Energy Policy 39 (2011) 1296–1304

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Accelerating the transfer and diffusion of energy saving technologies steel sector experience—Lessons learned

Teruo Okazaki [a,b,*], Mitsutsune Yamaguchi [c,1]

[a] Research Center for Advanced Science and Technology, The University of Tokyo, 6-1 Marunouchi, 2 Chiyoda, Tokyo 100-8071, Japan
[b] Global Environmental Affairs Department, Nippon Steel Corporation, 6-1 Marunouchi, 2 Chiyoda, Tokyo 100-8071, Japan
[c] Research Center for Advanced Science and Technology, The University of Tokyo, 13-207 4-6-1 Komaba Meguro, Tokyo153-8904, Japan

ARTICLE INFO

Article history:
Received 26 March 2010
Accepted 1 December 2010
Available online 21 January 2011

Keywords:
Industry's voluntary initiative
International co-operation
Energy efficiency

ABSTRACT

It is imperative to tackle the issue globally mobilizing all available policies and measures. One of the important ones among them is technology transfer and diffusion. By utilizing international co-operation, industry can promote such measures in two ways: through government policy and through industry's own voluntary initiative. Needless to say, various government policies and measures play essential role. By the same token, industry initiative can complement them. There is much literature documenting the former. On the contrary there are few on the latter. This paper sheds light on the latter. The purpose of this paper is to explore the effectiveness of global voluntary sectoral approach for technology diffusion and transfer based on steel sector experience.

The goal is to contribute toward building a worldwide low-carbon society by manufacturing goods with less energy through international cooperation of each sector. The authors believe that the voluntary sectoral approach is an effective method with political and practical feasibilities, and hope to see the continued growth of more initiatives based on this approach.

1. Introduction

The 15th Conference of Parties of the United Nations Framework Convention on Climate Change held in Copenhagen in December 2009 revealed how difficult it is to formulate an international agreement for coping with climate change. Nevertheless, it is imperative to tackle the issue globally mobilizing all available policies and measures. One of the important ones among them is technology transfer and diffusion. By utilizing international co-operation, industry can promote such measures in two ways: through government policy and through industry's own voluntary initiative. Needless to say, various government policies and measures play essential role. By the same token, industry initiative can complement them. There is much literature documenting the former. On the contrary there are few on the latter. This paper sheds light on the latter. The purpose of this paper is to explore the effectiveness of global voluntary sectoral approach for technology diffusion and transfer based on steel sector experience.

Section 2 reviews the steel industry's challenge and the promotion of international cooperation in the field of climate change.

Section 3 summarizes the potential CO_2 reduction from the diffusion of technology. The following section reviews the barriers to the diffusion of technologies.

In the section 5, case studies for removing barriers are discussed.

In the section 6, policies and technology development/transfers are discussed.

Section 7 is for the conclusion.

2. Steel industry's challenge and the promotion of international cooperation in the field of climate change (in the case of Japan)

The authors would like to begin with brief description of how the Japanese steel industry responded to the Kyoto target. In 1996, a year prior to the adoption of the Kyoto Protocol, Japanese steelmakers launched a voluntary action plan with challenging quantitative target: 10% reduction of energy consumption in 2010 compared to 1990. Since then, the steel industry has made steady progress toward achieving these goals. As a result, the energy consumption in 2008 was 11.5% less in comparison to the 1990 level (equivalent to 12.1% reduction in CO_2 emissions). In parallel with pursuing the highest energy efficiency, which they have

* Corresponding author at: Global Environmental Affairs Department, Nippon Steel Corporation, 6-1 Marunouchi, 2 Chiyoda, Tokyo 100-8071, Japan.
Tel.: +81 3 6867 2574; fax: +81 3 6867 4999.
E-mail addresses: okazaki.teruo@nsc.co.jp (T. Okazaki), mits@m-yamaguchi.jp (M. Yamaguchi).
[1] Tel.: +81 3 5452 5339; fax: +81 3 5452 5340.

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doi:10.1016/j.enpol.2010.12.001

already achieved as shown later, Japanese steelmakers have been promoting R&D programs to develop and utilize technologies in order to supply the high-performance materials that their users require. For instance, reducing the weight of automobiles requires steel panels with higher strength and steel bars and wires with higher specification. Hybrid vehicles require high-performance electrical sheets. Tanks for bio-fuels require light-weight steel sheets that can provide greater resistance to corrosion without making use of lead and other harmful additives.

With regard to mid-term (until 2020) and long-term (extending to 2050 or even to 2100) goals, Japanese steelmakers are developing low-carbon technologies (such as the use of biomass and waste materials through waste-tire gasification technology, etc.) and energy saving technologies mainly to secure their positions as a global leader in this field, and to contribute substantial reduction in global greenhouse gas emissions. Japanese steelmakers also hope to disseminate the information on the presence of such technologies among steelmakers and governments of other countries, so to encourage other steelmakers in the world to set challenging target in tackling global warming, while building more confidence among governments to introduce relevant policies for the same purpose.

