STRONGER MARKETS. CLEANER AIR

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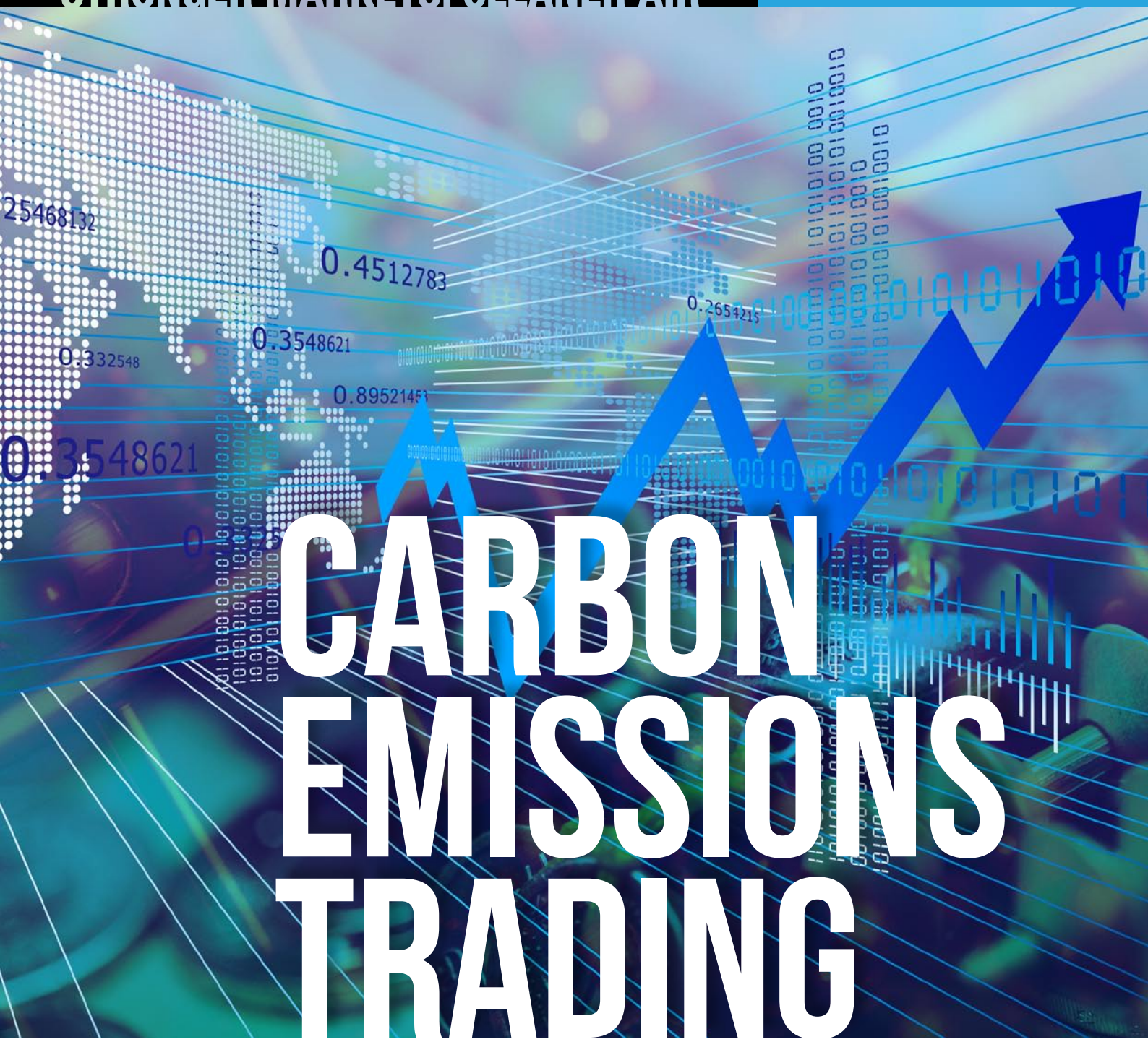

CARBON EMISSIONS TRADING

Rolling out a Successful Carbon Trading System

September 2015

保尔森基金会
PAULSON INSTITUTE

The big picture: Carbon emission trading can help China to achieve its emission reduction goals.

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About the Series: *Stronger Markets, Cleaner Air*

This paper is one in a series produced in 2015 by the Paulson Institute's Climate Change and Air Quality Program aimed at policymakers and influencers in China. The series provides recommendations on how policymakers can harness market forces to reduce emissions of both conventional pollutants and greenhouse gases that contribute to climate change. The topics covered by the series include power sector reform, electric power demand response, carbon emissions trading and building energy disclosure.

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Stronger Markets, Cleaner Air

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Rolling out a Successful Carbon Trading System

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Economic cost: According to the Chinese Ministry of Environmental Protection's 2010 estimate, the direct and indirect economic loss in China from pollution amounted to 1.54 trillion RMB, which is 3.5% of the GDP that year.

CONTENTS

1. INTRODUCTION

China is taking a leading role in developing emissions trading markets, and in many respects is far ahead of many countries and regions.

China is taking a leading role in developing policies to address climate change. In the last decade, China has established a range of energy targets and goals with objectives including energy savings, energy security, cleaner air, and lower greenhouse gas (GHG) emissions. These include reducing CO_2 intensity by 40 to 45% per unit of GDP from 2005 levels by 2020;[1] reducing industry emissions by 40% from 2015 levels by 2025;[2] lowering CO_2 intensity by 60 to 65% from 2005 levels by 2030;[3] achieving region specific carbon and energy intensity reduction goals;[4] peaking national carbon emissions by around 2030[5] and making best efforts to peak before then; increasing the share of non-fossil fuels in primary energy consumption to around 20% by 2030;[6] reducing ambient PM2.5 concentrations in major cities and regions; raising energy efficiency; increasing the share of renewable energy; reducing the share of coal in the national energy mix; and capping coal consumption on a national basis.[7] China's 12th Five-Year Plan (2011-2015) affirmed that China would significantly reduce the energy and carbon intensity of GDP, while regulating greenhouse gas emissions through a carbon emissions trading system.[8] The decision of the Third Plenum of China's 18th Party Congress in 2013 directed that measures be taken to implement ecological compensation systems and accelerate pricing reform of natural resources. The decision called for prices to reflect both market supply and demand as well as costs caused by environmental harm, under the polluter-pays principle.[9]

Similarly, China is taking a leading role in developing emissions trading markets, and in many respects is ahead of many countries and regions. The prescriptive language contained in the 12th Five-Year Plan and the Third Plenum decision underscores the merits of a carbon emissions trading system (ETS) as a way to integrate many of the nation's various policy goals, including those on energy efficiency, low-carbon energy and ambient PM2.5 concentrations. A carbon ETS caps the amount of carbon emissions from a group of enterprises, allows enterprises to select the most cost effective means to achieve an emissions goal, and provides for trading of emissions allowances to achieve emission mandates. In choosing the path forward, China can draw on its own current and past experiences with emissions trading as well as the experiences of the U.S. and Europe. This paper reviews the evolving record of emissions trading successes and challenges and draws several conclusions:

- **A carbon ETS can be used to achieve the various carbon, energy, and pollution reduction mandates contained in the 12th Five-Year Plan and the Third Plenum.** In addition to providing a means to guarantee the achievement of a particular reduction by a defined deadline, a carbon ETS also has the potential to help address many of China's urgent and related pollution problems. Many Chinese cities and regions

suffer severe air pollution resulting from the extensive combustion of fossil fuels including coal. Policymakers are also grappling with issues of water pollution and water shortages. In addition, the government is seeking to promote renewable energy, energy efficiency, and a gradual transition away from heavy industry as part of an economic green transformation. Capping and putting a price on carbon through an ETS is consistent with all of these goals.

- **The implementation of ETSs in the U.S. and European Union (EU) has shown that an ETS has major benefits, if designed and implemented correctly.** First and foremost, by setting a specific cap on carbon emissions, a well-designed and well-implemented ETS provides certainty that a specific emissions reduction goal will be achieved within a given timeframe.[10] In addition, emissions trading gives enterprises greater flexibility as to how they can satisfy their individual emissions reductions mandates. This flexibility, in turn, enables them to achieve reductions at lower cost while also promoting efficiency, innovation, and industry collaboration provided that the allocation periods are sufficiently long to allow capital to be profitably deployed.
- **China's current ETS pilot experience, combined with carbon-related directives issued by the government, suggests that China may have the ambition and political will to implement carbon trading across sectors with significant emissions to achieve policy goals based on the nation's unique circumstances.** Experience gained from the pilots in seven regions (five cities and two provinces) across China has provided important lessons regarding the development of its ETS program, facilitated the development of the necessary ETS infrastructure and given policymakers the confidence that a national ETS can be launched by 2017 and potentially fully implemented by 2020.
- **China's path toward a national carbon trading system will continue to take into account lessons learned from the regional pilots as well as China's unique policy goals and circumstances.** Among the most important issues to consider during this scale-up are: ensuring that the program features a central goal, is based on accurate data,[11] includes a cap whose integrity is maintained, provides for transparency, encourages long term decisions, provides for the use of high quality offsets, is based on a solid legal foundation, and is phased in over time.[12]

2. CHINA'S ENVIRONMENTAL CHALLENGES ARE MANY AND PRESSING

China presently confronts a number of serious environmental problems related to the country's heavy reliance on fossil fuels—especially coal—and the predominance of heavy industry within its economic structure.[13] These problems include severe air quality degradation, high near-term vulnerability to climate change, water pollution, and water shortages. These problems are exacerbated by the challenges associated with the need for institutions that can effectively control pollution that crosses provincial boundaries. In each case, environmental harm is associated with major economic and human health costs. For example, in 2012 the World Bank estimated that increased mortality and illness caused by pollution resulted in annual economic losses for China between US$ 100 billion and US$ 300 billion.[14] In 2010, China's Ministry of Environmental Protection estimated that pollution causes China RMB 1.1 trillion in direct economic losses each year, or 2.5% of GDP in 2010 alone. Including indirect losses such as damage to forest, wetland and grassland ecosystems raises the estimate to RMB 1.54 trillion, or 3.5% of 2010 GDP.[15] China is also uniquely vulnerable to climate change. As many as 60 million Chinese people live in low-lying coastal areas vulnerable to sea-level rise and flooding,[16] and many of China's regions suffer severe water shortages that are already threatening urban water supplies and agricultural production. Knock-on effects of temperature rises include increased energy use and higher emissions.

The government has recognized the urgency of each of these problems and taken a variety of measures to respond. These measures range from strengthened environmental laws and enforcement to policies that cap coal consumption in certain regions while promoting non-fossil energy sources such as solar and wind to meet new energy demand. By necessity, a large number of these policy initiatives relate to controlling emissions from fossil fuel combustion. While industry- or technology-specific standards and enforcement certainly have a role, a long-standing concern of such measures is that they are difficult to coordinate at the macro level in ways that reduce energy and emissions consistently overall, across sectors and regions.[17] In addition, carbon and conventional air pollutants are managed in separate ministries, hampering the realization of co-benefits. Given that China's ambient air quality problems and greenhouse gas emissions are strongly related to fossil fuel combustion, a carbon emissions trading system has the potential to help address both problems, while complementing other existing policies.

WHAT IS EMISSIONS TRADING?

Emissions trading is a market-based form of regulation that mandates the achievement of a defined environmental objective (such as capping and reducing air emissions of CO_2, SO_2, or NO_X) and provides covered enterprises with the flexibility to select the specific means to achieve the goal.

