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China's New National Carbon Market[†]

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On December 19, 2017, China announced the official start of its national emissions trading system (ETS) construction program. When fully implemented, this program will more than double the volume of worldwide carbon dioxide emissions covered by either a tax or tradable permit policy. Carbon pricing, through either policy, transparently equalizes the economic incentive to reduce emissions across firms and is synonymous with conditions for least-cost regulation.

The scale of environmental and economic consequences for China and the world make this an important program to understand and inform. Yet the context and program design differ from those of emissions trading programs in the United States and Europe. In particular, the design of the program follows a tradable performance standard (TPS).

Design choices matter (Schmalensee and Stavins 2017). In this paper, we review the policy context and initial program design of China's new national ETS. We then highlight important concerns, speculate about possible modifications, and suggest topics for further research. Our main point is that the multi-sector TPS design creates several opportunities to improve efficiency.

I. The China Context

China's decision to implement an ETS follows years of international and domestic commitments to mitigate climate change and policy experience. China's 2015 climate pledge or Nationally Determined Contribution (NDC) under the Paris Agreement, the global accord to limit global warming, includes meeting, by or before 2030, three goals: (i) peaking the country's carbon dioxide emissions; (ii) lowering those emissions per unit of GDP, that is, reducing the economy's carbon intensity 60 percent to 65 percent from the 2005 level; and (iii) increasing the share of non-fossil fuels (renewables and nuclear) in primary energy consumption to 20 percent. For its 13th Five Year Plan (2016–2020), the Chinese central government has set, and the Chinese Congress has ratified, two domestic legally binding targets addressing China's climate pledges. One is to decrease the economy's carbon intensity by 18 percent relative to 2015. The other is to increase the share of non-fossil fuels in primary energy supply to 15 percent by 2020. China's international commitments and domestic targets for addressing climate change mirrors President Xi Jinping's new development paradigm that attaches great importance to green development and climate change mitigation.

Over the past decade, China has adopted subsidy programs for energy efficiency investment projects, energy performance standards, and feed-in tariffs for renewable electricity as the primary policy instruments for low-carbon development. However, these policies would appear insufficient to meet China's climate pledge and achieve the domestic legally binding targets for low-carbon development. At the same time, the Chinese government has been attaching increasing importance to market-based policies to achieve environmental goals. For almost a decade, the government has considered introducing such a new policy instrument to control carbon dioxide emissions. This process involved a specific debate on whether China should introduce an emissions trading system (ETS) or a carbon tax.

The recent decision to implement an emissions trading system over a carbon tax reflects a number of factors. The National Development and Reform Commission (NDRC) would

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oversee an ETS and is the primary government agency in charge of major national initiatives. A tax would fall under the purview of the Ministry of Finance. Second, energy prices are heavily regulated and politically sensitive in China. A meaningful carbon tax in China is therefore unlikely at this time, whereas a reasonably ambitious ETS may be possible. Finally, the three-year-old ETS pilot programs in five cities and two provinces have provided ETS experience and momentum.

II. Carbon Market Design

In addition to the ETS announcement, the NDRC released its *Guidelines of National Carbon Emissions Trading System Construction*, which was approved by the State Council. This document presents the guiding principles and three phases of China's national ETS construction. The first phase ("infrastructure construction") will last approximately one year and focus on the construction of a national monitoring, reporting, and verification (MRV) system, a national registration to track allowance ownership, and a national platform for emissions trading. The second phase ("system test") will last another year and involve a trial run with only one sector, electric power generation, to test the operation of the national ETS, including the system's allocation, trading, registry, and compliance protocols. The third phase ("development and improvement") will mark the beginning of the full ETS compliance regime with the power generation sector and will gradually extend to other sectors.

Many program elements are not detailed in the document, particularly the allowance allocation protocol. Our description of the expected design is based in part on the recent document, in part on a comment draft of the *Guidelines of Cap Setting and Allowance Allocation*, and in part on experience with an allowance allocation trial that we expect will guide the final design. This trial was organized by the NDRC and conducted in three sectors (power generation, cement, and aluminum) in two provinces (Jiangsu and Sichuan) in May 2017.

A. *Coverage and Threshold*

China's national emissions trading system will ultimately cover eight sectors: electricity (including power generation, power and heat cogeneration, and grid distribution), building materials, iron and steel, non-ferrous metal processing, petroleum refining, chemicals, pulp and paper, and aviation. Companies with an annual energy consumption of more than 10,000 tons of coal equivalent, or roughly 26,000 tons of carbon dioxide, in the eight sectors must participant in the emissions trading system.[1] As a result, that system will regulate approximately 6,500 enterprises, covering one half of China's total carbon dioxide emissions.

