# Applicability of market-based instruments in developing countries – a case study on the $SO_2$ emission trading system in China and lessons-learnt for a China-wide $CO_2$ emissions trading system

Miriam Schroeder*

The debate on a post-2012 Kyoto regime depends to a large extent on the question of how to include developing countries into the global endeavour to cut greenhouse gas (GHG) emissions. The use of the Clean Development Mechanism (CDM) has been a first step to raise revenues and capacity for GHG reductions in developing countries. Voices that ask for a more stringent inclusion of developing countries in the world's efforts to combat climate change have become louder – especially the one of the U.S. which have almost made their participation in anything like the Kyoto Protocol conditional on the inclusion of large GHG emitters such as India and China in the regime.

From the perspective of most developing countries, the principle of "common but differentiated responsibilities" reserves them the right to development first, while the main responsibility to cut emissions rests with the already industrialized countries. Legally binding commitments to reduction targets are currently not an option for countries such as China and India. Taking this position into account, researchers and practitioners are coming up with several ideas of how to support policies for emission reductions in developing countries while not limiting their development prospects. Options range from the introduction of command-and-control measures such as carbon taxes (e.g. Cooper 2005) and market-based instruments such as emission trading (e.g. Persson 2006) up to a scaling-up of the existing project-based CDM to either a programme or even sector-wide application (e.g. Figueres 2006).

This article focuses on one of these approaches: the feasibility of a permit trading system for GHGs in developing countries. Positive experiences have been made with a sulphur dioxide ($SO_2$) emission trading system in the U.S. under the Clean Air Act of 1990. The system has been praised for having reduced emissions at least cost, while granting flexibility to companies of when, where and how to reduce emission in their installations. The recent launch of the European Union Emission Trading System (EU ETS) has raised confidence that such a policy instrument can be successfully applied to $CO_2$. If emission trading systems can be successfully implemented in industrialized countries, what are the prospects of applying a similar system in developing countries?

Market-based instruments such as emission trading have been promoted since about a decade for developing countries and countries in transition as an adequate mechanism to tackle growing environmental pollution. In industrialised countries, the state takes a facilitating role by initiating a market for the newly created good, provides some market regulations and sanctions non-compliance. For the rest of the game, cost efficiency and environmental effectiveness depends on companies operating according to their own cost-benefit calculations, but nevertheless providing the public good of environmental improvement. To be applicable in developing countries, market-based instruments have to be adapted to the special framework conditions of countries that might not have a fully liberalised market, fully privatised

* Research fellow at the University of Potsdam. Contact at: miriams@uni-potsdam.de

companies or a government with good rule-setting and rule implementation performance.

The research question of this article is thus “what kind of preconditions does the instrument of emission trading require for its successful implementation in developing countries?”. The research will be based on a discussion on various pilot emission trading systems for $SO_2$ established in People’s Republic of China (PR China) and in Hong Kong. While analysing strengths and weaknesses of the pilot $SO_2$ trading systems, some recommendations are drawn for applicability of emission trading in a developing country.

The discussion of the case study as well as the general discussion of applicability of emission trading in developing countries will provide lessons-learnt for a prospective $CO_2$ emission trading system in the PR China. As so far being the second largest $CO_2$ emitting country worldwide, China is under increasing international pressure to come up with domestic means of $CO_2$ emission reduction. Setting up a China-wide emission trading system modelled after existing Emission Trading Systems (ETS) such as the $SO_2$ trading system of the US or the ETS of the European Union might be one option. Based on the experience made with $SO_2$ trading systems, this article provides some first ideas of whether and how such a China-wide ETS for $CO_2$ might be feasible.

The outline of the article is as follows: Part I discusses how applying an economic instrument of emission trading may differ according to the role of the state in developed and developing countries. In part II, preconditions for the implementation of emission trading schemes are developed and compared with some data from four pilot projects for $SO_2$ emission trading in China. In the last two chapters, lessons-learnt from the Chinese experiences with $SO_2$ trading are drawn and feasibility and options for a $CO_2$ trading system in China are briefly discussed.

## I. The transferability of policy instruments - merits and pitfalls of using economic instruments in developing countries

Market-based instruments have been en vogue in developed countries as cost efficient means to internalise environmental costs into economic processes. Similar advantages of economic instruments can be seen for developing and newly industrializing countries. But while some positive and negative attributes of market-based instruments are valid for developed and developing countries alike, their different framework conditions demand for a thorough analysis of potential merits and pitfalls when using economic instruments in developing countries.

The transferability of the positive experiences made with emission trading in developed countries to developing countries depends on the match between preconditions necessary for the functioning of this economic instrument and the existing framework conditions in the country under consideration. Of course, addressing the question of transferability of policy instruments from “developed countries” to “developing countries” poses the danger of generalizing too such an extent that individual country situations are distorted. Nevertheless, some yardsticks for comparison between developed and developing countries are needed in order to allow for a structured evaluation of how successful the application of emission trading

has been in the Chinese pilot cases under consideration. On a generalized level, it can be said that developing countries differ from developed countries in some of their economic and political framework conditions. In the following paragraph, hypothesis about preconditions needed for a successful implementation of emission trading schemes in developing countries are deduced from the general discussion about the transferability of economic instruments – in this case emission trading – to developing countries.