Core ETS Program Elements

A well-designed and functioning ETS may feature these elements (presented alphabetically for ease of reference):

- **Accurate data:** The ETS is based on accurate and ever improving data.
- **Administration responsibilities:** ETS program administration responsibilities are clearly delegated to the central and various local governments.
- **Allocation method:** ETS administrators can distribute allowances for free, via government run sale/auction, or through some combination of methods. Free allowances may be distributed by considering a facility's historical emissions rate, its comparative emissions intensity, and its exposure to competition from similar enterprises outside of the ETS. Allowances not distributed for free can enter the market via auctions.
- **Banking mechanism and registry:** An administrative mechanism that allows ETS participants to store allowances so that they can be held for use or offered for sale at a later date. The existence of an emissions bank promotes investments in measures that reduce emissions and free up allowances. This feature may help encourage enterprises to over-comply and financial institutions to provide funding for such initiatives.[18]
- **Common requirements:** ETS programs are structured around a common core of requirements that apply to all entities within each category, including those applicable to ETS administrators, enterprises, market operators, and other stakeholders.
- **Compliance flexibility:** An ETS will also provide the flexibility to achieve emissions reduction in a variety of ways, for example: one or multiple sources on-site at a given enterprise, through another source within the control of an enterprise, or by paying another enterprise covered by the program to make the reductions instead.
- **Emissions allowances or quotas:** The currency of an ETS, allowances, provide enterprises with the permit to emit a defined quantity (often in tonnes) of emissions.
- **Emissions reduction deadline:** The cap will include interim (such as annual) deadlines by which time programmatic and enterprise-specific emission reductions must be achieved.
- **Enforcement:** There should exist a means by which the ETS administrator can impose meaningful consequences upon ETS participants (enterprises and traders) that emit more than allowed or act in other ways that are contrary to the ETS rules. Such consequences may include fines (flat or structured to correlate with recently transacted prices or the magnitude of the exceedance and nature of the violation), the forfeiture of allowances that have been (or would have been) issued in subsequent years of the ETS,[19] or incarceration. Depending upon the ETS and the nature of the transgression, the enterprise or one or more responsible individuals may be held liable.
- **Enterprise-specific caps and obligations:** Once caps are established for the entire ETS, enterprise-specific emission obligations (caps) are defined. In this way, each enterprise is allocated its proportional share of the cap (as defined by the ETS administrator). Further, specific operating requirements (and limits) should be assigned to each enterprise.
- **Goal:** An ETS should be designed to achieve a central goal (e.g., achieving a particular emission reduction by a defined date). Secondary goals (e.g., increasing green jobs, generating revenue for the government, or advancing low carbon technologies) may also be included but should not undermine the primary goal.
- **Legal foundation:** Authority to develop and administer the ETS is derived from a sound underlying legal foundation that eliminates uncertainty amongst stakeholders that the administering entity has the authority to implement the ETS and the enterprises must comply with the requirements related thereto.
- **Liquidity:** Liquidity is a measure of how easy it is to convert an asset to cash or how rapidly the asset can be sold. In carbon markets, greater liquidity signifies a healthier market because it means that companies are able to buy and sell emissions allowances in a timely manner to fulfill compliance obligations and manage risk.[20]
- **Long-term decisions:** The ETS includes measures that encourage enterprises to make decisions that allow for investments and compliance strategies that may be implemented over the short or long term.
- **Market:** A marketplace provides a means by which quotas and qualifying offsets can be transacted. Such markets can run through government-sponsored auctions, exchanges (private or government sanctioned), over the counter (directly between two parties), or by another means as dictated by the needs of the ETS and its participants. Generally, the operators and participants in such a marketplace are subject to government issued regulations and oversight.
- **Monitoring, reporting, verification (MRV):** An ETS must include a means by which actual emissions can be accurately monitored, reported to the enterprise and the government, and verified by the government. A primary objective is to ensure that emissions,

Core ETS Program Elements *Continued...*

allowances, and reductions are consistent with the ETS requirements, are accurately accounted for, and not double counted.

- **Offsets:** Emission offsets (in China, offsets are called "Chinese Certified Emission Reductions" or CCERS) represent emission reductions that are derived from actions taken by entities that operate emission sources that are not included in the ETS. Such reductions are created in accordance with government prescribed protocols. Under certain circumstances, emission offsets can be used in lieu of allowances. The presence of offsets can serve to increase the supply of allowances and thereby moderate allowance prices. It is common for an ETS to restrict the supply of offsets (e.g. by limiting the types of sources that are eligible to generate offsets, creation methods, and geographic areas from which they can be sourced, or methodologies that can be used), limit the maximum quantity that can be used (such as 5-10% of an enterprise's compliance obligation), and prohibit the use of emission reductions which may be associated with shifting demand.[21]
- **Program-wide emissions cap:** The cap represents the amount of emissions that can be released by all of the enterprises that are included in the program. Generally, the cap establishes a quantity of emissions that can be allocated at the start of the program, and a reduction that must be achieved in order to realize a health-based or environmentally-based standard.
- **Reconciliation:** At the end of each compliance period (such as each year) enterprises must true-up their compliance status. Those with emissions that exceed the quantity of retired quotas must secure and retire additional allowances. Those that do so may be judged to be in compliance with a central requirement of an ETS.[22]
- **Reserve:** A quantity of allowances may be held by the ETS administrator and released as per prescribed protocol (such as to fund auctions or to enhance or moderate volatility) or augmented by withdrawing previously distributed or acquired allowances from individual enterprises.
- **Scarcity:** Each enterprise covered by the ETS may be provided with a quantity of allowances that, in the aggregate, declines over time such that the enterprise must either reduce emissions or acquire allowances from other participants. Scarcity can also be influenced through limits that are imposed on the quantity of allowances that can be banked and/or through the injection of allowances via auctions.
- **Scope and thresholds:** The ETS will define criteria (typically type of industry and quantity of emissions) that are used to select which enterprises are included in the ETS. Such criteria will be consistent with the nature of the challenge and the resources that are needed to administer, support, and be subject to the ETS.
- **Transparency:** The ETS requirements should be clear and understood by all stakeholders. So too should the performance of the enterprises that must comply with the requirements and the ETS administrators. Transparency should also extend to the market wherein the quotas and offsets are transacted.

3. EMISSIONS TRADING IS A COST-EFFECTIVE WAY TO ADDRESS EMISSIONS CHALLENGES

A well-designed and implemented ETS offers policymakers certainty that emissions reductions will be achieved and provides covered enterprises flexibility as to how to achieve this reduction. This combination drives innovation and encourages industry to meet or exceed environmental policy objectives. Studies of similar trading systems in the U.S. for sulfur and NO_X emissions have shown that the systems reduced compliance costs and led to innovations, such as high-efficiency desulfurization equipment, improved coal cleaning, blending of low-sulfur coal, post-combustion emissions control with low-NO_X boilers, power plant optimization, and utilization rates of natural gas and nuclear power plants.[23]

A well-designed and implemented ETS offers policymakers certainty that emissions reductions will be achieved and provides covered enterprises flexibility as to how to achieve this reduction.

3.1 The U.S. has served as a laboratory for different trading systems

The U.S. has 40 years of experience in the use of emissions trading to address both conventional pollutants and greenhouse gases. These programs have been administered on the national, regional, and local levels. The most well-known programs are those that have been aimed at reducing acid rain, which results in part from the release of nitrogen oxides (NO_X) and sulfur dioxide (SO_2).

History

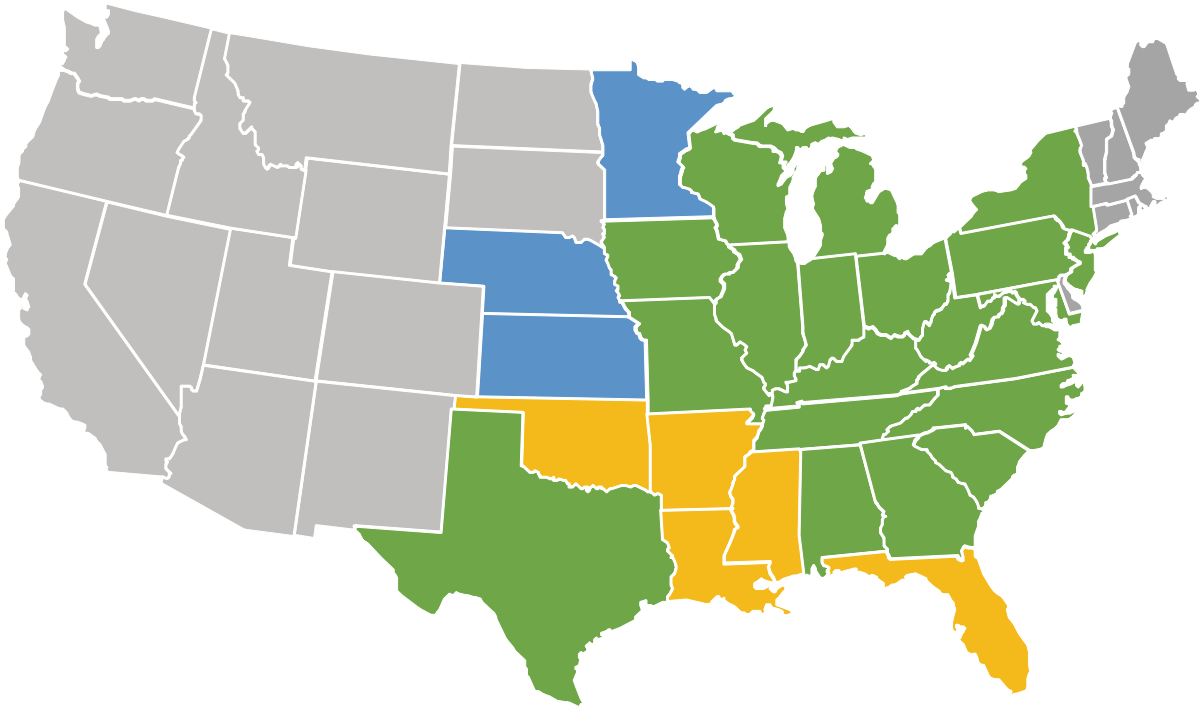
To achieve ambient air quality standards for ozone and its precursors, NO_X, SO_2, CO and lead (Pb), the 1970 Clean Air Act regulated emissions of these pollutants in a variety of ways, including technology and performance-based emissions standards for industrial equipment, power and heat generators, and mobile sources. The Clean Air Act included an early version of emissions reduction credit trading that provided compliance flexibility to certain enterprises. Enterprises were also allowed to expand in areas with substandard air quality provided that they secured offsetting emission reductions (offsets) to mitigate increases associated with their new and modified sources of pollution.[24] Later, in the 1980s, the U.S. Environmental Protection Agency (EPA) used trading to successfully control the lead content of gasoline, demonstrating both the viability of credit trading and the concept of credit banking to speed compliance and reduce cost.[25]

In 1990, Congress amended the Clean Air Act to tighten rules on SO_2 and NO_X, and give the EPA wider latitude to design emissions trading programs. Under the Clean Air Act's Acid Rain Program, 263 power plants began trading SO_2 allowances under a tighter cap in 1995, and in 2000 trading expanded to include almost all power plants. The program targeted fossil fuel combustion units in power plants and industry, covering over 1,200 facilities altogether. The EPA manages the system and oversees the accounting of allowances. Most allowances are distributed for free, while some are auctioned.