Like the seven ETS pilot programs, China's national emissions trading system will regulate only carbon dioxide emissions, not other greenhouse gases (GHGs). These emissions account for 83 percent of China's total GHG emissions.

B. *Output-Based Allocation*

Most emissions allowances will be distributed based on sectoral benchmarks or performance standards applied to actual production. This method is similar to the output-based allocation proposed for trade-exposed industries in 2009 US legislation (Waxman and Markey 2009). In that context, output-based allocation was used to allocate some portion of an overall, larger, and fixed cap. Here it is used in part to set the cap, which will vary on the basis of production levels. In that sense, it is essentially a TPS—also referred to as rate-based regulation or intensity standards. This choice follows from China's experience with seven carbon market pilot programs. Eventually, these programs all chose TPS once the data and MRV capacity for implementing sectoral emissions benchmarks was available.

Why? First, the electricity and district heat generators are not able to pass down increased costs to heat and electricity users due to government price controls. This argues for some type of free allocation. Second, growth remains high in many sectors and regions and there is a desire to accommodate that growth. Third, firms that have invested in cleaner technologies are often among the faster growing companies. Grandfathering tends to favor firms who have yet to invest in

[1] For comparison, the US Clean Power Plan would regulate power plants above 25MW, which is closer to 75,000 tons or more, depending on the fuel and capacity utilization.

such technologies and/or who are contracting. Finally, while ad hoc adjustments could address these concerns, these are costly to administer and increase opportunities for corruption.

As an example of how the program will work, the allowance allocation a that power generation facility will receive can be mathematically represented by

$$a = bq, \tag{1}$$

where b is the benchmark carbon dioxide emissions per unit of electricity, ton/MWh; and q is the actual electricity output for the compliance year. The parameter b is set by the NDRC and represents a performance rate set somewhere between the industry average and the best performing facility. This approach was used for the May 2017 allowance allocation trial for the power, cement, and aluminum sectors.

C. *Subcategorization*

Different generation technology subcategories for the power generation sector are subject to different benchmarks. There were 11 such subcategories in the allowance allocation trial organized by the NDRC.

D. *Indirect Emissions from Electricity*

Outside of the electricity sector, enterprises are responsible not only for mitigating on-site carbon dioxide emissions, or direct emissions, but also the carbon dioxide emissions associated with their consumption of electricity and district heat, or indirect emissions. That is, facilities are required to surrender allowances based on their use of electricity and heat multiplied by an assumed emission factor, in addition to direct fossil fuel emissions. The industry benchmark b is similarly determined based on these indirect as well as direct emissions.

E. *Provincial Government Role*

Provinces are allowed to increase the stringency of the sectoral benchmarks. Because these governments face compliance with the central government's requirement on carbon intensity reduction, for example, they may choose to use the national emissions trading system as a tool to meet that objective. The provincial governments of the regions where there are serious air pollution and other environmental problems can also auction a portion of the allowances.

III. A Multi-Sector TPS

One of the most interesting features of China's national emissions trading system is that it is effectively a multi-sector TPS. Like a cap-and-trade (CAT) program, emitters of carbon dioxide face compliance obligations based on their volume of emissions. Unlike a CAT program, they earn more allowances for every additional unit of output. In aggregate, the emissions limit varies with production.

A. *Single-Sector TPS*

There are many examples of single-sector TPS, most notably the US lead phasedown, California's Low Carbon Fuel Standard, and Corporate Average Fuel Economy. Renewable portfolio standards and clean energy standards have a similar design with obligations (rather than credit) assigned to production generally and credit (rather than obligations) assigned to renewable generation. Like TPS for pollution, these crediting standards for clean energy scale with production.

The main economic difference between CAT and TPS is that TPS tend to have smaller effects on product prices (Boom and Dijkstra 2009). CAT policies raise unit costs by abatement costs plus the carbon price applied to all emissions. TPS provide a rebate on those costs equal to the carbon price applied to the established performance rate, as illustrated in Figure 1. In the figure, emissions exactly meet the standard. With trading, however, cleaner firms will over-comply while dirtier firms under-comply. Over-complying firms with significant rebates can even see negative net cost impacts.

Relative to CAT, TPS leads to smaller increases in marginal production costs and, in a market economy, product prices. If relatively clean producers are the marginal cost producers, it can even lead to a decline in product prices in the short run (Fischer 2010).

