

The promotion of sustainable development in China through the optimization of a tax/subsidy plan among HFC and power generation CDM projects

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Abstract

China is expected to reach record growth by 2020 in the energy sector by at least doubling its electricity generation capacity. In order to protect the environment and foster economic development, China will greatly benefit from transfers of state-of-the-art power generation technologies through international agreements such as the Clean Development Mechanism (CDM). However, a buyer-driven carbon market and a highly competitive environment due to more cost-effective projects attribute to China's need to achieve a balance between sustainability and profitability for CDM projects implemented in China.

In the CDM Tax/Subsidy Optimization Model (CDMTSO Model) here developed, a sustainable development assessment method evaluates the CDM projects' economic and environmental benefits and an optimization program returns tax/subsidy rates at which the greatest number of CDM technologies becomes viable and where "better" CDM projects can be the most profitable, bringing China's development on a more sustainable path.

The results show that the CDMTSO Model brings the sustainable CDM projects' Internal Rate of Return closed to 10%. If a discount rate of 9% is considered, it allows three clean energy technologies (natural gas combined cycle, wind energy, and hydropower) to become economically viable and the environmental costs avoided are increased by 37%.

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1. Introduction

Over the past 100 years, global mean temperature has increased by 0.7 °C and is expected to continue its growth by a further 1.4–5.8 °C by 2100 (IPCC, 2001). There is growing evidence that most of this warming can be attributed to the emission of greenhouse gases (GHG) and aerosols from human activities. The most concrete initiative to date is the 1997 Kyoto Protocol, a protocol to the United Nations Framework Convention on Climate Change (UNFCCC). Under this multi-lateral agreement, the responsibility of developed countries to play a proactive part is underscored with mandatory targets on

GHG emissions while the needs of developing countries are taken into account through fostering transnational co-operation with flexibility mechanisms named Clean Development Mechanisms (CDM). This market-based solution works by assigning monetary value to the preservation of the earth's atmosphere through the trading of carbon credits. Under the CDM program, industrialized countries indirectly pay for projects that cut or avoid emissions in less developed nations by buying credits called Certified Emission Reductions (CER) that can be applied to meeting their own emission targets. Recipient countries benefit from the infusion of advanced technology and investment that allow their factories or energy generating plants to operate more efficiently. Lowered costs and increased profits contribute to a win-win business dynamic. Furthermore, ecological sustainability is promoted as future emissions are lowered.

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China's transition to a market economy has put this country among the world's fastest growing economies and has consequently led to a strong increase in demand for energy. The most populated country in the world also recently became the 2nd world's largest consumer of primary energy after the USA and will overtake after 2025 (EIA, 2006). As a result of this energy consumption, associated with significant inefficiencies in energy production and use,¹ and a heavy reliance on coal,² China is, with 12.7% of the world's total energy-related carbon dioxide emissions, the second largest emitter after the USA. China's share of world carbon emissions is expected to increase in coming years, reaching 17.8% by 2025 (EIA, 2006). Furthermore, environmental pollution due to energy production and use, especially from coal combustion, is damaging human health, air and water quality, agriculture and ultimately the economy. A recent study estimates that air pollution in China cost about \$48 billion in 1995 (7% of GDP), including impacts of acid deposition as well as health effects from air pollution (WB, 1997). Moreover, it is projected that under business-as-usual conditions, pollution-related health costs for urban residents will increase to \$98 billion by 2020 at current income levels or \$390 billion (13% of GDP) with adjustment related to growth in income.

Thus for China's energy production and use system, CDM is a unique opportunity to foster technology transfer with industrialized countries and to attract more foreign investment in the energy sector. Indeed, China would greatly benefit on economic and environmental levels from implementing CDM projects in this sector, and would so bring its all-time high growth on a more sustainable path. However, in a carbon market that might be buyer-driven in coming years, the energy-related CDM projects may have to compete with other kind of CDM projects with much lower abatement costs. Therefore, a solution must be found in order to balance between the great sustainable benefits energy CDM projects would mean for China, and the high profitability of the more competitive CDM projects.

2. CDM implementation in China

2.1. China's CDM implementation in the world carbon market

Because CDM is a project-based trading mechanism, it is quite challenging to assess the world CER trading market. In order to simulate the world carbon market and China's CER potential supply, a study carried out by the World Bank (WB, 2004) linked several energy-economic models,

¹For instance, the average efficiency of Chinese power plants is below 30% compared to 35–40% in industrialized countries (Michaelowa et al., 2000).

²69.6% of China's primary energy consumption is based on coal (BP, 2006).

including two energy technology models, a carbon market equilibrium model, and a computable general equilibrium model. Three scenarios were designed to present a reasonable range of China's traded CDM volumes. The results obtained points out a significant uncertainty on the volume of CER traded, both for China and on a global scale, but for the three scenarios, about half of the total CDM projects would be implemented in China. A much lower uncertainty was obtained concerning the international CER price with \$6/tCO₂eq for the base scenario. The relatively low carbon price obtained is caused by tough competitiveness between the CDM projects, the Joint Implementation (JI) projects, and countries of the former Soviet Union. Indeed, due to their economic breakdown, the latter countries have emission targets far above their current emission levels, so they could sell a part of their assigned amount units at a very low price since they are zero cost.³ Considering a carbon reduction of 225.9 MtCO₂eq from this "Hot Air" and a reduction potential of 331.8 MtCO₂eq and 163.9 MtCO₂eq for JI and CDM projects, respectively, it may pull the carbon prices down and lead thus to a buyer-driven market. By using a quantitative model of the Kyoto Protocol permit market, Michaelowa and Jotzo (2003) confirmed this assessment of a low carbon price with an international price obtained at a little under €4/tCO₂eq (\$5.3 tCO₂eq). In its analysis of the state and trends of the carbon market 2006 (Capoor and Ambrosi, 2006), the Carbon Finance Unit from the WB points out that with the recent collapse in European Union Allowances prices, it is now very likely that compliance installations will purchase and bank relatively low-priced units to meet their obligations.

Under the Kyoto Protocol, the competitiveness of the energy-related CDM projects is conditioned by their abatement costs, which depend on the interpretation of additionality. Lax additionality rules may even lead to negative abatement costs. Nevertheless, decisions by the CDM Executive Board (EB) to reject a number of baseline methodologies submitted by CDM project developers in June 2003 due to lack of additionality testing indicate that rules for additionality testing for CDM projects will be more stringent than expected. In a possible context of strongly buyer-driven carbon market, CDM projects implemented in China must thus be able to be additional and also to generate competitive CER prices.

2.2. China's eligible CDM technologies

Many relevant studies have pointed out the broad possible portfolio of eligible CDM projects in China (Liu, 2005; Hu and Zheng, 2005; Zhang, 2000; Michaelowa et al., 2000; WB, 2004). Indeed due to factors such as the diversity of its natural resources, its growing need for

³The targets set by the Protocol are based on the countries' individual 1990 emissions levels.

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