The SO_2 program has widely been deemed a success by the government, covered power plants, academics, and other observers.[26] The EPA estimates that during the first 13 years of trading, the program achieved SO_2 reductions at 57% lower costs than under a purely administrative system.[27] One key element of success was continuous emissions monitoring, with stiff penalties for monitoring violations. Compliance levels have exceeded 99%, with cases of non-compliance mainly due to accounting errors.[28] As with the EPA's lead (Pb) credit trading program, banking of allowances allowed for faster-than-anticipated reductions of SO_2 emissions.[29]

Beginning in 1999, an ETS was set up by several U.S. states to limit ozone season (summertime) emissions. The NO_x Budget Program initially involved 12 states in the U.S. Northeast, and was geared toward resolving seasonal summer problems with ground-level ozone. The program included a policy for banking allowances as well as a "flow control" policy that moderated the use of banked allowances.[30]

NO_x AND SO_2 TRADING UNDER THE CROSS-STATE AIR POLLUTION RULE AS OF 2014



States controlled for both fine particulates (annual SO_2 and NO_x) and ozone (ozone season NO_x)
States controlled for fine particulates only (annual SO_2 and NO_x)
States controlled for ozone only (ozone season NO_x)
States not covered by Cross-State Air Pollution Rule

Note: States in gray also engage in national trading of SO_2 allowances, but not under the Cross-State Air Pollution Rule.

In January 2015, the U.S. Environmental Protection Agency (EPA) launched the Cross-State Air Pollution Rule (CSAPR) and the blue, green and yellow states in this map participate in the program in different ways. The EPA estimates that CSAPR will reduce power plant SO_2 emissions by 73% and NO_x emissions by 54% in 2020 versus 2005 levels.[32]

Source: EPA, 2014

Notwithstanding these successes, by the early 2000s it had become clear that some states in the East Coast could not attain ambient air quality standards without greater action from so-called "upwind states." In response to this concern, in 2005 the EPA launched the Clean Air Interstate Rule (CAIR), setting lower caps on SO_2 and NO_X emissions and expanding the reach of emissions trading programs to more states. Litigation between upwind and downwind states held up implementation of CAIR for years. In 2014, the EPA finalized a revised version of CAIR called the Cross-State Air Pollution Rule (CSAPR), which came into force in January 2015. The EPA estimates that CSAPR will reduce power plant SO_2 emissions by 73% and NO_X emissions by 54% in 2020 versus 2005 levels.[31]

Carbon emissions trading has been discussed in the U.S. for many years. Thus far Congress has yet to pass national carbon cap-and-trade bills, but some states have adopted their own programs. In 2005, 10 states in the Northeast signed a memorandum of understanding to create a carbon trading market called the Regional Greenhouse Gas Initiative (RGGI).[33] RGGI held its first allowance auction in 2008 and the first compliance obligations were in 2009. The cap has reduced power sector CO_2 emissions by 40% since 2005, and is expected to reduce total regional carbon emissions by 50% through 2020.[34] At the national level, while the EPA's 2015 Clean Power Plan does not mandate power sector carbon allowance trading, it allows states to set up such programs or continue existing ones such as RGGI.[35]

In 2006, California's Republican Governor Arnold Schwarzenegger signed the Global Warming Solutions Act of 2006, or Assembly Bill 32 (AB32), into law, which requires the state achieve a reduction in carbon emissions to 1990 levels by 2020.[36] AB32 required the California Air Resources Board (ARB) to adopt regulations to achieve "maximum technologically feasible and cost-effective GHG emission reductions,"[37] and ARB has responded by adopting a variety of different regulations, including an emissions cap-and-trade system. The cap-and-trade mechanism covering entities responsible for 85% of the state's carbon emissions was approved in 2011, and the first auction was held in 2012.[38] The 2013 cap was set at 2% below the 2012 emissions level, and set to decline by a further 2% in 2014, and 3% annually from 2016-2020.[39] Because many carbon emissions reductions result from reduced fossil fuel use, there will be concomitant reductions in other pollutants such as SO_2,NO_X, and PM2.5.

The California program is already linked with emissions trading in Quebec, Canada, and is designed such that it can be linked with other state or provinces in the future.[40] On April 13, 2015, Ontario, Canada's largest province with 40% of country's population and almost 25% of its greenhouse gas emissions, announced its intent to launch a cap and trade program and link between Quebec and California.[41]

Lessons from the U.S.

Emissions trading in the U.S. highlights the large potential of an ETS for cost-effective emissions abatement. The Acid Rain Program for SO_2 emissions trading cost less than half the initial estimate,[42] and as already noted, the EPA estimates it also cost less than half what a command-and-control system would have required. For conventional pollutants like NO_X and SO_2, companies had a variety of ways to reduce emissions, including fuel-switching, use of cleaner fuels, upgrading boilers, and installing emissions-control equipment

such as scrubbers and selective-catalytic reduction (SCR). In addition, the ETSs for SO_2, NO_X, and carbon highlighted the essential importance of accurate source-specific emissions measurement and reporting, simplicity in program operation, transparency of emissions and allowance data, and swift and decisive enforcement actions.[43]

Early results from California's AB32 program are also positive. The program has contributed to innovation and entrepreneurship in clean energy and energy efficiency entrepreneurship.[44] It has also provided the state with monies that have been targeted to support a host of initiatives selected by Governor Brown.[45] The RGGI program has also generated funds which have been used to support energy efficiency and emission reduction measures in ten states.[46]

Ideally, ETSs can drive innovation, as can any pricing system that markedly raises the cost of more-polluting technologies and creates new markets for cleaner solutions. In practice, the impact of ETSs on innovation can be hard to precisely measure compared to alternative regulatory pathways.[47] The evidence from the U.S. SO_2 trading market suggests it promoted innovation in areas such as scrubber technology—in part through the flexibility it gave companies about how to comply.[48] Beyond the narrow technology area of scrubbers, the ratcheting up of emissions standards likely played a role in encouraging utilities to shift toward cleaner sources of energy such as natural gas and renewables.

3.2 EU emissions trading has successfully reduced emissions

In response to the Kyoto Protocol and international climate negotiations, in 2002 the European Union launched the EU Carbon Emissions Trading Scheme

California LA lessons: In 2006, then California Governor Arnold Schwarzenegger signed the Global Warming Solutions Act of 2006, which requires that the state achieve a reduction in carbon emissions to 1990 levels by 2020.

(EU ETS), in some ways building on the successes of earlier ETSs. Now the world's largest carbon market, the EU ETS has reduced emissions while spurring innovations in low-carbon energy.[49]

History

The EU ETS was launched in 2005 and now covers over 11,000 power stations and industrial enterprises from energy intensive industries in 27 countries that are responsible for about 45% of EU-wide emissions.[50] In the first phase of the system, from 2005-2007, industries received free allowances. In the second phase, from 2008-2013, the EU reduced the carbon cap and began auctioning allowances. In the third phase, now underway, carbon caps are being adjusted to reflect EU carbon emissions targets for 2020.[51]

Currently, EU-member states receive a specified amount of free allowances that have been decreasing each year since 2013. Member states also auction allowances, which can then be traded or banked.[52] Companies can also comply by purchasing Certified Emissions Reductions for avoided emissions—these offsets are governed and certified by the Clean Development Mechanism of the United Nations.[53] Compliance levels for the program have been high, as non-complying emitters pay a fine of Euro 100 per ton of excess emissions.[54] The European Commission estimates that the EU ETS will have reduced CO_2 emissions of its participants by 21% by 2020 compared to 2005 levels.[55]

Owing to a number of factors, mandated emission reduction obligations have been achieved ahead of schedule at prices that are lower than what could have been achieved using command and control.[56] European Union Allowance (EUA) prices dropped from Euro 20 in 2008 to Euro 2.46 in 2013.[57] Disappointed by the low price, a number of critics have pointed to a 2 billion tonne oversupply, which could grow to 4.5 billion tonnes by 2020.[58] The fact that emissions have declined to levels below the cap and at prices less than expected has prompted some critics to argue that the low price "gives industry only a weak signal to invest in low carbon technology."[59] Indeed, as of 2013, over 60 GW of new coal-fired power plants were reportedly planned for the EU, almost as large as the entire capacity of the French nuclear power fleet,[60] despite declining electricity demand. Efforts to reduce the cap and the concomitant allowance supply have come up against political resistance. Establishing larger reforms like a minimum carbon price or carbon tax[61] would require the unanimous agreement of all 27 EU member states.[62]

The EU ETS triggered innovation in a variety of ways that helped companies reduce emissions at lower cost.

Lessons from Europe

The EU ETS provides a number of lessons, four of which are noted here. First, carbon markets can work, in the sense of generating innovation beyond what might have happened without a flexible regulatory system. Second, in retrospect, some argue that policymakers tend to set caps too high and over-allocate permits, overestimating the negative effect of strict caps while underestimating the likelihood of allowance oversupply. Third, industry innovation and efficiency improvements often result in the achievement of targets ahead of schedule and at lower than expected cost. Fourth, after launching a program, ETS architects may find it difficult to secure political approval to lower caps as a means to increase emission reduction ambitions.

ETS policymakers should recognize that compromises made to address political or industry opposition will have consequences later on in the program.

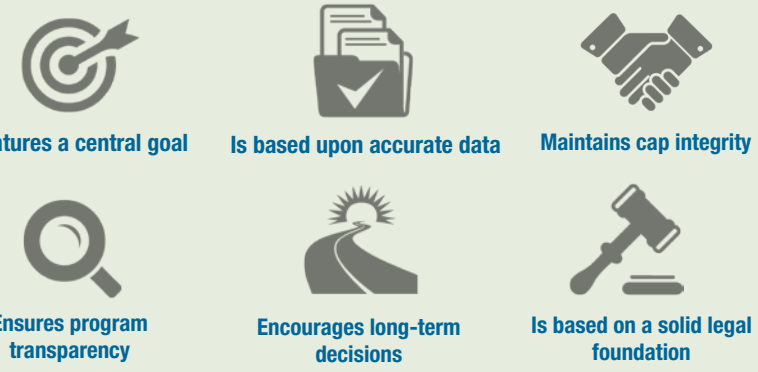
Some have suggested that the inclusion of a price floor[63] or cap adjustment mechanism could have addressed these problems.[64]

The EU ETS triggered innovation in a variety of ways that helped companies reduce emissions at lower cost. Carbon caps led to several cases of innovative cross-sector collaboration.[65] Overall the ETS likely accelerated utility and industry investments in renewable energy that were also promoted by policies at the country level.[66] The ETS has also contributed to a 50% acceleration of coal plant retrofits, resulting in lower emissions of carbon and other pollutants.[67] However, critics of the EU ETS note that the collapse of allowance prices reduced price signals for power plant dispatch while also reducing investments in R&D, plant upgrades, and fuel-switching.

In the West, notwithstanding RGGI's successful efforts to reduce the cap, experience with the acid rain program suggests that after the launch of an ETS, policymakers may not have the ability to adjust such fundamental elements as the emissions caps.[68] ETS policymakers should recognize that compromises made to address political or industry opposition will have consequences later on in the program. For example, in the face of concerns that an ETS will force the sudden internalization of previously externalized costs, to overcome opposition and as a matter of expediency, ETS architects may consciously elect to start the program with a higher cap. Such choices will, at least at the outset of the program, reduce the price on carbon.[69]

Given these two circumstances, ETS policymakers may consider the use of one-way cap ratchet mechanisms to ensure caps are not set too high to accomplish emissions reductions goals. After launch, in the event that the ETS produces better results in terms of emissions reductions achieved on a certain schedule, or at a lower cost of such reductions, and if further reductions are warranted, then the program-wide cap could be reduced. The reduction mechanics should be defined prior to the launch of the program, be transparent to all stakeholders, and be implementable without the need for further policy intervention.[70] Price floors are another option to ensure a minimum price on carbon.

To maximize benefits, China should endeavor to produce an ETS that:



4. CHINA'S EXPERIENCE WITH EMISSIONS TRADING AND CONSIDERATIONS FOR EXPANSION

This section looks at China's history with emissions trading since the early 1990s, progress to date with the seven regional pilots that were launched in 2014 and important considerations for China as the country begins to prepare to launch a national ETS scheduled to begin by 2017.

