INTERNATIONAL DEVELOPING COUNTRY ANALYSIS AND DIALOGUE

CHINA FACT SHEET

Analysis of GHG Emissions for Major Sectors in China: Opportunities and Strategies for Mitigation

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The Center for Clean Air Policy

CENTER FOR CLEAN AIR POLICY

November 2009

Acknowledgements:

This report was prepared by a team from the Institute for Environmental Systems Analysis within the Department of Environmental Science and Engineering at Tsinghua University of China. The major members of the team included: Prof Jining Chen, Dr. Can Wang, Wenjia Cai, Ziwei Mao, Ke Wang, Qing Pei, Junlian Cui, Andreas Oberheitmann, and Matthias Eifert. The authors would like thank Xuedu Lu, Chunxia Zhang, Dao Huang, and Yong Zhao for the information and ideas they provided. This work also benefited from the discussions at the Project Workshops held in Beijing, China, in December 2007, July 2008 and May 2009.

The authors also thank the Center for Clean Air Policy, the main sponsor of this report, and especially Ned Helme, Matthew Ogonowski, Haibing Ma, Anmol Vanamali, Thomas Polzin, and Mark Houdashelt. The authors also wish to thank Stylianos Pesmajoglou for his contribution to the project.

The authors wish to express their deep gratitude to Jos Wheatley, Sarah Love, and Aditi Maheshwari (formerly) of the UK Department for International Development (DFID) for their generous financial support for the project.

For avoidance of any doubt and for the purpose of clarity, the authors would like to state that this report is based on an independent study, and the contents of the report reflect their views and not necessarily the views of the governments of UK or China.

Introduction

The Center for Clean Air Policy (CCAP), in cooperation with policymakers and researchers in Brazil, China and India, has completed the analysis of mitigation and policy options in all three countries in the context of Phase II of the *Assisting Developing Country Climate Negotiators through Analysis and Dialogue* project.

In Phase I of this project, CCAP and its research partners conducted in-depth analyses of the electricity, iron and steel, cement, transportation, forestry and other sectors. This involved estimating business-as-usual (BAU) emissions for each sector through 2030, evaluating the emissions reduction potential and implementation costs of a variety of mitigation options, and developing recommendations for the realization of important mitigation opportunities. During Phase II of the project, some of the most promising of the Phase I options for GHG mitigation were selected for further evaluation, and a detailed analysis was conducted on issues associated with the implementation of each option. The Phase II analysis included identification of barriers to deploying each of these mitigation options (financial, technical, administrative, legal, etc.), elaboration of policies to overcome these barriers, identification of key actors that would be involved, estimation of potential emission reduction where appropriate, and the potential role of international assistance where feasible.

In China, policies related to key sectors that are announced by the central government, including China's ambitious energy intensity target for 2010, are translated by provincial governments in a manner most suitable for that particular province. The implementation analysis of a specific province is thus an important supplement to the national level analysis, and can also provide an example for analysis in other provinces. For this study CCAP and its in-country partner conducted a provincial-level analysis in Shandong Province[1] by identifying implementation strategies, stakeholders, barriers and policy solutions to overcome them specific to Shandong Province.

