The GHG Reduction Experiences and Strategies of China Steel Corporation (CSC)

Dr. Kuo-Chung Liu,

General Manager,
Environmental Protection Department,
China Steel Corp.

Bali, Indonesia
Dec. 10, 2007

Contents

I. Historical and Trend

1. Energy Saving Activities

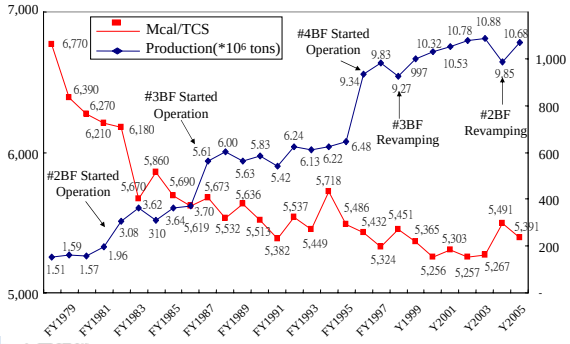
-Early Actions: Energy saving has been a measure to cut down production cost since early operation of CSC (resulting in a significant CO_2 reduction).

-Main energy saving measures: Including 100% continuous casting, efficient and large production facilities, high production rates and yields, various waste heat recovery and waste recycling installations.

2. Energy Intensity

-Compared to 1979, CSC's energy intensity has decreased by ~20 % **(Fig. 1)**, and CSC's specific energy consumption in 2006 was 5,391 Mcal/tcs (22.5 GJ/TCS) which is near the world top level.

Fig. 1: Trend of Steel Production and Energy Intensity

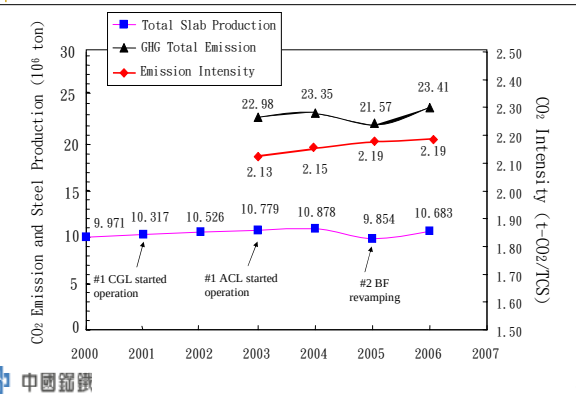


3. GHG (Green House Gas) Inventory

- CO_2 Inventory and Intensity: Since the 1st National Energy Conference in 1998, CSC has calculated its GHG inventory following IPCC methodology. Recently, CSC has switched to the ISO and GHG Protocol methodology. By transforming the inventory into CO_2 intensity, it can be cross compared with international steel mills.

- Verification: A trial external verification for CSC inventory was conducted in 2006 and a formal one is under way. Actual consumption data from production departments will be cross-checked with purchasing, storage and financial records.

Fig. 2: Trend of CO_2 Emission and Intensity



II. Projects and Performance

◆ **Internal Reduction Projects**:

1. Energy-saving Process and Improved Yield: Planned and implemented by Engineering and Production Divisions, with assistance from Technology Division.
2. Optimal Energy Management: Utility Department set up short, medium, and long term plans and put them into action, including improving power generation efficiency and switching to low carbon fuels or purchased power.
3. Energy-saving Products: Including high-strength, low iron-loss, treatment-free steels etc, for the energy saving of customers and final users.

中國鋼鐵 7

◆ Internal Reduction Projects (continued)

4. Enhance Waste Heat Recovery: Utility Department, R & D, and operation plants form a task force and select the best ones for implementation (under CSC's limitation, in space).
5. Energy Diagnosis and Continual Improvement: A special task force was formed to assist all operation units to find potential areas for improvement.
6. Promote Utility Energy Saving: Extensively applied to pumping systems, illumination, heat isolation, air conditioning etc, via design, procurement, maintenance, and daily practice.

中國鋼鐵 8

◆ External Reduction projects

1. Regional Energy Integration

- Energy Synergy: CSC has established a energy network in local community by supplying nearby plants with surplus energy products such as steam from waste heat or combined heat and power (CHP) plant and N_2, O_2, Ar from oxygen plant.
- Multiple Benefits: Through this network, not only the production costs of the participating plants are reduced, but also the overall energy efficiency are improved and the associated CO_2 and air emissions was reduced significantly.