*1. Hypothesis about legal precondition: Property rights on natural resources need to be properly defined.* One of the most prominent advantages of economic instruments used in environmental governance is their feature of inducing monetary value to natural resources. The attachment of monetary value to a natural resource functions via the assignment of a property right to the user. For example, air cannot longer be treated as a mere sink by polluting companies, but its usage as a sink is restricted to a certain limit set by the permit allocated. Assigning natural resources an economic value provides market signals that steer cost-efficient use of natural resources – in ideal conditions leading to an almost automatic environmentally conducive use of natural resources. One potential problem in developing countries (and this still holds for many developed countries as well) is the attribution of property rights to natural resources which used to be common goods. In addition, property rights are often not clearly defined or enforced. If even property rights to such goods as land, assets or natural resources such as fossil fuels or minerals have not yet been clearly enforced, the introduction of a new property right to usage of natural resources such as clean air or water may prove difficult. For example, if the government introduced permits for $SO_2$ emissions, it practically challenges the *de facto* right in air quality: what has been previously allowed (e.g. using air as a sink as much as one likes to) is now strictly limited (O'Connor 1996:19). In any government imposed emission trading system, it is the role of the state to set the constitutive rules of how a property right on natural resources is defined.

*2. Hypothesis about economic precondition: The market in the power and energy-intensive sector needs to be liberalised and companies need to be managed independently.* Especially in developing and newly industrialising countries which focus on speeding economic growth and raising living standards, a policy instrument should be inexpensive and neither limit economic growth nor the economic competitiveness of the domestic industry. Often "no regret" solutions are favoured when tackling environmental problems. In the case of emission reduction, the investment in better technologies can often lead to such a win-win situation for economic and environmental considerations as more efficient technologies reduce production costs while using either less natural resources or while emitting less environmentally harmful substances (Panayotou 1998:120). Especially emission trading has been praised as an economic instruments which grants utmost flexibility to companies in their decision making of how to reduce emissions. In contrast to pollution charges or emission standards, emission trading allows the company to decide by itself on timing, technology type and installation in which it chooses to reduce emissions. The questions of who reduces pollution and who pays for the reduction have become disentangled so that an equitable distribution of costs and benefits among companies obliged to reduce emission becomes possible, thereby establishing cost-effectiveness of the reduction measures (Panayotou 1998:12). Thus in theory, market signals determine the most cost-efficient way of emission reduction as market prices reflect the scarcity of the natural resource. Reality has shown

however, that even in developed countries market distortions such as polluters in a monopolistic position can distort the principle of cost-efficiency of permit trading. In order to avoid monopolistic behaviour and a distortion of permit prices on the emission trading market, market conditions should be as ideal as possible: full information and full competition should exist (Ellerman 2001:3). However, since fully liberalised energy-markets are not even found easily in developed countries, we cannot expect markets in developing countries to undergo a rush in liberalisation. Far more important is the predictable growth of the market and a system of decision-making that would also allow state-owned or state-dominated companies to have incentives for permit trading activities. Unfortunately, many developing companies grant either exemption from the rule to their state-owned enterprises or distort prices by subsidising energy costs to industry and consumers. Without the need to ensure cost-effectiveness, the major motivation of companies to engage in emission trading will be lost.

*3. Hypothesis about political precondition: The state needs to have an adequate rule-setting capacity*. For the initiation of an emission trading system, the state needs to set the constitutive and the regulative rules: constitutive in terms of types of emissions to be reduced and business actors to participate; regulative in terms of the mode of measuring, trading and accounting of emission permits. The government initiates the market for emission permits by defining the quality and quantity of emissions under the scheme, by identifying the installations covered, by deciding on the rules for allocation, banking, trading, and by setting non-compliance deterrents. Once the permit trading system is set and running, the state keeps the role of the controller – checking if the emission trading system is on the right track to meet environmental targets, ensuring a fair allocation of permits, and distributing revenues in an equitable manner (e.g. financing additional pollution control measures or compensating losers of the emission trading system). If the emission trading system is not one the right track anymore to reach its political targets, the states should intervene by taking corrective measures for e.g. increased environmental effectiveness or equitable distribution of gains and losses to market participants and affected citizens.

*4. Hypothesis about political precondition: The state needs to have an adequate rule-enforcement capacity*. Due to the flexibility in deciding how to reduce emissions, companies usually favour emission trading in contrast to emission charges or standards. Economic instruments that provide economic incentives are generally better accepted and enforceable than command-and-control measures in countries that tend to have limited enforcement capabilities, especially on the subnational level. As money is only paid to government institutions in cases of non-compliance, permit trading presents fewer opportunities for rent-seeking behaviour of government officials than emission charges. It can be said that they are perceived to be more effective and more equitable (Panayotou 1998:117). Nevertheless, the state needs to have the authority and measure to ensure compliance to the emission trading system. Only if companies belief the state administration to take punitive measures for non-compliance, limitations on natural resource usage and penalties are taken seriously. Lessons-learnt from the use of economic instruments in Latin American countries suggest that local authorities and strong institutional support play an important role in the success of economic instruments (Huber et al. 1998).