Brief statistics on energy intensive industries in China

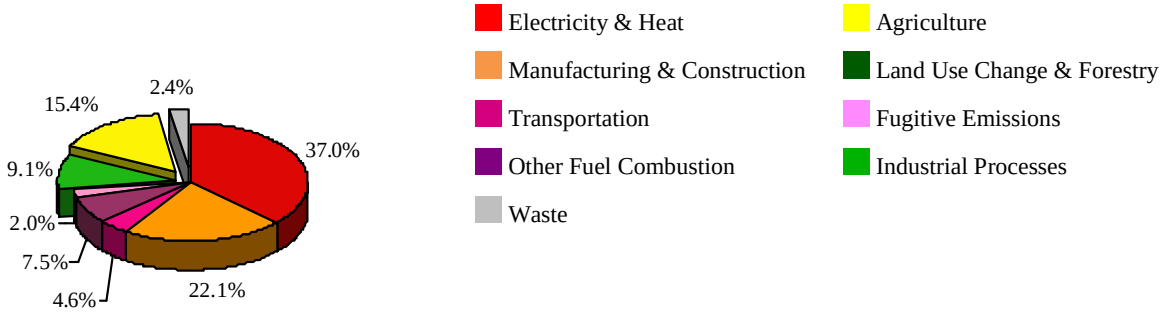
- Electricity generation – China's electricity sector has grown rapidly with total national installed capacity increasing from 69.13 giga watts (GW) in 1981 to 508.41 GW in 2005, at an average annual growth rate of 8.7%. Coal contributes to 76% to the electricity generation and will continue to dominate China's electricity generation capacity mix in the foreseeable future.
- Electricity Demand – Between 1996 and 2005, China's electricity demand has grown at a speed surpassing 5% annually[2]. The industrial sector consumed the most electricity of all sectors, accounting for about 72 percent of total electricity consumption in 2002.
- Iron & Steel - Since 1996, China has been the largest steel-producing country of the world and between 2000 and 2005, its share of global crude steel output increased from 15% to about 28%. The iron & steel industry is among China's most energy-intensive sectors which is apparent by the fact that while it contributes to 1.45% of China's GDP it consumes about 10% of the total energy.

[1] Shandong province was chosen because it is an industry-heavy province that has a significant share of energy-intensive and emission-intensive sectors. In addition, the team gained full support from Shandong provincial government which is the key to conduct implementation case study in China.

[2] China's power demand and supply is not in a perfect market system: the change of supply doesn't always follow the change of demand. The generation, gird transmission, and the end-use dispatching are under control of different companies in different provinces. The price signal doesn't reveal actual demand either because it was set by regulatory agencies instead of by the market. Not all installed capacities were put into full utilization either. All these reasons contribute to the imbalance between China's power supply and demand.

- Cement – China's cement industry has grown remarkably since the late 1970s. It only took China seven years (1978 -1985) to jump from being the fourth largest to the largest cement producer globally. With an annual output of about 1.4 billon tones in 2008, China accounts for more than half of world's cement production. Energy consumption accounts for roughly 40 percent of the total manufacturing cost of cement in China. The Mechanical Shaft Kiln is the largest single source of cement CO_2 emissions and accounts for 61.84% of cement sector's total CO_2 emissions.
- Transportation – As a reflection of China's booming economy and higher demand for travel and freight delivery, the passenger and freight traffic expanded dramatically from 1990 to 2000. The volume of passenger traffic almost doubled, and freight traffic in 2000 was 1.4 times the 1990 level. Road transport accounts for over 50% of the total gasoline and diesel consumption in China and is experiencing the highest growth rate in the transport sector. Therefore, the mitigation potential of road transport is larger than that of other transport modes.

China's Emission Profile[3] *(by sector in 2005)*



Summary of Phase I results (a)

Sector wide emissions in 2020	Pre-2000 Policy Scenario / Reference ($MMTCO_2$) (b)	Recent Policy Scenario (Unilateral) (c)	Advanced Options Scenario (d)
Electricity	3,102	5%	14%
Cement	1,098	15%	21%
Iron & Steel	323	9%	20%
Pulp & Paper	141	21%	26%
Transport	676	5%	32%
Total	**5,340**	**7%**	**19%**

[3] Emissions data are taken from the World Resources Institute's Climate Analysis Indicators Tool (CAIT) Version 6.0.

Notes: **(a)** Positive % figures denote emission reductions below reference scenario
(b) "Pre-2000 Policy" scenario considered only policies and programs adopted prior to 2000. For the analysis of mitigation options this scenario was used as the reference scenario.
(c) "Recent Policy" scenario (also called "unilateral actions") which considered the impact with implementation of all policies announced before 2006.
(d) "Advanced Options" scenarios Where appropriate, an analysis was conducted up to four variations of the Advanced Options scenario, based on the potential cost effectiveness (measured in $/metric ton CO2e reduced) of the mitigation measures analyzed. The described Advanced Options scenario considered all feasible (in the team's judgment) mitigation options.

