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Communication

Strategic route map of sulphur dioxide reduction in China

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HIGHLIGHTS

- A critical review on the policies of sulphur dioxide control in China.
- The successful route map for the reduction of sulphur dioxide.
- A useful reference for other countries in coping air pollutants emissions.

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ABSTRACT

China's economy has risen to the second place since 2010, accompanied by the largest energy consumption in the world. As one of the major air pollutants from the fossil fuel, excessive SO₂ emissions have severe negative impacts on eco-environments. In order to achieve the balance between economic growth and environmental protection, many efforts have been made on the reduction of SO₂. The route map for the reduction of SO₂ in China includes policy setting, economic and energy structure adjustment, and the construction of desulphurization facilities. These initiatives and efforts together had resulted in the significant reduction of SO₂ emissions along with fast economic development. This study provides a useful reference for other developing countries in coping SO₂ control. The findings also provide implications for reducing the other two air pollutants with binding control targets in the Twelfth Five-Year Plan period in China, i.e. NO_x and CO₂.

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1. Introduction

With rapid economic growth, energy production and energy consumption soared in the past decades in China (see Fig. 1). Between 1978 and 2010 energy production has surged from 627.7 million tons of coal equivalent (tce) to 2969.16 million tce in China, while energy consumption has reached 3249.39 tce in 2010 (NBS, 2012a). In the same year, China overtook US as world's biggest energy consumer (BP, 2011). As shown in Fig. 2 and Fig. 3, coal occupies an extremely important position in China's energy structure. From 2004 to 2010 coal production accounted for approximately 77% and 70% of the total energy production and the total energy consumption respectively (NBS, 2012a, 2012b).

In 2010, a total SO₂ emission was recorded as 21.85 million tons. Industrial SO₂ emissions and domestic SO₂ emission was 18.64 million tons and 3.207 million tons, which accounted for 85.3% and 14.7% of total SO₂ emission, respectively (MEP, 2012) (see Fig. 4). Thermal power industry is the biggest SO₂ emitter,

being responsible for more than 50% of the total industrial emission (see Fig. 5) although it has decreased slightly since 2006 (MEP, 2012). Therefore, more attention is required to this industry in order to reduce the total SO₂ emissions in China.

During the Eleventh Five-Year Plan period (2006–2010), the total SO₂ emissions decreased 14.3%, which over fulfilled 4.3% of the emission reduction target of the Eleventh Five-Year Plan (MEP, 2012). The national total emission in China is still larger than sum of that of America, England and Japan, and almost two times beyond the atmosphere environment capacity (Li et al., 2010). This shows severe impacts to air environmental quality and human health in China (Kaneko et al., 2010; Wang et al., 2012).

2. Research methodology

Policy documents and official statistics are reviewed to explore the route map of achieving SO₂ reduction in China. The policy documents include various laws, national standards, industrial policies, regulations and official reports released by government authorities including Standing Committee of the National People's Congress (SCNPC), China State Council (CSC), National Development

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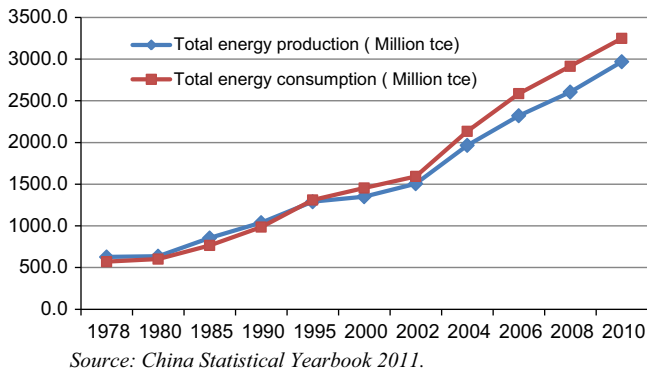


Fig. 1. Total energy production and consumption in China from 1978 to 2010.

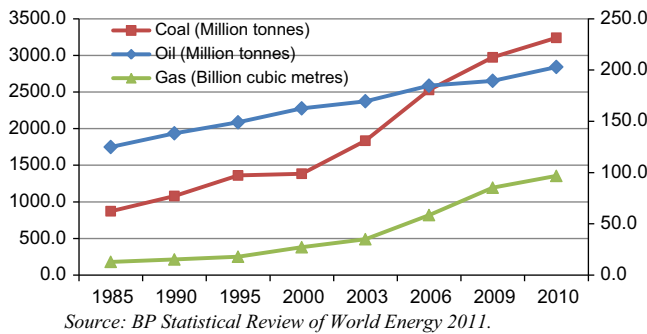


Fig. 2. Primary energy production in China from 1985 to 2010.