*5. Hypothesis about political precondition: State institutions need to have good administrative and monitoring capacities*. There is a long discussion about the different challenges command-and-control measures and economic instruments put towards administrative capacities. If one compares the need for managerial capacity between command-and-control measures and economic instruments, the latter might demand less, since government officials need not to decide on the most adequate and cost-efficient abatement technology (O'Connor 1996:8). However, permit trading still requires a high level of monitoring of companies' emissions, a registration and follow-up of the tradable permits and certain verification abilities for emission data of installations, that demand a qualified and well-equipped staff in state institutions. Due to the novelty of the permit trading system for many developing countries, staff of administrative institutions often lack the knowledge and experience of how to set up and implement economic instruments. Reliable data on past emissions of installations might be missing, which in turn might lead to difficulties in the allocation of permits based on a 'grandfathering' approach. Also monitoring capacities might be restricted by lack of financial resources, missing or old technology, limited staff and – sometimes also limited financial independence of staff from companies due to their low salaries.

*6. Hypothesis about political precondition: Costs and benefits of any emission trading system need to be distributed in a socially and environmentally beneficial mode among participants and affected citizens in order to ensure its acceptability.* The distributional implications of policy instruments matter especially for developing countries which often face large differences in economic prosperity among different groups of society due to rural-urban, gender and/or caste and class lines. In order to reduce inequity within society, some governments of developing countries favour policy instruments which redistribute revenues to groups which are disadvantaged. Who pays and how benefits most by emission reduction measures (e.g. small informal business vs. large companies, workers in a steel production town or holiday resorts affected by acid rain) is a question of equity. As market-based instruments by their very nature do not produce as many revenues for the state as command-and-control measures, the question of equity in distribution of costs and benefits is also less relevant, but still an issue that should be taken into the design of trading schemes. For example, an iterative phasing in of emission permit trading might ease the adjustment process for small-scale firms. Only if the public confidence in the fairness and equity of the emission trading system can be created, it will be accepted and complied with.

If these preconditions are given in a country like China, one can assume that an emission trading system is able to function successfully. In this article, the success of an ETS is simply measured by the numbers of permit trades accomplished. Other aspects such as market stability, price volatility, and market predictability are not considered. Similarly, the effect of the ETS is not of interest in this context, but the assumption is made that a successfully ETS is environmentally effective and delivers the political goal it was initiated for: in this case cost-effective reduction of $SO_2$ emissions.

6 preconditions $\Rightarrow$ successful ETS $\Rightarrow$ environmental effectiveness

Taking the $SO_2$ emission trading in Southern Chinese provinces as a case study, the following section examines whether differences in the economic and political

framework conditions of these regions within a developing country still match with the preconditions that could be found in developed countries for a successful use of emission trading. Based on the previous discussion on preconditions for a successful permit trading in developing countries, the Chinese $SO_2$ emission trading will be analysed with the help of the previous developed hypothesis about preconditions and operationalised as following:

1. Whether the property rights to natural resources are clearly defined will be determined by
    - how the cap for emissions is set with regard to its strictness and legal embeddedness
    - which installations are eligible for emission permits
    - time frame of the emission trading system
    - spatial scope of the emission trading system
2. Whether a liberalised market in the power and energy-intensive sector exist and whether companies are managed independently will be determined by
    - macro-level data such as number of companies in the market, and
    - ownership ratio of enterprises.
3. Whether the rule-setting capacity of the state is adequate for the initiation of an emission trading system will be analysed based on
    - the state's system for allocating emission permits
    - the interference of the emission trading system with already existing regulations for emission control
4. Whether the rule-enforcement capacity of the state is adequate for the implementation of the emission trading system will be assessed based on
    - the state's enforcement strategy and the imposed penalties for non-compliance
    - the legal back-up of the emission trading system
    - the power relations of the institutions responsible for emission trading in the overall political system
5. Whether the administrative and monitoring capacities of state institutions are adequate for an emission trading system shall be evaluated based on
    - the institutions' measurement abilities for the emissions of the affected installations
6. Whether the distribution of costs and benefits of the emission trading system are socially and environmentally beneficial is assessed on
    - on the usage of revenues by the state
    - the evaluation of the emission trading system's distributional effects by companies and affected citizens

## II. Case Study: Analysis of China's $SO_2$ ETS pilot projects

China has been chosen as a country for the case studies as air pollution is one of the major environmental problems the country faces today and several pilot projects of how to reduce this problem using economic instruments such as emission trading are implemented. Coal accounts for 70% of China's energy consumption and will continue to do so due to its abundance and cheap price. Coal burning is the major source of ambient $SO_2$, $NO_x$ and soot. Only one third of Chinese cities reach an air quality standard which is not causing health problems in the long-run to its citizens. Already in the mid-90ies, calculations of the World Bank estimated an annual economic loss of 6 billion Euro as a consequence of urban air pollution, indoor air

pollution, lead exposure and acid rain (World Bank 1997:23). Reasons for the bad air quality and the increase of acid rain are China's inefficient production plants, a power generation which depends to 75% on coal with a high sulphur content, and a steady increase in energy demand and transport (DeGraaf 2004:17).

Emissions of $SO_2$ – the main source for acid rain – have the feature of travelling across city lines and provincial borders, causing acid rain in places that have not necessarily contributed to $SO_2$ emissions themselves. Due to its transboundary nature, the problem of $SO_2$ emissions and acid rain can only be solved if all installations of an affected region reduce their emissions and free-riding is not possible. A prominent example for the negative transboundary effect and its free-riding potential are the emissions from industries in the Southern Chinese province of Guandong which cause severe air pollution and acid rain in neighbouring Hong Kong.