中國鋼鐵 9

◆ External Reduction projects (continued)

2. Replace Cement by BF Granulated Slag Powder: Replacing each ton of cement will result in 0.79 ton CO_2 reduction. CSC cooperated with academia and downstream plants to promote the slag powder industry for a market >5 million ton per year.
3. Optimal Use of Plant Residues: CSC has achieved "Zero-Waste" target since July 2002 with a variety of external recycling projects, thus reducing GHG emission via natural resource conservation and avoiding waste treatment.
4. Energy-saving Service and Others: Assisting CSC Group companies and customers to save energy, and diffusing experiences to other SMEs.

中國鋼鐵 10

◆ Main Energy Saving Since 1997

Projects	Reduction (in 1000 ton-CO_2/Year)	Remark
Waste Heat Recovery	1,300	Accumulative results during 1997~2006
2010 Energy-Saving Project	260	Energy saved in 2005~2006
District Energy Integration	162	Up to 2006, calculated based on oil equivalence
Replacing Cement with BF Granulated Slag	2,170	275 million ton slag by CSC, ~3 million ton Imported

中國鋼鐵 11

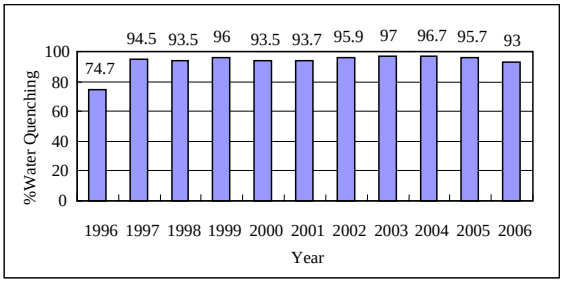
◆ Regional Energy Integration

-Estimated Energy Saving and CO_2 Reduction

	2006	2008	2013	Total
Energy Saving (net KL Fuel Oil/Year)	72,342	76,960	60,800	210,100
CO_2 Reduction (net Ton/Year)	162,200	+154,200	+153,000	469,400

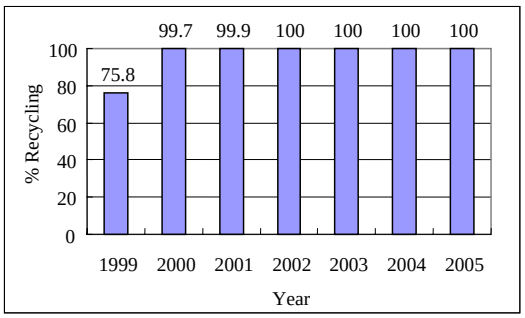
中國鋼鐵 12

◆ High Water-Quenching Ratio of Blast Furnace Slag (~100% Replacing Cement)



* Water-Quenching Ratio is lower due to start up of newly relined #2 blast furnace.

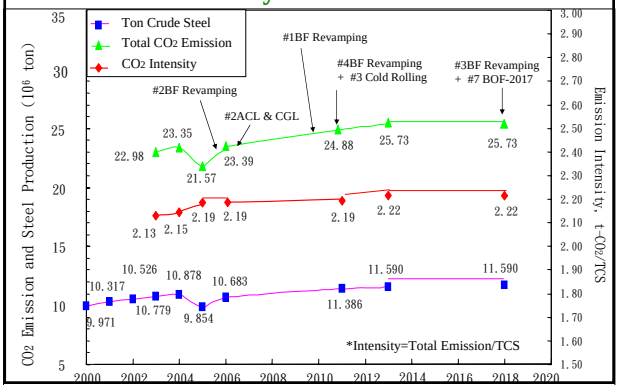
◆ 100% Recycling of Dust and Sludge (Zero Landfill Since July 2001)



III. Business As Usual (BSU) Scenario

1. "Double 2000" Expansion Project: To meet further needs of domestic steel market, CSC initiated a "Double 2000" expansion project in early 2007. There are major production increases and value-added new operations in CSC Group's two production sites (CSC and Dragon Steel). The projected CO_2 emission of CSC is shown in **Fig. 3**.
2. Allocation of Additional CO_2 Quota: Under current situation, it is not easy for CSC to acquire additional CO_2 quota from Taiwan government for business expansion. To solve this problem by internal and external reduction measures seems necessary.

Fig. 3: Projected Production, CO_2 Emission and Intensity for CSC in "Double 2000"



IV. Future Directions and Strategies

1. Basic Principles

(1) Fundamentally Sound: Obtain a good overview through widespread information collection and in-depth study. Borrow international experiences.

(2) Proactive Attitude: Participate in major domestic and international activities with certain contribution.