Thus from the Phase I study we deduced that (1) China had undertaken unilateral policies that will reduce emissions growth significantly in the electricity sector, through promotion of renewable energy, nuclear power and increasing efficiency of coal-fired plants (Renewable Energy Law and Tenth Five Year Plan), and the cement sector by pursuing policies to increase energy conservation and (2) with implementation of advanced mitigation options China could reduce emissions by 19% in 2020 compared to the reference scenario; the greatest potential being in electricity, transport and cement sectors. This analysis does not take into account China's recent 20% reduction target in nation-wide energy intensity and other actions elaborated in its National Climate Change Program released in 2007.

Highlights from results of Ph II study

- Electricity Generation - Further development of the IGCC-CCS technology is considered a promising implementation policy taking into consideration all relevant parameters in China, including barriers to implementation. The most significant barrier is the high implementation cost as the capital costs for IGCC is around 1,100-1,400 US$/kW for demonstration projects in China. Focused domestic R&D with international cooperation has been identified as a policy solution for bringing costs down. Development of wind power is another important policy to make China's power cleaner. Other than cost and market-related barriers the growth in wind power needs to tackle with the lack of grid management capacity in China; setting appropriate feed-in-tariffs to create economic incentives for various stakeholders is one of the major solutions. Sectoral restructuring is also important in China. In Shandong province, the goal is to keep and promote the large units and hold or close down the small, less efficient units. To encourage further adoption of long-term policies in this area, strict emission standard and advanced monitoring systems are needed.
- Electricity Demand – Demand side management is a crucial measure to enhance the mitigation action in China's electricity sector. Although the mitigation cost remains negative, the major barriers are the high cost of implementation on a nation-wide scale due to the vast structural differences among provinces and regions. With policy solutions such as reform of the electricity pricing system to create stronger incentive for energy efficiency, GHG reduction potential has been estimated to be as high as 428 Mt CO_2e in 2020.
- Transportation – Implementation of stricter fuel economy standards is one of the most promising mitigation options in China's transportation sector with an estimated GHG reduction potential of 232-274 Mt of CO_2e in 2020. The most effective implementation policies identified are specific taxes and other economic incentives like feebates. A major barrier identified is the lack of an over-arching institution that can implement such standards and hence a specific institution with the mandate to enforce fuel economy standards is an important part of the solution. If fully implemented, the proposed mitigation policy could save oil imports of US$ 147-178 billion and up to 94,600 human lives in 2030.
- Iron & Steel – Shandong province has identified the Top Pressure Recovery Turbine (TRT) as its focused mitigation option in the iron & steel sector. The most significant barrier for implementing this policy is the difficulty in securing domestic financing to support TRT, especially for those small and medium enterprises (SMEs). Although the potential energy-saving benefit of TRT outweighs capital

cost, the relative large up-front cost for adopting TRT were still viewed unaffordable by most SMEs and they also have hard time to get financial support from banks. A possible solution is to provide domestic financial institutions financial and capacity support to fund such projects. Stricter technology standards would also act as an incentive for iron & steel plants to utilize more energy efficient technologies.

- Cement – With a reduction potential of 47 Mt of CO_2e in 2020, waste heat cogeneration (WHC) has been viewed as the most promising mitigation option for the cement industry in Shandong province. The most significant barrier is the lack of financial incentives for the industry and lack of support from local financial institutions. On possible solution is the establishment of a subsidized fund from multi-lateral financial institutions that could provide finance for higher penetration of WHC technology. CDM is the only market-based policy option but in the future, when international carbon market is matured, China's cement sector will be ready to harness the corresponding opportunities.

Note: While there are multiple negative cost mitigation options available in the above mentioned sectors, the implementation of these measures face significant barriers which have been identified and listed in the summary table below.