China pursues a mixture of command-and-control and market-orientated instruments to achieve its environmental targets. China started experimenting with economic instruments just four years after it had opened its economy to the outside world in 1978: Beginning in 1982, the Chinese government imposed pollution charges levied as non-compliance fees on both the quantity and the concentration of discharges on air, waste, water, noise, solid waste and radioactive wastes (O'Connor 1996:10f.). While ambitious in its outset the system turned out to be inefficient due its low fee level, biased governmental officials, and the possibility for state-owned enterprises to hand down costs to consumers (Zhong et al. 1994). Similar negative experiences with charges on $SO_2$ emission have been made since 1992: the national $SO_2$ emission charges generated 1.15 billion RMB[†] (92 million Euro) within a decade, but its emission charges did not provide economic incentives to curb $SO_2$ emissions. The emission charge of 0.2 RMB (0,16 Euro) per kilogram of $SO_2$ is less than the average marginal abatement costs of $SO_2$ (Yang/Schreifels 2003:9). In the following two decades, China has tried several economic instruments to combat the growing deteriorating state of its environment: price regulations, subsidies, emission charges and standards, environmental funds, and taxes on natural resource consumption (DeGraaf 2004:94ff.)[‡]. While governmental regulation in form of command-and-control (CAC) measures might prove helpful to correct unintended negative consequences of economic instruments, this analysis focuses on the experiences made with emission trading as a means to achieve $SO_2$ emission reduction.[§]

As a first step to reach a total control of $SO_2$ emissions, the Chinese government identified key acid rain control and $SO_2$ pollution control zones known as the "Two

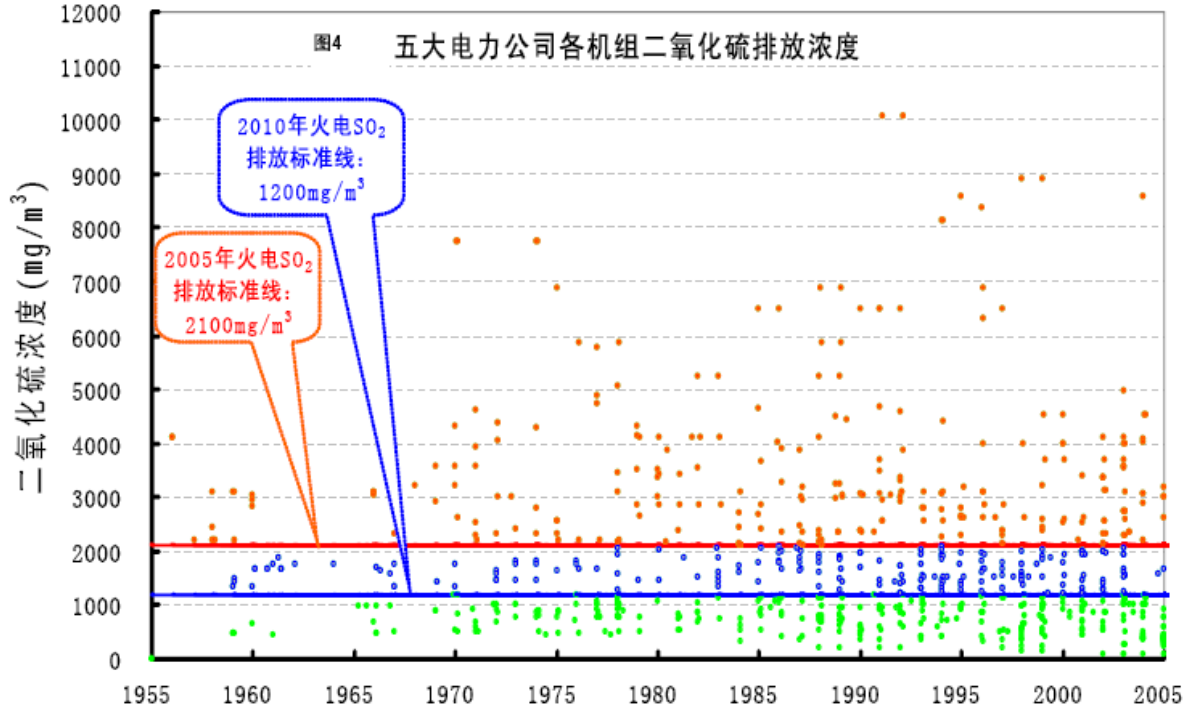
[†] RMB = Renminbi, official name for the Chinese currency, the Yuan. Exchange rate is 1 RMB = 0,8 Euro on 01.11.2006.

[‡] An interesting non-economic instrument to combat emissions used in China is the signing of "target-responsibility documents" on the control of $SO_2$ emissions between the central government and either the major power companies or provincial governments (SEPA 2006). In a non-command economy this would probably come close to a voluntary agreement.