For this reason, TPS can be preferred when there are concerns about impacts on downstream product users. Output-based allocations, for example, have been proposed as a way

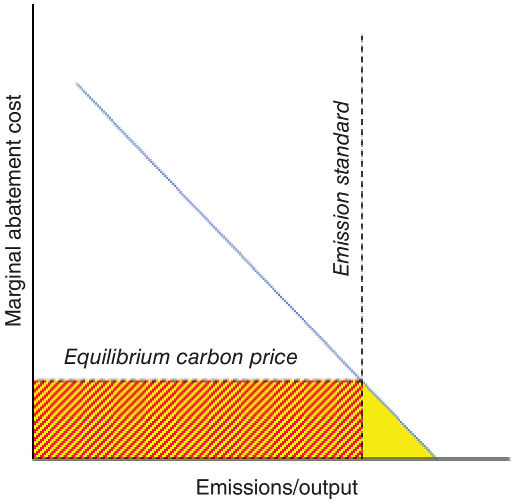

Figure 1. Unit Cost of TPS

Note: Shaded is abatement cost, striped is permit cost under CAT but rebated under TPS.

to mitigate emissions leakage tax interaction effects (Fischer and Fox 2007).

The main downside to TPS versus CAT is that TPS discourages cost-effective mitigation across sectors. For example, electricity price increases under CAT balance mitigation within electricity productions with efforts to reduce electricity consumption. By having a smaller effect on product prices, TPS fails to achieve cost-effectiveness in this dimension.

B. *Subcategorization and Multiple Sectors*

With a single standard, dirtier technologies face higher compliance costs than cleaner technologies. Subcategorization assigns tougher standards to cleaner technologies, and dirtier technologies can subsequently face lower costs. In fact, the net cost of dirtier technologies could be negative. This raises the specter that the emissions rate of the sector as a whole could rise if productions shifts significantly into the dirtier technology.

This is an important area for further work and here we briefly speculate about three possible solutions. One is to move closer to a single standard. Alternatively, one could restrict trade among subcategories, limiting transactions to those where the seller has an equally or more stringent standard than the buyer. Finally, a program could just keep an eye on the net position of each subcategory—its actual emissions rate versus its standard—and make adjustments. Those sectors substantially beating their standards might have their standard tightened.

A multi-sector TPS faces exactly the same risks as a single sector with subcategories. That is, dirtier sectors could end up being subsidized and aggregate emissions could rise. Remedies would similarly focus either on requiring dirtier sectors to face tougher standards, or limiting trades such that dirtier sectors must be buyers not sellers. Unlike technology subcategories within a sector, however, it is less obvious who is dirtier among sectors.

C. *Direct and Indirect Emissions*

A multisector TPS faces another issue when sectors can substitute between direct and indirect emissions. In particular, a sector that is regulated under a TPS based only on its own, direct carbon dioxide emissions from fossil fuels could instead consume electricity. The sector faces the equilibrium carbon price on its own use of fossil fuel. However, we have just shown that the electricity price will not reflect the cost of marginal carbon emissions under a TPS. This problem is further exacerbated by China's system of price controls in the power sector.

China's pilot programs dealt with this issue by both including a notion of indirect electricity emissions alongside direct emissions in both the compliance obligations and the established performance standard for regulated, non-electricity. Similar efforts are planned for the national emissions trading system as it expands to other sectors, though this is also an area where further work would be useful.

D. *Price Management*

Emissions trading programs, including China's ETS pilots, frequently seek out mechanisms to reduce price variability. In some of China's ETS pilots the government could buy and sell allowances to address price concerns. In California and the Regional Greenhouse Gas Initiative, there are floor prices for allowance auctions coupled with additional allowance reserves available at higher prices.

To maintain the price floor, China's pilot ETS approach has the disadvantage of requiring fiscal resources as the program grows. Yet, absent an allowance auction, there is no obvious alternative. This consideration points to a third area for further research.

IV. Conclusion

China's national emissions trading system represents a significant step for China and the world. The system's efficiency may be debated, but the fact remains that many more firms and individuals will see the cost of using fossil fuels more in line with true social costs. Moreover, the regulatory infrastructure is in place to increase the carbon price over time.

The relatively unique features in the China national emissions trading system raise new questions in policy design. Can the potential for inadvertent subsidization of dirtier sectors and incentives to increase emissions be avoided or managed? Can indirect emissions be effectively handled through secondary regulation? Can price management tools be developed and implemented? These important questions deserve further research.

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