4.1 China's experience with emissions trading prior to the regional carbon pilots

China's decision to deploy a national emissions trading system to combat climate change comes after a long history of experimenting with the use of such market instruments to address conventional and greenhouse gas pollutants.[71] In the early 1990s, the State Environmental Protection Administration (SEPA, now the Ministry of Environmental Protection) piloted an emission permitting system in 16 cities, on the basis of which six priority cities for pollution control were chosen to experiment with SO_2 emission trading. In the 2000s, to control acid rain and SO_2 emissions, China used international experience to design its ETS. With the support of the Environmental Defense Fund, SEPA oversaw an SO_2 ETS between 2001 and 2004 (during the 10th Five-Year Plan, 2001–2005)[72] that involved four provinces (Shaanxi, Jiangsu, Shandong and Henan), three cities (Shanghai, Tianjin and Liuzhou), and one enterprise (China Energy Group).[73] The program capped allowable SO_2 emissions and covered 727 companies (mainly in the power sector) located in 131 cities that were responsible for about 20% of China's SO_2 emissions.[74]

China's decision to deploy a national emissions trading system to combat climate change comes after a long history of experimenting with the use of such market instruments to address conventional and greenhouse gas pollutants.

Encouraged by the central government's demonstration projects, more provinces and cities began to use emissions trading as a tool to achieve their emissions control targets, especially for the compulsory targets of SO_2 and NO_X set by the 11th Five-Year Plan. In 2007, the Ministry of Environmental Protection and Ministry of Finance jointly launched another emissions trading program covering seven provinces, which subsequently expanded to eleven provinces (Jiangsu, Zhejiang, Tianjin, Hubei, Hunan, Inner Mongolia, Shanxi, Shaanxi, Chongqing, Hebei and Guangdong). An additional ten provinces not included in the national demonstration program voluntarily launched their own pilot ETSs.

4.2 Overview of China's seven carbon trading pilots

With this experience as a historical backdrop on October 29, 2011, the National Development and Reform Commission (NDRC) issued Document Number 2601,[75] establishing carbon trading pilots with the purpose of implementing "the 12th Five-Year Plan's requirement to gradually establish national carbon trading markets and promote market mechanisms to achieve by 2020 China's

goal of controlling greenhouse gas at a low cost."[76] Among other objectives, the NDRC directed the pilot regions to define the total GHG emission control target; formulate a GHG emission permit allocation plan; establish a local carbon trading supervision system and registry; and establish a trading platform. The seven pilot areas have a combined population that exceeds 250 million, and in 2014 their collective GDP represented about RMB 17 trillion, or 26.7% of China's total GDP.

A review of the progress to date suggests that China has already achieved, or is on-track to achieve these objectives. All of the pilots have built their programs around firm year one caps. Year two caps are also expected to be fixed, though whether the caps grow or shrink relative to year one is a variable design feature.

A review of the progress to date suggests that China has already achieved, or is on-track to achieve objectives.

In the first year of the pilots the relative proportion of carbon emissions averages 53% and ranges from 30% (Chongqing) to 60% (Tianjin). The total allowance of the pilots ranges from 33 million tonnes per year (Shenzhen) to 388 million tonnes (Guangdong), and the aggregate total for all seven pilots in their first year of trading (inclusive of the primary and secondary markets) was about 1.247 billion tonnes. In total about 2,052 enterprises are included in all seven pilots. Shenzhen and Tianjin mark the outside parameters of the number of enterprises included in the ETS—635 and 114, respectively[77]—and the emissions threshold that triggers an enterprise's inclusion in the ETS—3,000 tonnes per year in Shenzhen and 60,000 tonnes of standard coal consumption (the equivalent of 165,000 tonnes of CO_2 per year) in Hubei.

As of July 31, 2015, with the first full compliance year completed for five of the pilots,[78] Shenzhen and Shanghai have reported 100% compliance, while Tianjin, Beijing, and Guangdong report compliance rates that range from 96.5 to 98.9%.[79] Preliminary year two compliance reports have been provided for Shenzhen (99.7%), Shanghai (100%), Beijing (100%), Guangdong (99.5%), and Hubei (100%).[80]

Penalty provisions vary widely. In Shenzhen, enterprises that fail to retire sufficient quotas can face a fine (equal to the shortfall multiplied by a figure which is as much as three times the average market price realized over the prior six months) or the forfeiture of a quantity of quotas from the subsequent years (equal to the shortfall). On the other extreme, there are no fines for enterprises that violate the terms of Tianjin's ETS, though they may be excluded from certain bonuses under other policies.

The total volume of reported transacted quotas in all seven pilots (through July 31, 2015) is approximately 57.1 million tonnes valued at US$ 308 million (RMB 1.91 billion).[81] At the low end of the range, approximately 2 million quotas valued at about US$ 5.9 million (RMB 36.4 million) were transacted in Tianjin, while at the high end, about 21.2 million quotas valued at about US$ 75.4 million (RMB 467.4 million) have been transacted in Hubei (as measured by monetary value Guangdong had the largest share – 20.6 million allowances, US$ 147 million or RMB 911.1 million).[82] The average quota over the entire course of the pilots as of July 31 2015 ranged from US$ 2.88 (RMB 17.84) in Tianjin to about US$ 7.13 (RMB 44.22) per tonne in Guangdong.

CHINA CARBON TRADING PROGRAM STATISTICS (7/31/15)

Pilots (Start date)	Population (millions) (2013)	GDP (trillions US$) (2014)	Carbon Trading Program Design Parameters (Year 1)							ETS-wide Compliance (%)		Quota Market (6/18/13 – 7/31/15)			
			Cap Type	% CO_2 Under Cap	Capped CO_2 & Companies		Threshold (annual CO_2 and/ or tce)	Penalty Provisions				Total Quotas Traded		Avg. Quota Price over entire program ($/mte)	Avg. Quota Price of last 30 sessions ($/mte)
					CO_2 (MMT)	Cos		Fine (RMB)	Quota Debit	Year 1	Year 2	Traded (MMT)	Value (millions $)		
Shenzhen (6/18/13)	10.4	0.26	Firm	40%	33	635	3,000 CO_2	Shortfall x 3P6	Shortfall x 1	100	99.7	5.5	33.1	5.99	5.42
Shanghai (11/26/13)	23.7	0.38	Firm	57%	160	191	10,000/ 20,000 CO_2	50,000 to 100,000	Shortfall x 1	100	100	3.6	18.6	5.17	3.19
Beijing (11/28/13)	20.7	0.35	Firm	49%	57	490	10,000 CO_2	Shortfall x 3 to 5 Pa	-	97.1	100	3.8	26.9	7.01	6.87
Guangdong (12/16/13)	106.4	0.84	Firm	54%	388	242	10,000 CO_2	50,000 to 50,000	Shortfall x 2	98.9	100	20.6	147	7.13	2.54
Tianjin (12/26/13)	14.7	0.25	Firm	60%	160	114	20,000 CO_2	-	-	96.5	99.1	2.0	5.9	2.88	2.89
Hubei (4/2/14)	58	0.45	Firm	44%	324	138	60,000 tce (165,000 CO_2)	150,000 Shortfall x 1 to 3Pa	Shortfall x 2	100	-	21.2	75.4	3.55	4.14
Chongqing (6/19/14)	29.7	0.23	Firm	30%	125	242	20,000 CO_2	-	-	-	-	0.3	1.1	4.03	-
Pilot Totals	253 .2	2.77		53%	1247	2052						57.1	307.8	5.39	-
As % of China	18%	27%	P6 = Average quota price over prior 6 months Pa = Average quota price (no time period specified) Ph = Highest daily price of compliance period Shortfall = Quantity of quota shortfall (reported emissions minus surrendered quotas)												

Source: EDF 2015[83]

4.3 Considerations in China's future ETS design

The successor to the pilots is intended to be a nationally administered ETS. While the national ETS has yet to be defined, various communications from the government suggest that it may include the following characteristics:[84]

- A focus on eight industrial sectors: electricity and heat generation, metallurgy, non-ferrous metals, chemicals, paper, building materials, domestic aviation, and transportation;[85]
- A 3-4 billion tonne cap; and
- A market size of RMB 9.6 - 64 billion per year.[86]

The government has suggested that the program may launch by 2017 and the first compliance obligation may be in 2017 or 2018. Full implementation may occur by 2020.[87]

At this stage of the pilot program, it is possible to identify design parameters

that can be extracted from the experience gained thus far from the seven carbon trading pilots.

Underlying Legal Foundation

In order to reduce administration and implementation uncertainties, the ETS should have an appropriate underlying legal foundation.

Of China's seven pilots, only those in Shenzhen and Beijing are founded in law.[88] The other pilots are implementing their respective ETSs through administrative measures,[89] which have legal character, but are not binding on all local agencies and lack legislation's statutory authority when it comes to enforcement and compliance assurance.

HIGHLIGHTS OF CHINA'S ETS EXPERIENCE

16 CITIES

Early 1990s

State Environmental Protection Agency (now the MEP) piloted an emission permitting system in 16 cities

2001-2004

To control acid rain and SO_2 emissions, China used international experience to design its ETS that SEPA ran for four years, involving four provinces, three cities and one enterprise (China Energy Group)

2007

MEP and Ministry of Finance jointly launched another emissions trading program covering seven provinces. An additional ten provinces not included in the national demonstration program voluntarily launched their own pilot ETSs.

2011

NDRC established seven carbon trading pilots with the purpose of promoting market mechanisms to achieve by 2020 China's goal of controlling greenhouse gas at a low cost.

The seven pilot areas have a combined population that exceeds 250 million, and in 2014 their collective GDP represented about 17 trillion, or 26.7% of China's total GDP

96.5-100% COMPLIANCE

2015

After one full year of compliance, Shenzhen and Shanghai have reported 100% compliance, with Tianjin, Beijing and Guangdong reporting compliance rates ranging from 96.5 to 98.9%

2017

Government has suggested the national program may launch by 2017

2020

Full implementation may occur in 2020

Goal

Policymakers should design an ETS with the primary goal of first capping and then reducing emissions from covered enterprises. The goal should be expressed in absolute—not relative—reductions, and include a defined deadline. Moreover, the program should specify that enterprises may either deploy on-site solutions, such as emissions control devices, or market-based solutions, such as purchase of allowances. Secondary objectives, such as promoting green jobs or advancing a particular technology or fuel, can be included if program designers determine that such objectives will not undermine the primary goal. Program designers should also ensure that objectives such as market efficiency, volatility management, and new source accommodation do not trump—or undermine—environmental objectives.

The primary goal of China's pilot program is to use the pilots to field test the various methods and means that are available to develop an ETS with Chinese characteristics. NDRC's October 29, 2011 Document number 2601 (which mandated the establishment of the seven pilots) includes language which states that the purpose of the pilots is to implement "…the 12th Five-Year Plan's requirement to gradually establish national carbon trading markets and promote market mechanisms to achieve by 2020 China's goal of controlling greenhouse gas at a low cost."[90]

In order to reduce administration and implementation uncertainties, the ETS should have an appropriate underlying legal foundation.

Cap and Scope

Fundamental to a cap and trade program is the establishment of an emissions cap. The cap represents the amount of emissions that can be released by all of the enterprises that are covered in the program. Generally, the cap establishes a quantity of emissions that can be allocated at the start of the program, and a reduction that must be achieved in order to realize a health- or environmentally-based standard. Once established, the cap can be allocated among the enterprises (are required to operate within the emission limits defined by the quotas that they hold and any other applicable control requirements) or held by the government for future distribution to achieve programmatic objectives.