[§] Possible negative consequences of a purely market-orientated emission reduction approach might be the creation of emission hotspots - areas of heavily polluted air that occur because polluters purchased allowances on an unpredicted scale to be able to increase emissions. Emission hotspots can be prevented by setting e.g. emission standards that set an overall cap to the volume of emissions for an installation. Thus, in reality (also in the US experience with $SO_2$ emission trading) a mix of command-and-control and economic instruments often leads to the socially optimal outcome of emission regulation.

Control Zones" (TCZs). These two zones receive priority for investment and management to control emissions and host the current pilot $SO_2$ permit trading projects. Since 1996 China is pursuing the policy of total emission control (TEC), which sets a ceiling on total emissions for twelve major pollutants (including $SO_2$) in its Ninth Five-Year Plan (1996-2000). This target is equal to a national cap on $SO_2$ emissions, e.g. the goal for 2000 was 23.7 million tons (Yang/Schreifels 2003:10), which was allocated in turn among thirty-one regions. This goal was not reached as $SO_2$ emissions reached 25.49 million tons in 2005, up by 27% compared to 2000. Nevertheless, the cap on $SO_2$ emissions has been tightened in the latest 11th Five-Year-Guideline (2006-2010), which set the goal to reduce $SO_2$ emissions by 10% up to 2010, minimizing total $SO_2$ emissions under 22.95 million tons (SEPA 2006). The following chart displays the number of companies that reach a) the $SO_2$ emissions target for 2005 and b) for 2010.

**Chart 1:** $SO_2$ emissions of installations of the five large Chinese power producers and their compliance with emission reduction targets for 2005 (2100 mg/m$^2$) and for 2010 (1200 mg/m$^2$)




Source: Environmental Defense 2006

The instrument of permit trading is thus relatively new to China: the $SO_2$ permit trading system was first initiated in 1992 as a pilot project in the city Yichang, Hubei province as a $SO_2$ discharge permit system with charges levied on emissions exceeding the permitted level (O'Connor 1996:11). From early on, the Chinese government had been advised by foreign institutions on the adaptation of economic policies to Chinese context. As a result, several pilot projects in $SO_2$ emission trading have been or will be launched. Unfortunately, most of them are still in the design stage with some rules e.g. for allocation, not yet determined. Another problem for comparison is their different scale concerning time period and number of installations included. Planned or implemented pilot projects on $SO_2$ emission trading exist so far in:

1. *Benxi City and Nantong City*. This pilot project was initiated in cooperation with the US NGO "Environmental Defense". All industrial enterprises (mainly steel

producers) are be eligible. Overall caps for $SO_2$, soot and industrial particulates are established in five year periods based on the provincial and national goals for pollution control. Many administrative details still need to be worked out. [**]

2. *Jiangsu Province*. This pilot project incorporated 196 installations from the power sector. A cap on $SO_2$ emissions was set on the provincial level for five years, allowances were allocated based on an emission performance standard, and political control hinged upon the provincial Environmental Protection Bureau (EPB). Eventually, two power plants from different cities conducted an allowance trade (Yang/Schreifels 2003:14).
3. *Taiyuan City*. In this heavily polluted city, the ambitious target of reducing $SO_2$ emissions by 50% by 2005 compared to the 2000 baseline was set (Yang/Schreifels 2003:14). Taiyuan is situated in the emission control zone and its city government has been experimenting with several policy instruments for improving air quality before.
4. *Emission Trading Pilot Scheme for Thermal Power Plants in the Pearl River Delta Region.* The City of Hongkong and the neighbouring province of Guandong reached an agreement in 2002 to improve air quality by reducing $SO_2$ emissions by 40% up to 2010 using 1997 as a base year. This target shall be reached with the help – among others – of a joint emission trading system. In Hong Kong, power is mainly provided by two thermal power plants. Since the technology used in their installations has not much scope for efficiency improvement, the possibility for limiting emission on the Hong Kong side is limited. In contrast, power producers and industries on the Guandong still have much scope for efficiency increase and emission reduction, but lack financing. Thus the two administrations hope for a win-win situation if Hong Kong-based companies invest in Guandong companies via an ETS.
5. *Provinces of Shandong, Shanxi, Jiangsu, Henan, and cities of Shanghai, Tienjin and Liuzhou.* Upon successful completion of previous pilot projects, the $SO_2$ emission trading system became extended in 2002 on a trial basis to four provinces and three cities in Southern China. $SO_2$ emission permits may be now traded between power stations and other large emitters. The first trade of permits took place in 2003 between two power companies of different cities in Jiangsu province (DeGraaf 2004:115).

Due to their data availability, four of these pilots are chosen for a more in-depth analysis based on the operationalised hypothesis about preconditions developed above (for results based on the secondary literature available see the following table).

