



## Emission reduction of China's steel industry: Progress and challenges

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## ABSTRACT

China has become the world's largest country in steel production and consumption. Steel industry is one of the major high-polluting industries, and serious pollution problems have been caused by steel industry in China. In this paper, we first present a review of the development status and the emissions of China's steel industry. Then, the emission reduction measures of China's steel industry are analyzed. These measures include the overall actions on emission reduction in China and some actions on emission reduction of China's steel industry. Finally, suggestions in five aspects to further promote the emission reduction of China's steel industry are proposed and discussed, including eliminating backward steel production capacity, improving the legal system of emission control, strengthening government regulation, improving steel production technology and efficiency, and establishing the national carbon emission trading market of the steel industry.

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## 1. Introduction

In the early years of the foundation of the People's Republic of China in 1949, steel was in short supply in China, and the use of

steel was strictly restricted so that the limited steel can be used in the areas where it is most urgently needed [1]. Since the reform and opening up of China in 1978, China's economy and society have experienced a rapid development phase in the past few decades. Currently, China has become the world's second largest economy [2]. China's steel production has also kept growing in an alarming rate, and China has moved from being the world's 5th biggest producer of iron and steel in 1980 to being the largest one

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by year of 2006 [3,4]. The statistical data of World Steel Association [5] showed that China's steel production, accounting for 49.4% of global production in 2014, has far exceeded that of the United States. The iron and steel industry has played an important role in China's economic and social development [6,7]. The development level of steel industry is always regarded as a key indicator for a country's economic strength and comprehensive national strength [8–10]. Steel industry is one of the important basic industries in the national economy, and it is one of the supporting industries for a country to achieve industrialization [11]. It is the support of many other sectors, such as construction engineering, machinery manufacturing, energy production, and transportation. Steel industry involves and is highly associated with a wide range of industries, and it has a great ability to stimulate consumption. Steel industry plays an important role in economic construction, social development, financial revenue and taxation, national defense construction and promoting employment [12,13].

However, China's steel industry has long been energy intensive and low efficient [14–19], making it a major contributor of greenhouse gas emissions in China [20–22]. Also, because of its coal-dominated energy structure and high consumption of limestone, severe environmental problems have occurred around the iron and steel production plants. China's steel industry has become the third biggest CO<sub>2</sub> emitter, just following the power industry and construction materials sector [23,24]. The carbon emissions from steel industry accounted for more than 10% of the total carbon emissions in China [23].

Due to the rapid industrialization and the long-term extensive economic development, China is now facing many serious environmental problems, especially atmospheric pollution. China's air pollutant emissions have increased dramatically over the past few years [25]. A statistical report of International Energy Agency (IEA) indicates that China has become one of the world's biggest emitters, accounting for 24% (about 6.92 billion tons) of the global CO<sub>2</sub> emissions in 2009 [26]. It has also been reported that China has five of the ten most polluted cities around the world [27], and steel plants can always be found in many of the high polluted cities in China. For example, Hebei Province is the largest steel production province in China, and it has nearly 25% of the total domestic steel production in 2012 [28]. The steel production in Hebei Province has been ranked first in China for 12 consecutive years, and its highest steel production capacity even reached 200 million tons [29]. At the same time, the pollution in Hebei Province has become more and more serious [30]. It was reported that 7 cities were in Hebei Province among the 10 most polluted cities in China in September, 2013 [31]. The serious pollution caused by high-polluting industries like steel industry has significantly affected the health condition and life styles of people live there [32–34].

Therefore, to achieve sustainable development, China has to take immediate measures to reduce emissions and improve its environmental quality. It is estimated that China will need to cut 1651 Mt of CO<sub>2</sub> emissions in 2020 in order to achieve the goal of reducing 40–45% carbon emissions per unit of GDP compared with that in 2005 [35]. The green development of high-polluting industries is a key factor for China to achieve sustainable development of economy and society. The Chinese government has recognized the severe consequences of environmental problems caused by high-polluting industries, such as the power industry, the cement industry and the steel industry. Some actions have been taken, especially the strict policies and regulations on emissions control promulgated in recent years [36]. Steel industry is the focus of environmental improvement in China's 12th Five Year Plan (2011–2015). Therefore, it is of great importance to present a survey of the progress and challenges of China's steel industry in emission control.

This study is organized as follows. In Section 2, we review the development status and emission situation of China's steel industry. Section 3 presents the analysis of the measures for emission reduction of China's steel industry. Some suggestions for the further emission reduction of China's steel industry are proposed in Section 4. Finally, conclusions are made in Section 5.

## 2. China's steel industry and emissions

### 2.1. China's steel industry

China's steel industry has developed rapidly since the implementation of reform and opening-up in 1979, and now it has become a veritable “steel superpower”. The production of iron and steel in China has increased rapidly in the past decades. The changes of crude steel production of China and some other countries from 2005 to 2014 are shown in Fig. 1.

As we can see from Fig. 1, China's steel output has always been significantly higher than other countries in the past ten years. The growth rate of China's steel production was also the fastest. The gap between China and other countries was also growing rapidly. In 2014, China's crude steel production has reached 822.7 Mt, which was 9 times more than that of the United States.

The production of crude steel and pig iron of ten countries, i.e., France, Germany, United Kingdom, Russia, United States, Brazil, China, India, Japan, and Australia, in 2014 are shown in Fig. 2.

Fig. 2 indicates that China's iron and steel production was much higher than some other countries. The productions of crude steel and pig iron in China in 2014 were 822.7 Mt and 711.6 Mt, respectively. China has definitely become the largest steel producer in the world.

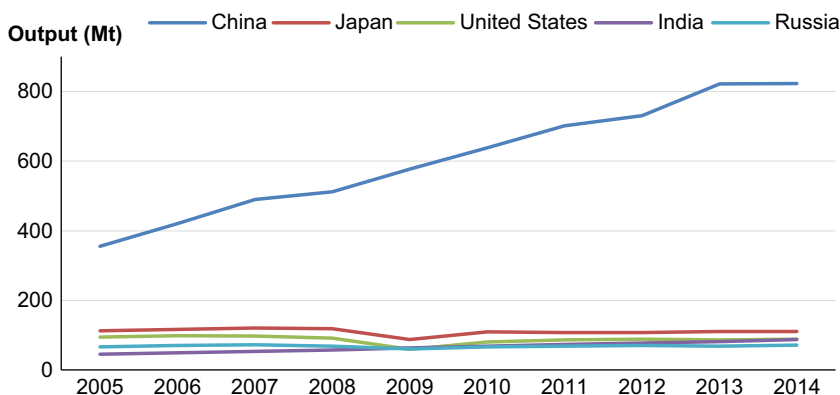


Fig. 1. Crude steel production of different countries from 2005 to 2014. Data Source: World Steel Association [106].

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