Collective CO_2 emissions in the Chinese provinces and municipalities hosting the pilots exceed 2.4 billion tonnes.[91] In total, about 53% of the total CO_2 emissions of these jurisdictions are included in the first year of the pilots. The seven pilots have ETS-wide absolute caps. Policymakers in these programs have affirmed that additional allowances will not be introduced into the system for the then-current year, regardless of economic growth rates and whether emissions exceed the initial cap. Nonetheless, at least one of the pilots—Guangdong—has affirmed that the cap for the second year of the pilot will be larger than the first year.[92]

Allocations

Allocation methodology is an important design consideration. The merits of grandfathering (giving allowances to enterprises based on their historical emissions) and benchmarking (distributing quotas based on an enterprise's relative carbon intensity as measured against like sources) have been

widely debated. Another important consideration is the degree to which the allocation measures encourage long-term planning. Decisions concerning when quotas are issued, in what vintages, for what duration, and whether the quotas can be adjusted, will have significant influence on whether a compliance manager will rely upon or avoid the quota market. At one extreme is the U.S. SO_2 Acid Rain program quotas, which were issued in fixed quantities over a 30-year duration. In the Chinese pilots, enterprises may be notified of the quantity of CO_2 quotas that they receive on an annual basis and may have the quotas adjusted at the end of each year.[93]

Banking Mechanism and Registry

An emissions bank is an administrative mechanism that allows ETS participants to store allowances or credits for later use or sale. Existing ETSs generally include banking mechanisms that afford protections to unused quotas and offsets. This is the case with the EU ETS, the Acid Rain program, RGGI, and, to a degree, AB32.[94] Unlimited banking represents one extreme which when combined with overly generous allocations (made over the short- or long-term), will moderate the level of carbon reduction investments. This is the case in the EU ETS, where some critics have urged the abolition of surplus allowances or the imposition of controls that would restrict their use.[95]

In China, to some degree, all of the pilots allow for the carry-over, or banking, of unused quotas. Concerned about the effect that surplus quotas may have on market price, Hubei has included a "use it, trade it, or lose it" provision that will result in the cancellation of unused quotas unless they are used or traded.[96] In other pilots the ETS administrator can cancel surplus quotas, regardless of whether the quotas have been acquired through trades. And some pilots have actively contemplated the use of funds to purchase and retire quotas as means to moderate falling prices from any excess supply.

Data Accuracy

The accuracy of data used to define the baseline (starting point) of the program as a whole, the initial allocations, and the quotas/offsets issued to (and used by) covered entities is of great importance. As ETS program administrators, covered entities, and service providers gain experience, MRV data collection systems will improve, and necessary and appropriate programmatic and facility-specific adjustments should be made.

Each of the pilots has undertaken efforts to develop and improve emission inventories, and each pilot follows its own protocols. Thus far the NDRC has formulated fourteen MRV guidelines and an additional 12 are expected to be finished by this year. National electronic reporting systems are also under development.

China's carbon pilots launched while in the midst of developing and improving their emission inventories. This process invariably involves data secured by and through the enterprises, third-party verifiers, local DRC implementers, statistical bureaus, and other sources. The quality of the inventories has improved over the course of the first year, and will continue to improve during the remaining two years of the pilots.

Third parties play a prominent role in verifying enterprise emissions in China's ETS pilots. Such verifiers must meet qualification criteria and can be subject to significant penalties if the government determines that they failed to perform their responsibilities. The qualifications of third-party verifiers vary by pilot, but generally verifiers should have independent corporate capacity and fixed premises, a certain number of professional and technical personnel, and working experience in GHG emission verification for a certain period of time.

Direct and Indirect Emission Sources

Many ETSs focus on direct emitters of pollutants. Care should be taken to ensure that the emissions inventory, allocations and credits, and compliance assessments are drawn from the same data set. Particular effort is made to establish distinct inventories and programs for: (a) direct point sources of emissions; and (b) entities whose emissions are indirect (that use electricity or power generated by a third party where generation resulted in the release of emissions) or cannot be reliably measured. While it can be acceptable to allow indirect sources to satisfy compliance obligations with direct-source derived allowances, measures undertaken by indirect sources (such as energy efficiency) should generally not be used to generate offsets or free up quotas that can be used by direct sources.

China's ETS pilots include direct and indirect emission sources. Power generators (such as power plants) and users (such as large commercial buildings) are included in the same ETS, provided allocations, and allowed to trade quotas with each other. Double counting may occur when the power

Chinese lessons: Shenzhen (pictured here) is one of the seven pilot sites for carbon ETS and after the first year reported 100% compliance. The other six pilots are Shanghai, Beijing, Guangdong, Tianjin, Hubei and Chongqing.

user (indirect source) undertakes an energy efficiency project that results in the use of fewer allowances and can sell surplus allowances. Meanwhile, if the power generator (direct source) is in the same region, because the power user is consuming less power (as a result of the energy efficiency project) the power plant needs fewer allowances and, therefore, can sell such surplus allowances. The sale of the surplus allowances by both the power user and the power generator makes the tracking of emissions problematic and could result in double counting of emissions and reductions.[97]

Diversity of Sources

An ETS may focus on a single sector (both RGGI and the US SO_2 Acid Rain program focus on the electric power sector) or multiple sectors (such as California's AB32 and the EU ETS). A single sector ETS may be attractive to administrators because of the comparative ease of development, implementation, and enforcement. An ETS that includes multiple sectors is likely to include a larger number and diversity of enterprises with greater diversity of control costs and more opportunity for cost savings. A covered entity may consider trading with another entity if cost savings (or profits, in the event of a seller) can be realized via a trade as compared to on-site solutions. Such savings (or profits) are more apt to be realized if the program includes entities that have different marginal control costs.

All things being equal, sources with similar marginal costs of controls will have little incentive to trade with each other.

All things being equal, sources with similar marginal costs of controls will have little incentive to trade with each other.[98] Such similar sources may be better managed through the use of command and control in which the regulator defines and prescribes a single (or common) solution that is to be adopted by similar sources. Enterprises representing at least 32 different sectors are included in China's seven carbon trading pilots. With representatives from about 26 different sectors, Shenzhen may have the most diverse ETS. At the opposite extreme, Guangdong focuses on four sectors: cement, electricity generation, iron and steel, and petrochemicals.[99]

Long-term Stability and Visibility for Market Participants

One measure of the success of an ETS is the degree to which enterprise compliance managers invest in long-term solutions. A program that facilitates such planning would likely have a multi-year duration, stable rules, long-term emission reduction objectives, multi-year offsets, the ability to use offsets without buyer liability, and a banking mechanism. Without such provisions, risk-averse compliance managers may find it prudent to pursue on-site compliance solutions that apply a very high discount to opportunities that may be available through the ETS market.

Existing ETSs have varying levels of success in encouraging long-term solutions. If considering just the term of the program, for example, the U.S. Acid Rain ETS effectively issued and afforded protections to 30+ year quota streams. This, in turn, provides compliance managers with the confidence that allows them to make long-term investments in facility upgrades (that achieve compliance or free up surplus quotas) and pursue multi-year or multi-decadal emission reduction investments and quota purchase and sales strategies.

In contrast, California's AB32 program has, at best, a seven-year term. Sources in Phase III of California's AB32 will operate within the program for barely three years before the program ends.[100] Such a short time frame (and the concern as to what will become of the ETS and assets and liabilities related thereto) may discourage long-term investments.

China's ETS pilot policymakers and enterprises face multiple challenges in this regard. Unless extended,[101] all of the pilots will cover emissions only through 2016. Given that the pilots launched, issued allocations and published rules as late as June 2014 (in the case of Chongqing), the term may be as short as 18 months. Enterprises are further discouraged from making long-term plans because rules limit quota issuance to current years,[102] prohibit the trading of yet-to-be issued quotas, and still do not allow for the use of risk hedging mechanisms like options. The planning horizon is further narrowed as all pilot administrators reserve the ability to adjust allocations at the end of each year.

Market Volatility

Markets, though powerful, can also be unpredictable. While policymakers may applaud the positive attributes of a market—including faster, better, and cheaper achievement of environmental objectives—they may also be concerned about managing two challenges: market volatility and manipulation. Policymakers for existing ETSs have developed a number of means to mitigate these concerns. In the face of extreme prices, RGGI and California's AB32 include provisions that make available additional quotas (which, in the case of AB32, are included within the cap, but held back just for such purposes). In both circumstances, price triggers and volumes are defined in the implementing regulations. The AB32 program also includes provisions that monitor and prohibit behavior that may lead to market collusion or manipulation.

Like their western counterparts, Chinese ETS policymakers are also concerned about these issues. In order to moderate volatility, some pilots allow the local DRCs to release more quotas (which were initially held back from the initial allocations) with the intent of bringing prices down. In the event that prices fall too low, some pilots provide the ETS administrator with the ability to purchase quotas, with the intent of boosting prices. However, some of the pilots have provided opaque guidelines stating when or how the government will intervene and the precise objectives that such intervention may be designed to achieve.[103] Opaque guidelines introduce an element of uncertainty that can curb enterprises' willingness (and that of financial entities) to participate in the market. A concern for all pilots is to ensure that such actions do not undermine and thwart the very forces that have the potential to make the market work.

With the EU ETS experience in mind, Chinese ETS administrators have incorporated a variety of volatility management measures to adjust the quantity of quotas available to individual enterprises or the market as a whole, detect illegal market manipulation, and impose penalties to deter behavior that could exacerbate market volatility.[104] Auctions (including auctions with price floors) have also been used as a means to manage price volatility in

the first year of the pilots.[105] Depending upon the program, additional quotas (those held back from initial allocations and subsequently distributed) can be designed into the initial cap, as is the case with Shenzhen. The total quantity of quotas can be adjusted up or down ex-post based on production data and the carbon intensity of operations.[106] In the first year, ETS administrators have injected additional quotas[107] through the use of auctions[108] and withdrew from circulation quotas that were deemed to be surplus.[109]

An ETS must have at its core a reliable means to detect, confirm, and remedy noncompliance. Specifically, there must be meaningful and consequential enforcement.

Meaningful Enforcement and Consequential Penalties

An ETS must have at its core a reliable means to detect, confirm, and remedy noncompliance. Specifically, there must be meaningful and consequential enforcement. Enterprises must know with certainty that scofflaws will be caught and the consequences will always be more expensive than operating in compliance. And regardless of how an enterprise's transgressions are treated, there should be a mechanism to make the environment whole. Specifically, if excess emissions are released in year one, an equal or greater quantity must be retired in subsequent years.[110]

Pilot policymakers in China constructed their ETSs with the Administrative Penalty Law in mind,[111] which limits the amount of penalties that can be assessed against noncompliant enterprises.[112] Therefore, the consequences of noncompliance vary widely. Not all of the pilots have direct fines or penalties that are specified for violators of the ETS. For example, violations in Shenzhen can result in a fine that is up to three times the market price as well as a subsequent year deduction of a quantity of quotas equal to the shortfall. Guangdong, Chongqing, and Hubei also have the ability to confiscate a multiple of the shortfall from the subsequent year's allocation. Noncompliance can also include a form of naming and shaming that can affect an enterprises' ability to bid on government contracts. On the other hand, enterprises that are in compliance can be rewarded with direct financial support or favorable treatment of applications associated with energy conservation and emission reduction projects.

Mobile Sources

While most ETSs focus on stationary sources of pollution, California is an exception.[113] Mobile sources contribute a significant quantity of CO_2 emissions in China and in the pilots, and are specifically targeted in the Shenzhen ETS. In Shenzhen, the number of vehicles on the road has grown from about 200,000 in 2003 to more than 3,000,000 in 2014.[114] Given this rapid growth, the high number of vehicles per square kilometer (1,536 in Shenzhen versus 16 in Hubei), and vehicles' contribution to Shenzhen's CO_2 emissions, Shenzhen understands that it cannot cap and reduce emissions unless it includes mobile sources in the ETS.[115] Shanghai has also elected to include mobile sources in its ETS, including domestic aviation and dockside port sources.