[**] More project information is available at: www.usembassy-china.org.cn/sandt/Benxiweb.htm and http://www.usembassy-china.org.cn/sandt/ptr/Emissions-Trading-prt.htm

**Table 1: Comparison of the design of pilot projects for $SO_2$ emission trading systems in Benxi City, Taiyuan City and Hongkong/Guandong**

| | | Benxi City | Taiyuan City | Jiangsu Province | Hong Kong - Guandong |
|---|---|---|---|---|---|
| **Definition of property rights** | Emission cap | Not fixed yet, will be in conformity with provincial and national five year guideline | Reduction of $SO_2$ emissions by 50% to 125,000 tons up to 2005 using 2000 as a base year | Total emission control (TEC) limits for the 10th Five-Year-Guideline to be broken down for province level | Reduction of $SO_2$ emissions by 40% up to 2010 using 1997 as a base year |
| | Eligible installations | All companies, others: chemical, cement and manufacturing plants | 23 sources accounting for 50% of total $SO_2$ emissions | 196 power plants | Two power plants in Hong Kong and several in Guandong Province |
| | Timing | Five year period | | | To start in 2006 |
| | Trading area | City | City | Province | Two provinces |
| **Liberalised markets and independently managed companies** | Ownership of companies | Largely state-owned enterprises | | | |
| | Market structure | Dominance of two steel companies | Installations have heterogeneous marginal abatement costs | | Dominance of two power companies |
| **Rule-setting capacity of the state** | Allocation method | Not fixed yet | Based on historic emissions, yearly free allocation, auctioning allowed | Based on emission performance standards | |
| | Banking | Allowed | Allowed | | |
| | Interference with other policies | | Participating companies are not exempt from other emission charges, e.g. levies on $SO_2$. | | |
| **Rule-enforcing capacity of the state** | Legal framework | City government, which is independent legislative authority that can enact its own local ordinances with only provincial-level approval. | "Administrative Regulation for $SO_2$ Emission Trading in Taiyuan City" document adopted by city government | Document by provincial EPB and Economic and Trade Comission | PRD Regional Air Quality Management Plan |

| | | | | | |
|---|---|---|---|---|---|
| | Position of responsible institution | Local EPB is administrative authority. | Local EPB cooperates closely with city government, but it does not have power to act in case of violations. | Local EPB is independent in its decision on the total emission cap, the allocation method and the identification of sources. | Hong Kong Environmental Protection Department |
| | Enforcement strategy | 5,000- 10,000 RMB/ton. | 3,000 – 8,000 RMB/ton, but with upper limit of 30,000 RMB. Legal liability of enterprises and financial penalties for non-compliance. Mediation committee is planned. | | |
| **Administrative and monitoring capacities of state institutions** | Mode of emission measurement, reporting and verification | No emission monitoring equipment available. | CEMs, periodic source monitoring, and material balance; an online emission and allowance tracking system is planned | CEMs, periodic source monitoring, and material balance | |
| **Equal distribution of costs and benefits** | Use of revenues | Revenues from fines shall be used to purchase new monitoring equipment | Revenues from auctioning allowances is set aside for improving urban air quality | | |
| **Trading situation** | | None so far | 4 trades up to now. | 1 trade between two power plants | None so far |

Source: Morgenstern et al. 2004, Yang/Schreifels 2003, http://www.usembassy-china.org.cn/sandt/ptr/Emissions-Trading-prt.htm, www.usembassy-china.org.cn/sandt/Benxiweb.htm

Ad 1) *Definition of property rights.* The $SO_2$ emission trading system in China is legally embedded in the "Air Act", which was enacted in 2000 as a framework law. It identifies key cities for pollution control (e.g. Taiyuan) and requires local governments to set up plans for pollution control. Emission caps are set at the national level in form of the TEC and then transferred to the provincial level. Local governments are thus given the target, but have relative freedom on the means to reach it. In all of the examined cases, the local government has chosen the local Environmental Protection Bureau (EPB) as the focal point for implementation. This should be due to the Chinese understanding of $SO_2$ emission trading being rather an environmental issue than an economic issue. On the one hand, the choice of the local EBP is appropriate as it has been also the institution in charge of the levy system on $SO_2$ emission, thus avoiding unnecessary confusion. On the other hand, the normal political position of a local EBP is not strong enough to make authority demanding decisions such as whom to allocate which amount of emission permits. In China, the local EBP is responsible towards the local government and the EBP on the provincial level. Being embedded in two hierarchies does not increase its political standing. In the evaluation conducted for some of the pilot projects under consideration, voices were heard that asked explicitly for a more senior level backing of the ETS in order to give it more legitimation and compliance pull.

Ad 2) *Existence of liberalised market in the power and energy-intensive sector.* In the analysis of the pilot projects this category has remained a black box in the literature. Several authors such as Dobridge (2001:25) state that economic obstacles and economic planning are obstacles to any ETS implemented in China. Especially in the energy sector at the national level most energy companies are still state-owned enterprises (SOEs), because this sector is regarded as being very sensitive in terms of national energy security so that privatisation of companies is not advocated. However, first steps towards liberalisation of the power market have been made since 2003: the State Power Corporation was dissolved into five independent power producers, two grid providers and several other service organisations. Even if these companies are still state-owned, the power market in China is no longer a strict monopoly. For the local level, a similar dominance of SOEs can be assumed. Even if thus an important precondition for the establishment of an ETS is not given at present, one can hope that the gradual transformation of the command-and-control economy of the communist China towards a "socialst market economy" of the present China will ease the way for the successful application of economic instruments.

Ad 3) *Rule-setting capacity of the state*. In principle, the choice of an allocation method is a political decision. Ellerman (2001:13) regards the issuance of allowances as one of the most difficult tasks for the EPBs since distributing the cost burden of the required emission reduction among companies and sectors of one jurisdiction is highly political, and thus prey to the power and interest games in which the EPB in general does not have a prominent stand. But even if the alternative of taking a command-and-control policy instrument would make the distribution of the cost burden less obvious, its total costs are expected to be greater (Ellerman 2001:13). In order to make permit allocation more equitable, and thus more politically acceptable, the local authority might want to deviate from its usual allocation principle of grandfathering in some cases (e.g. to grant some less stringent requirements on companies facing high international competition). For such a justified deviation from the allocation rule, the administrative institutions would need thorough information

about the financial situation and technological standards of the firm, which is often not available or made accessible in China.