Summary Table

Sector	*Geographic Scope*	*Mitigation options*	*Mitigation Potential*	*Estimated Costs & co-benefits*	*Major Barriers*	*Recommended Policy options*
Electricity supply	National	IGCC-CCS	• 19.1 Mt of CO_2e reduction in 2020 (mitigation effect only) • 20.3 Mt of CO_2e reduction in 2020 (combined impact with policy option)	• 39 US$/t CO_2e in 2020 (mitigation option) • Less than 29 US$/t CO_2e in 2020 (policy option)	• High installation costs • Uncertainties regarding GHG reduction effectiveness • Lack of expertise and insufficient in-country technological know-how and capacity	• Speeding up the development and local production of key IGCC equipment based on R&D • Policy incentive to ensure higher return of IGCC-CCS investment
	National	Wind Power	• 7.61 Mt of CO_2e reduction in 2020 (mitigation effect only) • 10.21 Mt of CO_2e reduction in 2020 (combined impact with policy option)	• 38 US$/t CO_2e in 2020 (mitigation option) • Less than 36.8 US$/t CO_2e in 2020 (policy option)	• Low feed-in-tariff combined with high up-front cost • Uncertain grid capacity in rural and remote areas • Lack of access to advanced technologies	• Setting up fixed countrywide feed-in-tariff • Encouraging domestic production of key equipments and components • Grid management capacity-building • Increase in R&D investment
	Provincial (Shandong)	Sectoral Restructuring	• 15.6 Mt of CO_2e reduction in 2020 (baseline scenario) • 20.8 Mt of CO_2e reduction in 2020 (technical scenario)	• 91.7 US$/t$CO_2e$ (baseline scenario) • 78.8 US$/t$CO_2e$ (technical scenario)	• Local government's short-vision interest in building small and inefficient thermal plants • Lack of market-based mechanism	• Keep and promote the large units and hold or close down the small units in the industry • Strengthen emission standard and monitoring system
Electricity demand	National	Demand Side Management	• 428.8 Mt of CO_2e reduction in 2020	• Less than zero (-2.96 $/t CO_2e)	• Complexity of of nation-wide implementation • Lack of financial support • Large differences between provinces and regions	• Creating sufficient financial incentives • Reform of electricity pricing system • creating stable and adequate DSM funding
Transportation	National	Fuel Economy Standard	• 232-274 Mt of CO_2e reduction in 2020	Co-benefit: • Saved oil imports of US$ 147-178 billion in 2030 • Up to 94,600 saved lives in 2030	• Unavailability of key technologies to domestic automakers • Lack of specific institution to enforce the fuel economy standard	• Specific tax and incentive policy such as feebates • Fuel & Vehicle tax and fees • Domestic R&D and manufacture capacity

Sector	*Geographic Scope*	*Mitigation options*	*Mitigation Potential*	*Estimated Costs & co-benefits*	*Major Barriers*	*Recommended Policy options*
Iron and Steel	Provincial (Shandong)	Top Pressure Recovery Turbine	• 0.19 Mt of CO_2e reduction in 2020 (mitigation effect only) • 0.38 Mt of CO_2e reduction in 2020 (combined impact with policy option)	• -70.37 US$/t CO_2e (mitigation cost) • -56.53 US$/t CO_2e (policy implementation cost)	• Difficulty to secure the financing for SMEs • Existing electricity market structure making it impossible for plants to directly use self-generated power • Complex procedures and processes of TRT application	• Discount Loans system • Stricter technology standard
Cement	Provincial (Shandong)	Waste Heat Cogeneration	• 49 Mt of CO_2e reduction in 2020 (with the help of policy option)	• US$ 1.4 billion of total net cost in 2020	• High initial cost for SMEs • Lack of financial from banks and other financing institutions • Prohibitive electricity regulation • Non-strop rapid growth of demand	• Subsidized funds from multi-lateral financial institutions to support WHC penetration • Harness carbon market opportunities

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