Offsets

High-quality emission reductions derived from sources outside of the cap and trade program can reduce the cost of compliance for enterprises within the ETS. Offsets should be disallowed from activities that result in shifting

demand (such as offsets resulting from capped sources that compensate for reductions by moving emitting activities outside the cap) or that cannot guarantee post-project enforcement and monitoring. The importance of offsets depends on the level of the initial cap, the robustness of the economic growth of the covered enterprises, and the relative quantity of offsets that are permitted for compliance purposes.

Existing ETSs provide for the use of offsets. In the EU ETS, CCER and quota prices are significantly lower from peak years (pre-financial crisis); the prospect of an excess supply contributed to California's decision to limit both the quantity of offsets allowable for compliance purposes[116] and the number of methodologies that can be used to create offsets. China's pilots limit the quantity of CCERs acceptable for compliance purposes to 5-10%.[117] Some pilots have also imposed local content requirements that specify that some quantity of CCERs result from projects within the geographic boundaries of the pilot (such as 50% in Beijing and 100% in Hubei). And some pilots restrict (or mandate) the use of particular methodologies. Thus far, a relatively small quantity of CCERs has been transacted.[118]

Risk Hedging Tools

Private capital will tend to flow toward low-carbon investments when there is long-term certainty in policy, most directly represented by a stable, long-duration forward curve for carbon prices. While stable rules are key, the same is true for the ability to use financial instruments that allow enterprises to manage risk. The ability to transact puts, calls and other derivatives allows compliance managers to establish a forward (out-year) curve for prices and access the futures market; access and reduce the cost of capital needed to implement emission abatement projects that have large capital outlays and out-year returns; manage price volatility; lock in exposure to fluctuating prices; lock in long-term credit supply and delivery; lock in long-term carbon revenues from abatement projects; leverage scarce capital to manage risks and participate in the market; and reduce the amount of capital needed to participate in the market, comply, and operate profitably.

At their launch, most all of the Chinese ETS pilots allowed enterprises the ability to transact only the physical product.[119] This restriction effectively limited trading to quotas already issued in year one.[120] In the first compliance year of the pilots, year two and year three quotas were not issued and could not be traded, except in Shanghai.[121] Although a number of carbon quota and CCER trading funds and loan-related announcements have been made,[122] enterprises cannot yet use derivative products that provide them with the opportunity to cost-effectively hedge risks and maximize opportunities. Such instruments include options (puts and calls), insurance related products, futures contracts, margin agreements, and related derivative instruments. One potential path forward is the establishment of a national emissions trading futures market in Guangdong, announced in China state media in early 2015. A national futures market, regulated by appropriate national financial authorities and managed by the NDRC, could help improve carbon price transparency as well as enable compliance enterprises to manage risk.[123]

Thresholds

An ETS should establish thresholds that are applied to determine which enterprises are included in the ETS. Such thresholds are often expressed in terms of GHG emissions.[124] In California's AB32, enterprises that emit 25,000 tonnes or more of GHGs are included in the program. Six of the seven pilots in China have emissions thresholds. Shenzhen, a city that has a few large emitters, has the lowest threshold: 3,000 tonnes per year for manufacturing facilities. Chongqing and Tianjin each have established a 20,000 tonnes per year threshold. Hubei, which has a relatively higher proportion of heavy industries and large energy users, has an ETS that features a threshold that is equal to 60,000 tonnes of standard coal consumption equivalent and equates roughly to 165,000 tons per year of CO_2.

Transparency

The success of an ETS is highly correlated with its transparency. This is particularly true as it relates to program requirements, regulations, and quota and offset markets. Additionally, information must be available that allows for the government and enterprises to assess facility-specific performance data. And all stakeholders—the government, enterprises, and the public—must have access to information that can be used to independently assess the aggregate performance of both the ETS, the compliance status of the enterprises, and the performance of government officials that are charged with its administration.

5. CONCLUSIONS AND SUGGESTIONS

China is presently developing a national carbon ETS that capitalizes on its unique circumstances and serves policy objectives for carbon, energy, air pollution, and water. There are a number of reasons to give strong consideration to using a well-designed and well-implemented ETS.

An ETS provides participants with the freedom to select the most cost effective means to achieve a government-mandated objective while providing the government with the means to ensure that the objective is achieved.[125] A successful ETS encourages participants to seek out and pursue strategies that result in over-compliance, which frees up quotas that can be later used or sold. These incentives are examples of Premier Li Keqiang's call for innovation and mass entrepreneurship as engines of China's economy.[126]

A national ETS can also be designed to achieve climate objectives that will deliver both carbon and conventional pollutant emissions reductions, since there is a direct correlation between actions which cap CO_2 and those that also reduce PM2.5, NO_X, and CO_2. In contrast, a locally-effective conventional pollutant reduction program can aggravate national CO_2 emissions, for example by promoting the production of gas from coal gasification, or by simply shifting emitting activity out of a specified jurisdiction and into another.

An ETS expands the pool of capital that is available to reduce emissions. An ETS encourages enterprises to implement additional controls that serve to simultaneously reduce costs and free up quotas that they can then sell to other participants, use to accommodate expansion, or bank for future needs and market trading. The emission reduction benefits of an ETS also extend beyond the facility. An ETS featuring offsets encourages investments (and spreads the benefits) beyond the geographic or sector boundaries of the cap and trade program.

China can benefit from the lessons learned by ETSs in other countries: China can selectively adopt and adapt those design characteristics that underlay the success and avoid those features that have hobbled other programs:

- The EU ETS experience has shown the value of a firm cap, the importance of offsets, the proper function of multi-sector fraud monitoring, and the need for severe penalties. However, it also illustrates how it can be difficult to increase environmental ambitions by tightening the cap after the program has started. RGGI, in contrast, suggests that it is possible tighten the cap.
- The U.S. Acid Rain Program has similarly illustrated the value of a firm cap, the importance of up-front issued quotas that can be traded far into the future, the value of robust MRV systems, and the role of meaningful penalties.

A national ETS can also be designed to achieve climate objectives that will deliver both carbon and conventional pollutant emissions reductions, since there is a direct correlation between actions which cap CO_2 and those that also reduce PM2.5, NO_X, and SO_2.

- California's AB32 trading program also shows the importance of consequential noncompliance penalties; the workability of a multi-sector, firm cap; how to provide for a limited supply of high-quality offsets; the importance of risk hedging products; and how to encourage international linkage with other trading programs. On the negative side, AB32 features a limited program term (2020) which introduces uncertainty and makes it difficult for enterprises to pursue long term carbon management strategies. AB32 also features buyer liability offsets that increase costs and build in unnecessary uncertainty.[127]
- The U.S. RGGI program has common core program elements around which nine sub-national programs have linked their individual programs while preserving the ability to administer select aspects of their respective programs. Limitations include RGGI's focus on a single sector and lack of offsets.

At the heart of an ETS should be a central goal. The achievement of carbon reductions by a defined deadline may be the primary goal.

To derive the maximum benefits, China should endeavor to move forward with a process that produces an ETS that:

1. **Features a central goal:** At the heart of an ETS should be a central goal. The achievement of carbon reductions by a defined deadline may be the primary goal. Secondary goals – such as reducing conventional pollutants, transitioning to low carbon fuels, greening the supply chain, and creating jobs may be important, but should not undermine the primary goal. These goals should fundamentally shape the design of the resulting ETS. Further, program designers should ensure that market efficiency objectives do not trump environmental objectives.
2. **Is based upon accurate data:** The accuracy of data used to define the baseline (starting point) of the program as a whole, the initial allocations, the allowances/offsets issued to (and used by) covered entities, and the compliance performance is of great importance. As ETS program administrators, covered entities, and service providers gain experience, systems used to monitor, report, and verify data will improve and necessary and appropriate programmatic and facility specific adjustments should be made.[128]
3. **Maintains cap integrity:** The program should start with and keep an absolute cap on emissions whose integrity is always maintained. To that end:
    - The program must be designed to prevent double counting of emissions and/or credits.
    - The cap should include allowable emissions that have been issued to covered entities and allowances reserved for new sources (or price volatility management).
    - Non-compliance situations resulting in excess emissions should always be resolved by retiring a quantity of emissions that is equal to or greater than the exceedance (as opposed to being resolved only through the payment of a fine). Penalties (monetary and otherwise) imposed on non-compliant sources should, in general, be greater than the economic benefit realized from being in noncompliance.[129]

- High quality emission reductions derived from sources outside of the cap and trade program will reduce the cost of compliance and should be encouraged. However, offsets should be disallowed from reductions from capped sources that compensate for reductions by moving emitting activities outside the cap, or from activities that cannot be guaranteed post-project enforcement and monitoring.

4. **Ensures program transparency:** Covered entities, regulators, and relevant third parties should have a clear understanding of rules, associated obligations, opportunities to derive economic benefits/ operational flexibility, and the consequences of non-compliance. Further, robust MRV systems should be included to ensure an accurate accounting of emissions and compliance obligations.

5. **Encourages long-term decisions:** Compliance managers are generally risk averse. Most will choose more costly solutions that they can manage over those solutions that are potentially more lucrative and risky. This is because the consequences of non-compliance are so much more certain (and meaningful) than the uncertain potential for reward. This situation is particularly acute in management structures where decisions are subject to ex post facto prudency reviews. The long term and aggregate consequence of a tendency towards internal compliance solutions (and an aversion to trading) can be fewer allowances or credits being created and greater aggregate costs. ETS program designers can mitigate these concerns by including the following design elements to contribute to stability and predictability:

   - Clear rules that are not subject to frequent and unpredictable change.[130]
   - Emission allocations and offsets issued over multi-year periods.[131]
   - Secure emissions banking process.
   - Trading of multi-vintage streams of allowances and offsets.
   - Financial tools that transmit a robust and long-term carbon price throughout the economy, incentivize abatement measures and clean technology innovation, and allow enterprises to manage risk.[132]

6. **Is based on a solid legal foundation:** In order to ensure that enterprises clearly understand and will comply with the ETS requirements and the directions of ETS administrators, the ETS should be based on an appropriate legal foundation.

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Josh Margolis is the Director of Environmental Markets for EDF's China Program. In this capacity he provides training to enterprises and ETS policymakers from the NDRC, all seven of China's carbon trading pilots, and non-pilot regions. He works closely with national, provincial and municipal governments in their efforts to develop ETS systems that are effective and appropriate considering China's unique challenges and opportunities. Josh supports EDF's efforts to use simulations to provide training and build capacity amongst Chinese ETS enterprises and government policymakers.

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Prior to joining EDF, Josh ran the environmental desks at a financial services firm and two consulting and engineering firms. Josh is a co-inventor of a patent that provides for the neutralization/offsetting of equities. Josh graduated with honors in Public Policy Sciences from Duke University in 1981.

Dan Dudek

Dan Dudek received his PhD in Agricultural Economics from the University of California, Davis. He began his professional career in California in 1975 with the Economic Research Service focusing on nonpoint source pollution from irrigated agriculture. As an assistant professor at the University of Massachusetts he developed an interest in acid rain. He joined the Environmental Defense Fund in 1986.

He is widely credited with developing the cap-and-trade model included in the Clean Air Act amendments of 1990 that led to dramatic reductions in sulfur dioxide emissions, the cause of acid rain. President George H.W. Bush praised the EDF team for breaking the logjam on acid rain. Dudek has partnered with BP to develop their internal GHG trading system, with the Polish Environment Ministry to pilot SO_2 emissions trading, with Russia's Goskompriroda on the US Initiative on Joint Implementation, and with Illinois on VOC trading. He has also been an adviser and consultant to numerous international organizations and governments, including the OECD and UNCTAD; the Secretary of Energy's Advisory Board; US EPA's Science Advisory Board; and California's AB-32 Market Advisory Committee.