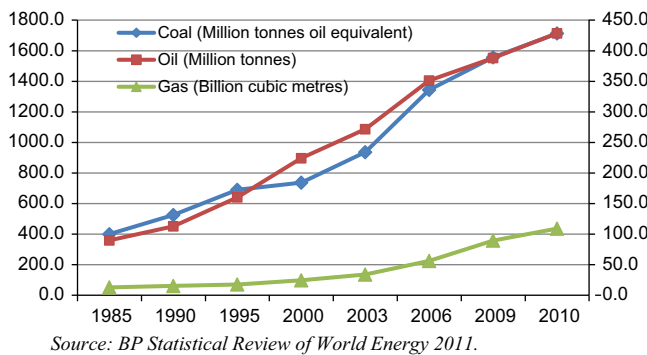


Fig. 3. Primary energy consumption in China from 1985 to 2010.

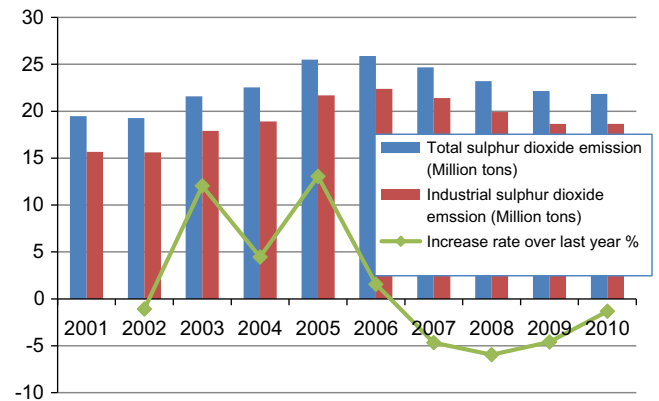
and Reform Committee (NDRC), Ministry of Environmental Protection (MEP), National Bureau of Statistics (NBS), National Energy Administration (NEA) and China Electricity Council (CEC). The official statistical data came from the China Statistical Yearbooks (CSY), China Energy Statistical Yearbooks (CESY) and Environment Statistics Annals (ESA).

3. Approaches for SO₂ reduction

3.1. Emission reduction by policy setting

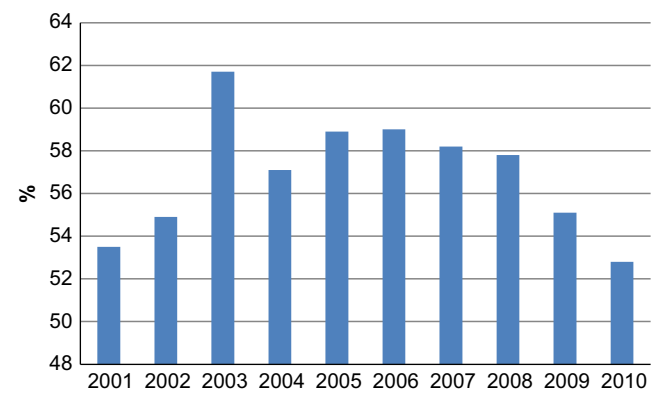
3.1.1. Laws and standards

The first law on the prevention and control of air pollution was issued on September 5th, 1987 by SCNPC (1987). This law determined some principles for air environmental pollution



Source: Environment statistics annals 2010.

Fig. 4. Total SO₂ emissions and industrial SO₂ emissions in China.



Source: Environment statistics annals 2010.

Fig. 5. SO₂ emissions from thermal power industry in China.

whereas no specific contents on the control of SO₂ emissions. It was revised twice in 1995 and 2000 with more detailed articles on SO₂ (see Table 1). The latest version stipulated clearly that the State encourages enterprises to adopt advanced technology for desulphurization and dust removal. It is mandate to install SO₂ facilities in all newly built or expanded thermal power plants.

Emission standard of air pollutants for thermal power plants was also revised for several times since 1991. As shown in Table 1, the emission concentration limits on SO₂ become stricter. For example, there were only maximum permissible emissions specified without emission concentration limit of SO₂ before 1997. The concentration limit of SO₂ for a coal-fired power plant built after 1997 is 2100 mg/m³, 400 mg/m³ and 200 mg/m³ since the year of 2005, 2010 and 2014, respectively.

More detailed items in the environmental laws and stricter limits on emission concentrations in the national environmental emission standards have paved a solid policy foundation for the reduction of SO₂ emissions in China.

3.1.2. Five-Year Plans

Five-Year Plan is the most important government document of China. It is a series of economic development initiatives, mapping strategies for economic development, setting growth targets and launching reforms in the relative time frame (Shiu and Lam, 2004). Since the First Five-Year Plan issued in 1953, China Central Government has established 12 Five-Year Plans (Yuan and Zuo, 2011).

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