As to global co-operation, several alliances have already been formed: a bilateral alliance between the Japanese and Chinese steel industries since 2005; a seven-country alliance under the auspices of APP (The Asia-Pacific Partnership on Clean Development and Climate, which currently includes seven countries: Japan, U.S., Australia, South Korea, China, India and Canada. These seven countries account for about 54% of the world's CO_2 emissions in 2005. The steel industry is a participant as one of the eight APP task forces) since 2006, and a 55-country alliance under the auspices of the World Steel Association (“worldsteel” based in Brussels has 130 member companies and steel federations representing 50 countries and regions. Members account for about 85% of the world's crude steel production) since 2007.

With regard to the Japan–China alliance and APP, common guidelines have been established for accelerating transfers and utilization of the latest technologies. There are also exchanges between steelworks experts as well as other forms of co-operation. Furthermore, activities through “worldsteel” will become the basis for the Global Voluntary Steel Sectoral Approach (GVSSA). These activities are expected to promote even the development of breakthrough technologies (for example, CO_2 separation and reduction of CO_2 emissions by use of hydrogen as a reducing reagent for iron ore, etc.) and the establishment of a common long-term vision.

3. Reduction potential and the improvement of energy efficiency in the global steel industry

In recent years, steel production has increased rapidly in developing countries, particularly in China. As a result, CO_2 emissions from steel industry have also increased significantly. The question is how much emission reductions are possible by introducing various energy saving technologies. Three estimates are analyzed; by APP, RITE (Research Institute of Innovative Technology for the Earth, the Japanese think tank) and IEA (International Energy Agency). IEA focuses solely on CO_2 emissions reduction and no co-benefits (such as reduction of SOX and NOX) are taken into account.

The seven member countries of APP selected 10 representative energy saving technologies in the steel industry from among the environmental and energy saving technologies included in the SOACT Handbook (State-Of-the-Art Clean Technology handbook; available at APP (2010). This is one of the products of APP activities). Studies were performed at designated steelworks in each country to investigate the possibility of diffusing these ten particular technologies and to promote their widespread use. The potential for reducing CO_2 emissions (technologically possible reductions potential) was then calculated, assuming full diffusion of these technologies, and was immediately achieved in 2005. This study revealed the potential for an annual cut of 130 million tons per year of CO_2 emissions (for the selected technologies and their reduction potential, refer to Table 1).

RITE performed a study to determine the potential for CO_2 emission reductions based on the assumption that all countries achieved the same energy efficiency as that of Japan (RITE, 2008). In this study, technologies selected were process related, such as coke production efficiency indicators (Table 2). The global reduction potential, by RITE, through these technologies and the breakdown by country are shown in the first column from the right in Table 3. RITE found that the global potential reduction was 360 million tons and that in the APP member countries was 190 million tons, which is about 40% higher than the APP's 130 million tons reduction described above. The difference in the scope of technologies selected is probably responsible for this gap (Table 2).

The same explanation may apply to the IEA study. It covered both specific and process-related energy saving technologies

Table 1
Technologically possible CO_2 reduction potential by energy saving technology (APP study). Based on the assumption that those energy saving technologies were fully introduced in 2005.

Major processes	Energy saving technologies	Reduction potential of CO_2 emissions million tons of CO_2/year
Coke production	CDQ (Coke Dry Quenching)*	20.9
	CMC (Coal Moisture Control)***	5.4
	COG (Coke Oven Gas) recovery**	36.1
Iron ore sintering	Recovery of heat from sintering cooler*	5.2
Blast furnace	BFG (Blast Furnace Gas) recovery**	36.1
	TRT (Top pressure recovery turbine)*	5.4
	Pulverized coal injection***	3.7
	Waste heat recovery from hot stove*	0.9
Basic oxygen furnace	BOF(Basic Oxygen Furnace) gas recovery**	10.1
	BOF sensible heat recovery*	5.2
	Total of above 10 technologies	129.0

Prepared by APP Steel Task Force (2009) based on 2005 crude steel production volumes. (According to The World Steel Association (2007), 2005 crude steel production in million tons was 355.8 in China, 112.5 in Japan, 94.9 in the U.S., 47.8 in Korea, 45.8 in India, 7.8 in Australia, 15.3 in Canada for a total of 679.8 million tons/year (Crude steel production in major countries outside the APP was 165.1 in the EU (15 counties) and 66.1 in Russia; worldwide total was 1,150.))
Categorization of energy saving technologies as explained below and rough estimation of reduction potentials are based on one of the co author's experience through the NEDO energy saving model projects and CDM projects. Brief explanations of above technologies and reduction potential are as follows;

* Waste energy recovery to produce steam and/or power. Typical examples of CO_2 reduction potential of each installation are; for CDQ 100–200 kt-CO_2/year, for TRT 50 kt-CO_2/year and for waste heat recovery from hot stove 30 kt-CO_2/year and so on.

** By-product gas recovery. Typical example of CO_2 reduction potential of each installation for BOF gas recovery is 40 kt-CO_2/year.

*** Other energy saving technologies for CMC 20 kt-CO_2/year.