JISF’s global Energy Saving activities

Japanese steel industry promotes global cooperation in energy saving area

**China** since 2005
Japan-China Steel Industry Environmental Protection and Energy Conservation Technology Conference

**India** since 2011
The Public and Private Collaborative Meeting between Indian and Japanese steel industry

**ASEAN** since 2014
ASEAN: ASEAN-Japan Steel Initiative