(3) Progressive Actions: Stepwise approach, pick low-hanging apples first.

(4) Cost-Effectiveness: "Simple is better". Apply "Producing more with less" not only in technical issues but also in other related issues.

(5) Fit Indigenous Conditions: Better actions and results.

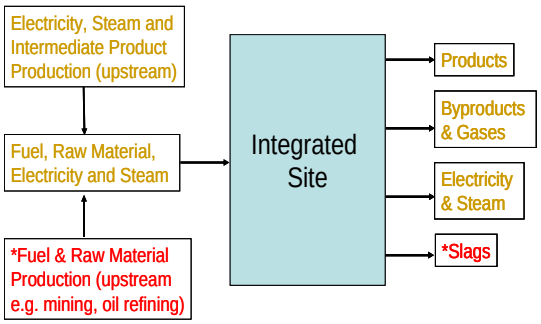
IV. Future Directions and Strategies (continued)

2. Benchmarking for CO_2 emission

(1) Target Index for CO_2 Emission : Benchmarking in CO_2 intensity for an integrated steel mill can be used as a target index for CO_2 emission in Voluntary Agreement or when "Cap and Trade" is applied (e.g. like the "Benchmark Covenant" in the Netherlands and Belgium).

(2) Need Common Basis for Cross-Comparison: With the coordination of steel associations, a common basis for CO_2 benchmarking could be formulated **(Fig. 4)**. Under this common basis, a benchmark in energy consumption and CO_2 emission could be determined.

Fig. 4: Establish a Common Basis for Energy Intensity and CO_2 Benchmarking (Hot-Roll Product Basis)



* Reported Separately

IV. Future Directions and Strategies (continued)

3. Prepare and Propose for "Cap and Trade"

(1) Fundamentally Sound Basis: The rules adopted should comply with good-practice principles such as "common but differentiated obligations", "cost-effectiveness", "fair and simple", and "encouraging early actions" etc.

(2) Reasonable and Simple Rules for Allocation: For large businesses, the CO_2 emission quota can be determined by multiply CO_2 intensity benchmark by the total production at the base year(s), provided the energy/CO_2 intensity benchmarks could be derived.

IV. Future Directions and Strategies (continued)

4. Internal Reduction at CSC

- Continue efforts in following areas:

(1) Low Energy Steel Products: CSC has formulated 8 Strategic Alliance groups with downstream steel customers to develop high-value-added steel products, including higher grade energy-saving steel products.

(2) Energy Saving: To save energy by 192 Mcal/TCS (3.6%) in CSC by 2012, with energy intensity approaching 5,200 Mcal/TCS or 21.7GJ/TCS. CO_2 will be reduced by 630,000 ton, while CO_2 intensity reduced by ~0.06 Ton/TCS.

4. Internal Reduction at CSC (continued)

(3) Waste Heat Recovery: CSC has very limited land space. It is not easy to install facilities to recover waste heat, upgrade emission control and for business expansion. Nevertheless, CSC is committed to do its best in optimization.

(4) Higher Efficiency for Power House: Additional energy saving can be realized in the internal power house with the following measures:

- revamping the old #1 power house to improve its energy efficiency
- replacing steaming coal by low carbon energy sources such as natural gas or purchased electricity.

5. Participation in External Reduction

- Cover wide varieties, grouped as follows:

(1) Low Carbon Public Projects: To invest in clean transportation projects to cut down CO_2 emission, such as Taiwan High Speed Rail, Kaohsiung Mass Transit System and the connecting bus lines. Regional CO_2 capture and sequestration opportunities will also be considered when available.

(2) Low Carbon Energy Projects: Look into investment opportunities in fuel efficiency additives and devices, waste energy recovery, bio-diesel, renewable energies, and energy service companies (ESCO), clean coal, as well as promote the use of these energies.

◆ Participation in External Reduction (continued)

(3) Cooperative Voluntary Reduction: Establish domestic credit-sharing rules for CVR borrowing from JI (Joint Implementation). Apply these rules to CSC's cooperative projects such as Granulated BF Slag and Regional Energy Integration. Select suitable ones for international VERs (Verified Emission Reductions).

(4) Reduction Funds: Reduction funds will be allocated by CSC Group to facilitate reduction projects at research and demonstration stages. A wide range of activities is covered, including energy service and ESCO, new energy demonstration, fuel efficiency trials, studies to promote low carbon energies, energy benchmarking studies etc.

Thank You Very Much
for Your Attention!

Dr. Kuo-Chung Liu：048603@mail.csc.com.tw