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64. Brigitte Knopf, Ottmar Edenhofer, "Save the EU Emissions Trading Scheme: set a price band," Energy Post, October 21, 2014, accessed at http://www.energypost.eu/eu-emissions-trading-scheme-can-saved-price-band/ The authors of this paper do not necessarily concur with the conclusion that cap adjustment mechanisms or price floors would mitigate the noted problems. As with other policy matters, the efficacy of these prescriptions depends on many factors, not the least of which are the details of how the solutions are implemented and the context within which they are implemented.

65. "The EU Emissions Trading System – Results and Lessons Learned," Environmental Defense Fund, 2012, accessed at: http://www.edf.org/sites/default/files/EU_ETS_Lessons_Learned_Report_EDF.pdf, Appendix A, page 43ff

66. Karolin S. Rogge et al., "The innovation impact of the EU Emission Trading System - Findings of Company case studies in the German power sector," Ecological Economics 70 (2011), November 16, 2010, accessed at: http://www.sciencedirect.com/science/article/pii/S0921800910003915,

67. Karolin S. Rogge et al., "The innovation impact of the EU Emission Trading System - Findings of Company case studies in the German power sector," Ecological Economics 70 (2011), November 16, 2010, accessed at: http://www.sciencedirect.com/science/article/pii/S0921800910003915.

68. RGGI is one notable exception. After program launch, in the face of chronically low allowance prices and less than fully subscribed auctions, the nine RGGI states agreed to reduce the cap from 165 million to 91 million short tons. "Regional Greenhouse Gas Initiative: The World's Carbon Markets: A Case Study Guide to Emissions Trading," Environmental Defense Fund, May 2013, accessed at http://www.edf.org/sites/default/files/EDF_IETA_RGGI_Case_Study_May_2013_0.pdf.

69. Depending upon the program design, a higher cap may also result in cap that has a steeper rate of decline and, by extension, a higher cost of credits in the out years.

70. However, caution should be exercised by ETS policymakers who may be tempted to use carbon price as a metric that may trigger programmatic adjustments. While a great deal of concern has been expressed by some in the face of low EUETS carbon prices, politicians could expect to hear an even louder hue and cry had allowance prices moved in the other direction (for example, had the European recovery been more robust and/or the supply of CDM CERs dried up). In such event a different group of advocates – perhaps with greater clout – could have expected to press politicians to print additional allowances and, thereby, bust the integrity of the cap. For this reason, it is important to remember that a carbon price, while important, is not the objective – it is a means to an end.

71. "国务院办公厅关于进一步推进排污权有偿使用和交易试点工作的指导意见" [published Guidance on Further Promoting Compensation for the use of Pollutant Emission Right and Trading Pilot], China State Council, August 25, 2014, accessed at http://www.gov.cn/zhengce/content/2014-08/25/content_9050.htm.

72. "Acid Rain Control in China: Total Emission Control and Emission Trading," SO2 Total Emission Control and Emission Trading Policy Implementation Demonstration Working Group, Beijing: China Environmental Science Press, 1999.

73. Shandong, Shanxi, Jiangsu, and Henan Province; the cities of Shanghai, Tianjin, and Liuzhou; and the Huaneng Group.

74. Tao Pan, Zhihong Wei and Deshun Liu, "Pilot SO2 Emission Trading Projects in Power Sector in China," Research Center of Contemporary Management, Global Climate Change Institute, Tsinghua University, accessed May 4, 2015, at http://joa.csee.org.cn/Public/DownloadFile.aspx?FileStorageId=f49242e8-c380-43a9-a0e5-330bf3d4a36f.

75. "国家发展改革委办公厅关于开展碳排放权交易试点工作的通知, [regarding the development of carbon emission rights trading pilot work notice], Document Number 2601, National Development and Reform Commission, October 29, 2011, accessed at http://www.sdpc.gov.cn/zcfb/zcfbtz/201201/t20120113_456506.html.

76. "国家发展改革委办公厅关于开展碳排放权交易试点工作的通知, [regarding the development of carbon emission rights trading pilot work notice], Document Number 2601, National Development and Reform Commission, October 29, 2011, accessed at http://www.sdpc.gov.cn/zcfb/zcfbtz/201201/t20120113_456506.html.

77. Not including public buildings in Shenzhen.

78. Launch dates were as follows: Shenzhen on June 18, 2013; Shanghai on November 26, 2013; Beijing on November 28, 2013; Guangdong on December 16, 2013; Tianjin on December 26, 2013; Hubei on April 2, 2014; and Chongqing on June 19, 2014. The first compliance year ends one year after launch date. At the time of publication, the first compliance year has been completed for Shenzhen, Shanghai, Beijing, Guangdong, Tianjin. Hubei and Chongqing have not yet reported the first year compliance results.

79. Compliance in Shenzhen is often reported as 99.4% (see Annual Report of Shenzhen Carbon Emission Trading System Operation). This figure reflects that 631 of 635 companies were found to be in compliance at the close of the first year. However, the Shenzhen DRC reports (through conversations with EDF in November of 2014) that the remaining four companies came into compliance during a grace period which is provided for in Shenzhen's ETS interim measures.

80. At this time it has not been possible for the authors to verify year one or two compliance assessments.

81. These quantities include both those purchased on the primary market (by the government through government auctions) as well as the secondary market (by and between enterprises as well as financial entities and individuals that do not have compliance obligations).

82. This data has been compiled by EDF from data provided by the individual pilots over the time period between a June 2013 to July 31, 2015. The volumes and values include both the primary market (comprised of pilot sponsored auctions as well as some (but not all) of the trades that were executed on the secondary market (i.e., trades by and between enterprises and other entities, (those that do not have compliance obligations). Through May of 2015, auctions have been conducted in Guangdong, Hubei, Shenzhen, and Shanghai. During this time auctions have been used to facilitate the transaction of 16,329,463 tonnes of quotas transacted at approximately US$ 127,661,770 (about RMB 798 million).

83. Capped CO2 and companies data pertains to year one. Note that data has been collected and evaluated by EDF through discussions with local DRC officials and from a variety of electronic resources including the pilots' (and/or their respective exchanges') WeChat subscriptions and websites (i.e.,Shenzhen: http://www.cerx.cn/; Beijing: http://www.bjets.com.cn/; Shanghai: http://www.cneeex.com/; Guangdong: http://www.cnemission.com/; Tianjin: http://www.chinatcx.com.cn/tcxweb/; Hubei: http://www.hbets.cn/; Chongqing: http://222.178.87.205/index.html). Some of these sources overlap in their coverage but yield conflicting information regarding the products that have been traded. In such cases the authors have made reasonable efforts – with varying degrees of success -- to reconcile conflicts. Also, it should be noted that transaction summaries reported here do not reflect trades that were not cleared and/or reported by the exchanges. Finally, no information regarding CCER trades has been included. For this reason, the reader should take such into account prior to using this information.

84. EDF discussions with NDRC officials September 2014, and "蒋兆理: 争取2016年夏季启动全国碳市场保留7-10家交易机构" [Jiang Zhaoli: Strive for Summer 2016 Start of National Carbon Trading Market, Preserving 7-10 Trading Exchanges], East China Forestry Exchange, February 4, 2015, accessed at http://www.hdlqjy.com/Archive/CarbonNewsDetail.aspx?id=4101 and subsequent discussions with NDRC officials. Given the early stage of the ETS development process, numbers included here should be considered to be indicative of the total market parameters. Actual numbers for sectors to be covered, cap size, market volume and value will be a function of several key decisions (and market conditions) that have yet to be made by national ETS policymakers.

85. EDF calculations derived from http://www.iea.org/bookshop/648-CO2_(emissions_from_fuel_combustion) and http://www.iea.org/bookshop/642-Energy_Balances_of_Non-OECD_Countries (emissions from energy) for electricity and heat generation, metallurgy, non-ferrous metals, chemicals and petrochemicals, building materials, and domestic aviation, The inclusion of transportation emissions would likely increase the emissions attributable to the eight sectors.

86. "蒋兆理: 争取2016年夏季启动全国碳市场保留7-10家交易机构" [Jiang Zhaoli: Strive for Summer 2016 Start of National Carbon Trading Market, Preserving 7-10 Trading Exchanges], East China Forestry Exchange, February 4, 2015, accessed at http://www.hdlqjy.com/Archive/CarbonNewsDetail.aspx?id=4101.

87. During this time period, it is possible that the pilots themselves may continue to operate, at least for a period of time, even as the national program is rolled out. It is not possible to know which enterprises (types, sizes, locations) are located in the pilots as opposed to the national ETS.

88. "我市碳排放权交易立法进展顺利," Government of Chongqing Municipality, March 29, 2014, accessed at http://www.ccpc.cq.cn/xxjc/lfgz/201404/t20140429_72567.html.

89. Shanghai, Guangdong and Hubei's Carbon Trading Management Decree were passed during the provincial or municipal government executive meetings and published by the government, while Tianjin's Carbon Trading Management Decree was a government document published by the Tianjin Municipal Government Office.

90. "国家发展改革委办公厅关于开展碳排放权交易试点工作的通知, [regarding the development of carbon emission rights trading pilot work notice], Document Number 2601, National Development and Reform Commission, October 29, 2011, accessed at http://www.sdpc.gov.cn/zcfb/zcfbtz/201201/t20120113_456506.html. Noticeably absent from this directive is language mandating the achievement of a particular emission reduction. The lack of such language is entirely consistent with the reason why the pilots were established.

91. Collectively, the seven pilots had a cumulative year one cap of ~1.247 billion tonnes and include ~2,052 enterprises. The largest is Guangdong, with a first year cap of ~388 million tonnes of CO_2 and 242 enterprises. Though Shenzhen has the smallest cap – 33 million tonnes – it has the largest number of enterprises – 635.

92. EDF interviews with local Development and Reform Commission officials, Spring 2015.

93. On the need for stable allocations Brian McLean notes that "… allocations should not be adjusted at the end of each year; any significant adjustments should be made with at least 10 years notice as most large capital investments require a 10 to 20 year payback period." B. McLean (private communication, 2015).

94. AB32 offset holders are somewhat cautious because offsets can be invalidated years after their issuance if it is determined that the offset creator broke the rules, even if the transgression occurred years before the credits were sold and placed in the bank.

95. "EU Emissions Trading System - the future of the System," U.K. Department of Energy & Climate Change, October 22, 2014, accessed at https://www.gov.uk/eu-emissions-trading-system-the-future-of-the-system; Bryony Worthington, "Europe needs to fix or ditch its emissions trading scheme," Guardian, July 14, 2014, accessed at http://www.theguardian.com/environment/2014/oct/15/europe-needs-to-fix-or-ditch-its-emissions-trading-scheme.

96. "湖北省碳排放权管理和交易暂行办法" [Hubei Province Emissions Allowance Management and Trading Short-Term Method], Hubei Province People's Government, April 4, 2014, accessed at http://gkml.hubei.gov.cn/auto5472/auto5473/201404/t20140422_497476.html.

97. One commenter has a different view on the concerns stated here regarding the merger of directs and indirects. The commenter suggests that the problem alluded to here – double counting – is a matter of opinion. Double counting can be eliminated by means of allocation. What is key is to ensure that quota allocation is done in such a way that makes it clear that an enterprises' responsibility is to reduce emission, electricity consumers (indirects) are responsible for saving electricity, and power plants are responsible for improving production efficiency and therefore reducing carbon emission per unit production.

98. This should not be read to imply that enterprises within the same sector will have similar marginal costs of control. Brian McLean notes "In the US programs I was surprised to find that the marginal cost of reducing a ton of SO_2 or NO_x varied considerably from power plant to power plant and from unit to unit within a plant." B. Mclean (private communication 2015).

