Chapter 24
The Impact of Electricity Market and Environmental Regulation on Carbon Capture & Storage (CCS) Development in China

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ABSTRACT

Carbon Capture & Storage (CCS) has been regarded as a significant mitigation strategy to tackle global warming although the uncertainties of carbon price and CCS technology exist. Given that China is the biggest coal consumer and around four fifths of its electricity comes from coal power plants, many think CCS has to plays a central role in cutting the carbon emission of China's coal power fleet. Most existing researches on CCS development in China emphasize the importance of sufficient funding, technological access, and market readiness, but put little light on the role of environmental regulation and electricity market establishment. This chapter examines the impact of Chinese electricity market establishment and environmental regulatory institution on CCS. This chapter argues that Chinese government should protect Intellectual Property Right (IPR), liberalize electricity market, and enforce environmental regulation in order to harvest CCS benefits successfully.

INTRODUCTION

CCS in Process

"Carbon Capture and Storage (CCS) is a process consisting of the separation of CO2 from industrial and energy-related sources, transport to a storage location and long-term isolation from the atmosphere"(IPCC, 2005, p.3). The Intergovernmental Panel on Climate Change (IPCC) regards CCS as an important transitional technology to stabilize carbon concentration in the atmosphere(IPCC, 2005).

CCS can be applied in various energy and heavy industries, including coal, oil, natural gas, power, steel, and cement, but power sector has the

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biggest potential to cut carbon emission because about half global electricity production comes from coal power plants and coal combustion has higher carbon dioxide concentration. CCS is still in the stage of Research, Development and Demonstration(RD&D) due to technological and economic challenges as well as uncertain impacts on environment and public health. Although large-scale commercial coal power CCS project with 250 MW capacity or more, has not been successfully deployed commercially, dozens of demonstration projects are implemented. Most of them are undertaken by companies from North America, Europe, and Australia. That is because developed countries have financial and technological advantages in developing CCS. In 2008, the G8 countries planned to put billions of dollars to support 20 large-scale CCS demonstration projects by 2010(E3G, 2009).

Cost of CCS

The calculation of CCS cost is very complicated because its cost is determined by so many factors, including power generation technology, carbon capture approaches, transporting distance and methods, geological situation, storing approaches, as well as international carbon market, environmental regulation, and other energy resources' prices.

An estimate about the cost of Pulverized Coal with capture and geological storage is US$0.06-0.10/kWh (IPCC, 2005). China's electricity generation in 2008 was 3221.798 billion kWh, four fifth of which came from coal power plants. If two thirds of coal electricity is generated by the plants with CCS till 2050, the cumulative investment of CCS projects would be around US$ 97-161 billion through to 2050.

Hamilton (2009) builds up an analytical framework to compute the cost of coal power CCS projects with Supercritical Pulverized Coal(SCPC) Boiler technology from 2010 to 2050 in the United States. Regarding the gradual cost reduction and stably growing carbon price, the analysis shows that the cumulative cost gap between the cost of CCS projects and the carbon credits received from carbon market ranges in US$20-301 billion in 2010-2050 in the United States. This estimate can be a reference for China's CCS development cost in the same period as China and America have the similar coal power dominance in electricity market, close combustion technology and immense carbon storage capacity. American estimation shows that developing coal power plants with CCS in China would be very costly.

CCS Development in China

After becoming the global carbon emission leader in 2007, China has paid more attention to CCS. China is one of the biggest potential consumers of CCS technology. With CCS, China's coal power industry is supposed to reduce 1.2Gt CO2 a year by 2050(IEAa, 2008). Given that China's coal power plants account for 82% of carbon emission form energy use in 2008(EIA, 2008), CCS deployment in China makes big difference in tackling global warming in decades to come.

There are quite a few small-scale CCS projects across different industries, but large coal power CCS projects in demonstration are mainly two: GreenGen and Shenhua CtL (Table 1). Both have strong connection with clean coal technology because the technology is prioritized in China's energy security strategy in the medium and long term (Morse et al., 2009).

Challenges to CCS Development in China

CCS development in China have some controversial advantages such as inexpensive human capital, business-friendly regulation and policy, and rich storage sites. Ironically, to large extent, these so-called advantages have enabled China to grow carbon intensified heavy industries in large scale and in rapid pace over the past two