Ad 4) *Rule-enforcement capacity of the state*. The authority of the state in rule enforcement depends much on the power position of the institution responsible for the emission trading system. In most cases, the local government has initiated or at least supported the emission trading system, but operation and administration of the system are in the hands of the local EPB. This might cause problems for enforcement in cases if e.g. the EPB has identified a non-compliant behaviour of a company but has not the authority itself to impose penalties because it lacks the requisite jurisdiction. In addition, the dependency of the EPB and its staff on the local government makes them not very willing to enforce penalties against powerful interests of their local community. The penalty itself is seen as too low to motivate companies to comply with the reduction limits. This is also the case for the $SO_2$ levies which have to be paid for all emissions even if they are within the installation's emission allowance (Morgenstern 2004:25f.).

Ad 5) *Administrative and monitoring capacities of state institutions.* Continuous emissions monitors (CEMs) are not the standard equipment in industry stacks and many power plants do not possess internal emission monitoring systems (Dobridge 2001:25). If they are available, their standard concerning installation, operation and calibration varies. Foreign institutions like the Asian Development Bank are assisting Chinese administration to purchase more monitoring equipment and to train relevant staff.[6] In addition, the Chinese government's pressure on polluting industries to install CEMs is growing.[7] Besides the technical equipment, data quality varies according to the data collection experience and authority of the responsible state institution. Indirect emission measurements via used fuel types and sulphur content calculations are not always reliable (Morgenstern 2004:24). Experience with the $SO_2$ levy system has shown that data control and its verification is often negotiable, thus opening the door to corruption. One solution to these kind of disputes might be to increase the transparency of the system by e.g. the set up of a mediation committee consistent of senior government officials, key enterprise managers and possibly academic and media representatives as planed for Taiyuan City (Morgenstern 2004:26). Some form of limited public disclosure exists in China in the form of air quality index for some of the major cities which are updated and published every day. Data on the performance of installations under the ETS could easily be included in such a disclosure system to increase transparency and compliance pressure (Morgenstern 2004:28). In addition, Chinese administrative institutions have not yet any experience in the set up and functioning of allowance tracking systems for the follow up of issuance and trading operations. Keeping an allowance tracking system is not just an administrative matter, but the precondition for knowing which installations possesses how many permits, and thus knowing who is compliant and who is not. The capability to operate it is thus one of the more simple, but important requirements for the success of a permit trading scheme. The advantage of a functioning allowance tracking system is its discretion in the determination of compliance: either permits are turned in by the eligible installations in the required amount or not – not much scope exists for negotiation, thus limiting the possibilities for corruption (Dobridge 2001:25).

[6] More information available at: www.cleanairnet.org/caiasia

[7] In Hong Kong, only 18% of factories are fitted with CEMs. In the Taiyuan trading scheme, 11 of the participating 26 installations possess on-line $SO_2$ monitoring systems. The remaining 15 installations are required to install similar equipment by the city government.

Ad 6) *Distribution of costs and benefits of the emission trading system*. As the pilot projects have not yet shown much trading activities, it can also be assumed that costs to the ETS participants are low. If neither costs nor benefits of the established ETS have much political weight – as the pilot projects imply so far – acceptance of the ETS should also not rely to a large extent on the distribution ratio.

## III. Lessons-learnt from the $SO_2$ pilot projects

The most obvious drawback of the pilot projects in $SO_2$ emission trading is the lacking development of permit market. There has been some trading, but much of it seems to be politically motivated. As a preliminary finding from the secondary literature it can be concluded that the design of the ETS pilot projects has been good in general terms, but that the implementation of the ETS pilot projects has not been very successful if measured in terms of accomplished trades in emission permits. Several reasons can be summarized: the low price of non-compliance penalties has not provided a large incentive for trading. A market dominance of a small number of large companies (e.g. two steel companies in Benxi City) in some of the pilot projects also limited trading possibilities. This is to a large extent due to the limited spatial and time dimension of the pilot trading schemes. Trading on a city level can naturally be only very limited and the market is easily distorted and monopolized by a dominant company. Timeframes of a year are too short to create abatement pressure for polluters. In addition, the allowance of banking does not give any incentive if the trading scheme has a pilot character with no future trading periods in prospect. The absence of a strong enforcement system is another reason for the slow progress of the emission trading system. Penalties for polluters are weak: in some of the pilot projects exist a maximum fine a facility has to pay, and once it exceeds this limit, there is no further check on emissions.

As the use of economic instruments is relatively new to China, the initiation of an ETS is more challenging than well-experiences market economies such as the United States. In China, economic instruments are not yet fully complementary to the predominant CAC instruments: in the case of $SO_2$ emission reduction, the ETS does interfere with the levy system on $SO_2$ emissions. This has not yet caused much disturbance because in both systems' penalties on emissions have been too low to cause harm. If emission trading is chosen as the instrument for reducing emissions in China for the long-term however, the levy system has to be either abolished or properly linked to the trading system (e.g. by designing a system where the incentive for abatement is clearly set by the price of the emission allowance in the market, but where a small levy exist for raising revenues, Morgenstern 2004:27).

