Controlling Air Pollution from Coal Power Plants in China: Incremental Change or a Great Leap Forward

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China is in the midst of the largest and fastest period of economic growth in global history. While this growth at 9–10% GDP per year has lifted hundreds of millions of people from poverty, the all out prioritization of economic prosperity has created serious air and water pollution that are affecting the health of the local population, and also have increasing global climate impacts. A World Health Organization (WHO) report estimated that diseases triggered by indoor and outdoor air pollution kill 656,000 Chinese citizens each year. In addition to local criteria air pollutants like sulfur dioxide (SO₂) and nitrogen oxide (NOₓ), China is now the largest emitter of greenhouse gases (GHGs) in the world.

Strategies and policies to control air pollutants have been on the books for decades, but shifting local government focus away from the sole prioritization of economic growth and including environmental protection has proven very challenging. China has been implementing the single pollutant control strategy and focus on short-term main pollution control target. From the early to take soot as the main control object to total pollution control of SO₂ since 9th five-year plan. After years of effort, pollution control achieved some success. Thermal power plants have been effectively controlled dust emission since 2000, while sulfur dioxide also reached its turning point of decline in 2007 and reduced 14.3% of SO₂ during the 11th five-year plan period (see Figure 1). Although control of sulfur dioxide has made great progress, other kinds of air pollution and CO₂ increased a lot in the past decade. The NOₓ, mercury, and CO₂ from thermal power sector in 2010 were 1.51 times that of 2005. The rapid development of China will not stop. In the next 10 years, China’s GDP will increase to 4 times that of 2010. Without new pollution control policies, the NOₓ, mercury, and CO₂ from thermal power industry sector will be 1.28 times that of 2010. Since 12th five-year plan, China starts to control NOₓ and target to reduce 10% of NOₓ. In addition, the international pressure on carbon reduction push China to promised to reduce its carbon intensity—the amount of CO₂ it emits for each dollar of economic output—by 45%.

There are significant advantages of a pollutant by pollutant approach, which allows operators and designers to target system design and hone operational features of new technologies. The single pollution control target will induce enterprises invest on end-of-pipe pollution control. In such condition, technology innovation and multipollution control technologies will be less cost-effective than single pollution control. During the 11th five-year plan period (2005–2010), China has installed 500,000 MW desulfurization that 86% units have flue gas desulfurization (FGD) systems. However, the end-of-pipe pollutant controls will increase other pollutions, for example, controlling SO₂ increases coal use, which increases associated CO₂, mercury, and NOₓ. The used 600 MW unit in China should use average 1.58% auxiliary electricity for desulfurization. That is the removal of 1 kg SO₂ will bring 6.1 kg CO₂ and 0.015 kg NOₓ. In addition, the significant reductions in SO₂ emissions will reduce the cooling impact of reflective aerosols. Thus, the single pollution control strategy will press the bottle gourd, but played a gourd ladle. In addition, with the increasing pollution control types, resulting in continued expansion of pollutant purification equipment, regardless of investment or operating costs, the complexity of purification systems are facing great difficulties.

Meanwhile, since air pollutants and GHGs often derive from the same sources—fossil fuel combustions—there is an opportunity to address the two problems simultaneously. Control technologies that are capable of simultaneously reducing emissions of multiple pollutants may also offer the potential to achieve this at lower cost and reduced footprint when compared to conventional controls. Taking other air pollution and GHGs’ environmental impact into consideration, the total costs of coal-fired plants will be not lower than nuclear power, hydropower, or wind power. Thus, one of most important implication of

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co-control of air pollution and GHGs will make investors rethink about the cost-benefit of different energy sources. Co-control of air pollution and GHGs will reduce the total social cost and make more investment on new energy technology. In addition, co-control strategies will also make technologies which can improve energy efficiency more attractive, such as clean coal technology, etc. Thus, the co-control strategies by using new energy or technologies will be more cost-effective than single pollution control strategy. Both the U.S. and Europe experience has shown that an integrated pollutants co-control strategy will be more cost-effective than a single pollution control strategy.3

On the other hand, technology enables co-control of a variety of possible contaminants, such as catalytic reduction (SCR) or selective noncatalytic reduction (SNCR) technology to achieve combined desulfurization and denitrification, and the pulse corona plasma (PPCP) can removal of NOX and SO2 and PM together, electro-catalytic oxidation (ECO) technology can effectively reduce SO2, NOx, PM2.5, and mercury emissions together.4 If taking into account the reduction of carbon dioxide, flue gas desulphurization and denitrification with ultrasupercritical power generation technology (SC/USC + FGD + SCR), circulating fluidized bed boiler (CFBC), pressurized fluidized bed combined cycle (PFBC–CC), integrated gasification combined cycle (IGCC) will achieve higher desulfurization and denitrification rate, as well as provide coal-fired power plants a more feasible way to treat CO2 and mercury. Therefore, co-control strategies can effectively improve the efficiency of air pollution and GHGs reduction in a long-term perspective.5

It is easier to imagine Chinese policies continuing to pursue power plant efficiency and a continued push to fasttrack P3 (SO2 + NOx + mercury) controls throughout the country, as has already been piloted in some provinces like Shanxi. However, without stricter environmental regulations and multipollutant control strategy, it appears unlikely that the P4 pathway (SO2 + NOx + mercury + CO2) will be the road taken. While economists in the U.S. have been proffering similar advice for decades, China may have a better chance of actually implementing the longer term planning and stable perspectives to guide power plant construction policies.

![Figure 1. SO2 discharge in China and emission discharge from thermal power sector (NOx, mercury and CO2) from 1995–2020. The historical emissions discharge is from China’s Year Book. The trend of emission discharge is estimated based on IEA’s report.](image-url)