99. Guangdong has announced its intention to expand the ETS to include buildings, ceramics, nonferrous metals, paper, plastics, textiles, and transportation. EDF interviews with local officials, Spring 2015.

100. Proposals have been put forward to extend the term of AB32's cap and trade program to 2030. "First Update to the Climate Change Scoping Plan," California Air Resources Board, May 2014, accessed at http://www.arb.ca.gov/cc/scopingplan/2013_update/first_update_climate_change_scoping_plan.pdf.

101. A number of the pilots—such as Hubei, Shanghai, and Shenzhen—are reportedly considering a second phase which would have the effect of continuing the ETS beyond 2015. The scope of enterprises included in any such second phase may increase (to include those below the phase 1 threshold and/or in a previously excluded sectors) or decrease (for example, in the event that a national ETS picks-up sectors and/or enterprises that were previously included in phase 1). It is also possible that there will be two levels of ETS programs operating simultaneously – the national program and a local/provincial program that is administered by the province/municipality that covers sources/activities which are otherwise excluded from the national ETS (such as those which are excluded from the national program based on their emissions, carbon intensity, energy usage, or sector that are otherwise considered to be important by the local authorities).

102. With the exception of Shanghai.

103. One notable exception is Beijing. The Beijing Municipal Development and Reform Commission (DRC), the Beijing Municipal Finance Bureau of Beijing issued draft guidance ("北京市发展和改革委员会北京市金融工作局关于印发北京市碳排放权交易公开市场操作管理办法（试行）的通知," Beijing Municipal Commission of Development and Reform, June 10, 2014, accessed at http://www.bjpc.gov.cn/tztg/201406/t7851003.htm) that the procedures that may be implemented in the event that prices are deemed to be too high or too low. Paraphrasing the guidance, if for ten continuous trading days, the weighted average price of secondary market price is higher than RMB 150, then the Beijing DRC can (but is not obligated to) organize temporary auction. If for ten continuous trading days the weighted average price of secondary market price is lower than RMB 20, then exchange shall report this information, and the related government agencies shall decide if buy-back will occur. Though this guidance suggests when and how the government may intervene, it leaves much to the discretion of the government and, therefore, leaves market participants without the ability to implement effective risk management strategies.

104. The ability to use CCERs and price floors are also considered to be a volatility management mechanism. Allowing any amount of CCERs to be used dampens price increases. Limiting the amount which may be applied against enterprise compliance obligations to 5-10% is meant to help ensure that prices do not fall precipitously.

105. Shenzhen, Guangdong, and Hubei have distributed a portion of quotas through the use of auctions. Guangdong's auctions have included a price floor of RMB 60/tonne in seven auctions held in first year; while in the second year, this floor price was dropped to RMB 25/tonne.

106. The ETS administrator's ability to adjust quotas after their issuance (ex post adjustment) may be inconsistent with the need to set clear signals to enterprises.

107. Which quotas were included within the original caps but held back in a reserve from the initial allocations.

108. As was done by Shenzhen when less than 200,000 tonnes were offered and 74,974 tonnes of quotas were sold at a price of RMB 35.43 per tonne through an auction that was held on June 5, 2014.

109. Through an end-of-year one post-adjustment process, Shenzhen reportedly reduced the quantity of vintage 2013 allowances by 2,328,700 tonnes. Hubei's regulations mandate that quotas be cancelled at the end of the year unless they have been used or traded.

110. For example, under AB32, the California Air Resources Board can respond to violations by enjoining enterprises and levying civil or criminal penalties. Those that fail to retire a sufficient quantity of quotas must retire a quantity equal to four times the shortfall. Fines can also be levied for the false or late reporting of information. Under California Health and Safety Code Sections 38580 fines equal to US$ 25,000 to US$ 250,000 (up to US$ 1 million if the defendant is a corporation), and/or nine months in jail. And CARB can suspend, revoke, or restrict holding accounts of enterprises that are determined to be in violation of AB32. "Climate Change Draft Scoping Plan a Framework for change, Appendices, June 2008 Discussion Draft," California Air Resources Board, June 2008, accessed at http://www.arb.ca.gov/cc/scopingplan/document/draftscopingplanappendices.pdf.

111. "Law of the People's Republic of China on Administrative Penalty," China.org, March 17, 1996, accessed at http://www.china.org.cn/english/government/207306.htm.

112. All of this changes with the new Basic Environmental Law passed in April of 2014. Under this law there will be no limits on penalties. And penalties will now be assessed on a cumulative basis levied from the day of violation to the date of compliance. For the first time in China, incentives will be aligned so that compliance will be cheaper than noncompliance.

113. The U.S. runs a Corporate Average Fuel Economy (CAFE) trading program that uses market based measures to encourage the manufacture of clean energy vehicles. California runs a Zero Emissions Vehicle (ZEV) program that includes a market-based elements and Southern California's South Coast Air Quality Management District uses market-based measures to encourage ride sharing. The U.S. has developed protocols through which emission reductions can be rewarded to entities that reduce emissions associated with marine vessel, accelerated vehicle scrappage, use of remote sensors to repair high-emitting vehicles, truck stop electrification, and train retrofits. Also, California's AB32 cap and trade program expands in 2015 to include suppliers of natural gas, distillate fuel oil, and liquefied petroleum gas.

114. "200万!深圳汽车保有量内地第二全省第一" [2 million! Shenzhen Car Market is Number 2 Domestically and Number 1 in Province," Sohu, February 28, 2012, accessed at http://guangzhou.auto.sohu.com/20120228/n336132538.shtml.

115. Shenzhen has stated its intention to build an ETS that also targets public buses and taxis, private vehicles, and freight and cargo vehicles.

116. California's AB32 limits the quantity of offsets that may be used to 8% of an enterprise's compliance obligation. This compares to the EU ETS which includes limits of 50% in Phase I and 13.4% in Phase II.

117. Which, considering the aggregate volume of quotas, suggests that CCERs could be used to satisfy compliance obligations of – at most --102 MT. Other requirements (such as those regarding geographic location of the project creating the offsets and the user, methodology used, date of creation) further reduce the quantity of CCERs that are available for use by covered enterprises.

118. Just 75,522 tonnes in Beijing and 210,000 tonnes in Guangdong have transacted. This compares to a traded volume of >38 MT of quotas in both cities.

119. Shanghai being a notable exception.

120. Year-one equates to vintage 2013 quotas for Shenzhen, Shanghai, Beijing, Guangdong, and Tianjin. Year one equates to vintage 2014 in Hubei and Chongqing.

121. Shanghai issued and allowed enterprises the ability to transact vintage 2013, 2014, and 2015 quotas.

122. Note that over the course of the pilots a number of important innovations have been introduced which do serve to enhance market liquidity. Consider the following examples: In November 2014, an RMB 30 million RMB fund was established by Huaneng to trade quotas in Hubei ("Huaneng sets up China's first carbon fund," Reuters, November 26, 2014, accessed at http://www.reuters.com/article/2014/11/26/china-carbon-idUSL3N0TG3HM20141126). In November 2014, a Huaneng subsidiary obtained an RMB 300 million loan from the China Construction Bank using quotas as collateral. In December 2014, launched by Shanghai-based Haitong Securities and Treasure Carbon announced an RMB 200 million fund that will invest in projects that generate CCERS ("Shanghai companies launch 200 mln yuan carbon fund," Reuters, December 31, 2014, accessed at http://mobile.reuters.com/article/idUSL3N0UF23P20141231?irpc=932). In March 2015, an RMB 50 million trust fund was announced by CMB Sinolink Investment with JIC Trust as a limited partner to invest in CCER projects ("Bank to launch first China carbon trust fund," Carbon Pulse, March 19, 2015, accessed at http://carbon-pulse.com/leading-bank-to-launch-first-china-carbon-trust-fund/). In March 2015, Shanghai Development Bank made an RMB 50 million loan to a Guangdong-based subsidiary of Huaneng using 150,000 Guangdong quotas as collateral ("Bank to launch first China carbon trust fund," Carbon Pulse, March 19, 2015, accessed at http://carbon-pulse.com/leading-bank-to-launch-first-china-carbon-trust-fund/). In March 2015, a fund (perhaps equal to RMB 30 million RMB) was established by GDR Carbon Asset Management to trade in unspecified types of quotas and CCERs ("Shenzhen trader sets up carbon fund," Carbon Pulse, March 16, 2015, accessed at http://carbon-pulse.com/shenzhen-trader-sets-up-carbon-fund/). In March 2015, an RMB 600 million carbon fund which may be launched by Guangdong's municipal government is discussed. The monies would be derived from quota sales through Guangdong's auction. ("Guangdong close to launch 600 million yuan carbon fund," Carbon Pulse, March 17, 2015, accessed at http://carbon-pulse.com/guangdong-close-to-launch-600-million-yuan-carbon-fund/).

123. Stian Reklev, "China to set up carbon futures exchange in Guangdong: State media," Carbon Pulse, February 9, 2015, accessed at http://carbon-pulse.com/china-to-set-up-carbon-futures-exchange-in-guangdong-state-media/.

124. Either over a specified baseline period prior to the start of the ETS and/or which are introduced after the commencement of the ETS.

125. Robert Stavins, "Cap-and-Trade, Carbon Taxes, and My Neighbor's Lovely Lawn," Robert Stavins' Blog, October 21, 2012, accessed at http://www.robertstavinsblog.org/2012/10/21/cap-and-trade-carbon-taxes-and-my-neighbors-lovely-lawn/.

126. "李克强: 装备走出去倒逼提高企业竞争力 [Li Keqiang: equip 'Go' campaign to increase entrepreneurial competitiveness], Xinjing Newspaper, April 6th, 2014, accessed at http://politics.people.com.cn/n/2015/0406/c1001-26803410.html

127. Buyer liability is a concept which requires the purchaser of an offset to ensure that the offset is maintained. It is in contrast to a seller liability program, which imposes this obligation on the creator of the offsets.

128. One reviewer recommends that China should give consideration to measures that would improve reliability of those who are responsible for the MRV systems. In particular, the establishment of an independent auditing body that oversees third party supervisory organizations, independent of the government's functional departments is recommended. Those that offer auditing services would need to comply with standards, have their work audited, and be subject to punishment measures when deficiencies are discovered. So as to avoid conflicts of interest, this organization could implement a rotation system whereby facilities are audited by different auditors each year. The commenter further recommended that systems should be established such that the quality of the report is maintained and the independence and objectivity of the auditor is preserved. In particular, the government should provide guidance regarding fees and, in some circumstances, subsidies.

129. One reviewer recommends that local governments should have a role in quota allocations, emission reduction mandates, and compliance assessments. Local government using policy funding such as budgetary or other funding (e.g. quota auctions) to channel private capital into the market. This should improve the local government's ability to regulate and channel the funding and its liquidity.

130. Notwithstanding the need for stable rules, consistent with China's penchant to a learn-by-doing approach, the ETS should be phased in over a period of time. As experience is gained, data quality improved, stakeholder capacity built program administrators can gradually expand the ETS coverage to more sectors, enterprises, and geographies.

131. One reviewer notes that it is important for local governments to regulate markets, foster conditions that promote liquidity, and channel funding. To this end it is recommended that local governments should have a role in quota allocations, auctions, and actions that may encourage the injection of private capital into the market.

132. One reviewer notes that the ETS should be established and run in a fashion that encourage financial innovation, provides policy support for financial institutions' participation in the market. Of particular concern is the need to accommodate the use of financial tools that improve liquidity and price discovery. Regarding this matters, the roles of the NDRC, accreditation bodies, and government finance bodies should be clarified as early as possible.

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