Besides many shortcomings, the pilot projects with $SO_2$ emission trading can be positively evaluated as what they are: experiments and demonstration projects in order to learn of how to improve the implementation a new policy instrument. In contrast to many developed countries, China seems to follow an iterative system of law-making: new ideas are experimented with at the local level before they are imposed as national law (Ellerman 2001:4). The pilot projects are the result of a positive attitude of the Chinese government towards economic instruments, and they are test-runs for the preconditions needed to make emission trading possible on a national basis in China. It took the U.S. over a decade to make its $SO_2$ emission trading scheme working properly after the Clean Air Act Amendments were signed.

Under present framework conditions, achieving a successful $SO_2$ emission trading scheme in e.g. a three- to five year period as envisaged for Taiyuan City (Morgenstern 2004:31) in China would be a grant success. In the future, an extension of the current $SO_2$ emission trading pilots to other cities, provinces or even the national level would be needed to increase its efficiency. The current extension towards the four provinces Shandong, Shanxi, Jiangsu and Henan, and the three cities of Shanghai, Tianjin and Liuzhou, is already a step to upscale experiences made with ETS in the pilot projects.

## IV. Prospects for a possible $CO_2$ emission trading system

The experiences of the pilot projects in reducing $SO_2$ emission trading by setting up ETS have shown that the Chinese government in principle takes a favourable position towards market-based policy instruments. So far, ideas about setting up local, regional or even national permit trading schemes on $CO_2$ emissions are voiced in China, but actual implementation seems to be a rather long-term task.

In order to be able to make a statement about future prospects of an $CO_2$ ETS on a China-wide scale, the fundamental variable to examine is the motivation of the Chinese government to implement such a scheme. For the $SO_2$ ETS the main incentive has been the unbearable situation of local air pollution and acid rain. One factor easing the initiation of $SO_2$ emission trading schemes has been the availability of a national "quasi-cap" on $SO_2$ emission in form of the Total Emission Control goal for $SO_2$ as part of the Five-year guidelines since 1996. The national goal of $SO_2$ reduction has so far been split between different regions. For the future, it could be further broken down to lower levels of government and ultimately to the emitting facilities similarly as it is done in the EU ETS (Ellerman 2001:11). For $CO_2$ emissions no cap currently exists neither by international agreements such as the Kyoto Protocol nor by national legislation. Prospects that China will agree on an international cap on GHGs are not very likely as China in the past has preferred to keep as much national sovereignty as possible and strongly upholds its right to development.[8] But even if the issue of climate change is probably not the driving force behind Chinese GHGs emission reduction efforts, other considerations such as energy security are.

The current 11$^{th}$ Five-Year-Guideline (2006-2010) has set the goal of improving energy efficiency by 20% up to 2010. Similarly as with the Total Emission Control on $SO_2$ the goal has been set, but means of achieving it are not further specified. Establishing an ETS for $CO_2$ emissions might be one option. Implementing such a scheme on a national level might be a way for China to achieve more efficient use of carbon-intensive natural resources at home. With an energy demand that increases by 10% annually, China is in need for means to limit its growing dependence on fuel imports. Closely linked to its growing dependence on foreign energy, China has set itself very ambitious targets for the increased use of renewable energies. According to the "Middle- and long-term development plan for renewable energies", renewable energy is supposed to contribute 10% in 2010 and 16% in 2020 to China's total

[8] The only possible option of an acceptable international cap on GHGs emission for China would be a cap according to the equal per-capita principle, which would put no pressure on China to act before 2040 (Jiang 2003:236).

power production. With these two targets on increased energy efficiency and increased usage of renewable energies established, a China-wide $CO_2$ ETS should set strong incentives for power companies to channel their future investments into cleaner energy production already now.

But even if the political will to use market-based policy instruments exists and caps for $CO_2$ emissions could be deducted from existing targets, actual implementation of such a scheme might prove difficult. This is not only a problem of governance capacities at the local level, but closely linked to the transformative state of the Chinese economic system. The analysis of the experiences made with the $SO_2$ ETS pilot projects has shown that some preconditions deemed necessary for a successful ETS are not yet given in China. On the one hand, it is difficult to generalise lessons-learnt from the pilots in $SO_2$ emission trading for the feasibility of a $CO_2$ ETS on the national level. On the other hand, since it seems more likely that a potential $CO_2$ ETS will be first tested on a local scale, some preliminary suggestions for an adequate design of an local $CO_2$ ETS can nevertheless be drawn:

1. Property rights need not only be defined on paper, but enforced in reality;
2. State owned enterprises are not the right addressees of a policy instrument that has its merits in reducing the costs of emission abatement;
3. Rule-setting has to be as transparent as possible;
4. Not the Environmental Protection Bureau but the local institution responsible for economic development should be made the focal point for compliance enforcement;
5. Administrative and monitoring capacities of state institutions need to be further improved, e.g. by international development cooperation; and
6. The burden sharing for costs of the ETS should be made economically bearable to companies and socially and environmentally beneficial to affected citizens.

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