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Carbon Capitalism with Chinese Characteristics: Establishing An Emissions Trading Scheme in China

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Carbon Capitalism

WITH CHINESE CHARACTERISTICS: ESTABLISHING AN EMISSIONS TRADING SCHEME IN CHINA

THOMAS LEE

> ***"Popular grassroots activism a is major driving force pushing the largest emitter on the planet to take concrete climate action."***

When discussing energy policy for mitigating global climate change, China is the single most important country to examine. It has been the largest national emitter of greenhouse gases since 2007, accounting for almost 30% of global emissions,[1] and is projected to contribute more than half of the increase in world emissions.[2] Even on a per capita basis, the most populous nation emits 7.2 tons of carbon dioxide per person, exceeding the world average of 5.1 tons and the EU's 6.8 tons[3]. In response, China is taking significant steps of leadership on climate action: the government has pledged significant mitigation targets, while setting realistic plans to implement these targets through its proposed national cap-and-trade system.

Following a series of local pilot programs, China's National Development and Reform Commission (NDRC) announced on August 31, 2014 to establish a national carbon emissions trading scheme that aims to be operational by 2016[4]. On December 10, 2014, the NDRC officially released its "Interim Regulatory Measures for Carbon Emissions Trading" for further policy development[5]. If successfully designed and executed, a Chinese cap-and-trade strategy represents a crucial victory for economists as well as the planet.

Mitigation Commitements

The large potential for China's climate policies stem from a context of rapid economic development and reliance on fossil fuels. From 2000 until 2011, China experienced an annual real GDP growth of 10% on average[6]. Although GDP growth has slowed from reduced industrial production and exports due to counter-inflation policies, the current leadership under President Xi and Premier Li is still focused on long-term and sustainable growth, particularly with an economy driven by greater domestic consumption. The persistence of poverty and inequality between regions means that economic development will remain a priority.

How will this growth be powered? Currently, the vast majority of the Chinese energy mix is fossil fuels with about 70% from coal, by consumption[7]. Energy itself constitutes the largest piece of the overall emissions mix. Within energy, the power sector (40%), manufacturing sector (23%), and other industrial processes (12%) are the three largest contributors to China's emissions.

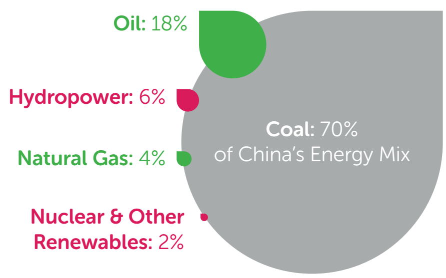


figure 1 Visual representation of China's energy mix.

1 International Energy Agency. (2014). CO2 Emissions from Fuel Combustion Highlights. Retrieved from https://www.iea.org/publications/freepublications/publication/CO2EmissionsFromFuelCombustionHighlights2014.pdf
2 U.S. Energy Information Administration. (2011, March 31). Emissions of Greenhouse Gases in the U.S. Retrieved from http://www.eia.gov/environment/emissions/ghg_report/ghg_overview.cfm
3 Global Carbon Project. (2011). Global Carbon Budget. http://www.globalcarbonproject.org/carbonbudget/14/hl-full.htm#regionalFF
4 Chen, K. & Reklev, S. (2014, August 31). China's carbon market to start in 2016 - official. Retrieved from http://www.reuters.com/article/2014/08/31/china-carbontrading-idUSL3N0R107420140831
5 People's Republic of China National Development and Reform Commission. (2014, December 10) Number 17 - Interim Regulatory Measures for Carbon Emissions Trading. Retrieved from http://qhs.ndrc.gov.cn/zcfg/201412/t20141212_652007.html

6 International Energy Agency. (2014). CO2 Emissions from Fuel Combustion Highlights. Retrieved from https://www.iea.org/publications/freepublications/publication/CO2EmissionsFromFuelCombustionHighlights2014.pdf
7 Ibid

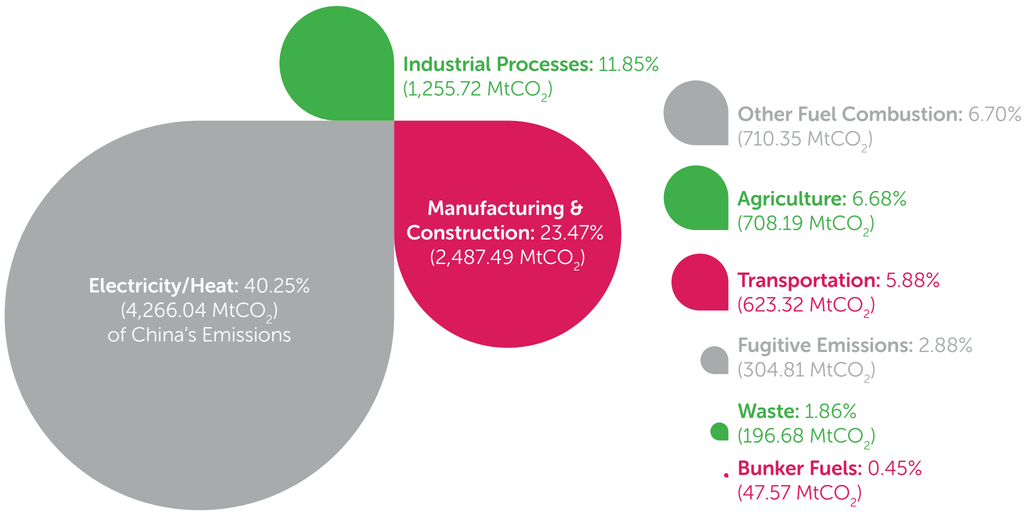


figure 2 Visual representation of China's Emissions by Sector (Excluding Land Use Change & Forestry) - 2011

In addition to international pressure for stronger climate change mitigation efforts, the government leadership faces mounting pressure from masses of grassroots environmental protests. In 2013, the Ministry of Environmental Protection cited 712 cases of "abrupt environmental incidents" — an official term for environmentally-inspired protests — a 31% jump from the previous year. From the perspective of regime legitimacy, China must contend with how its energy system leads to local environmental health impacts through associated unrest, regardless of international climate change. As a result of this citizen activism, the energy policy choices are about more than just environmental conservation, but about public health - especially respiratory health impacts to local communities due to fossil fuel and manufacturing pollution such as particulate matter. The official policy terminology is shifting towards becoming a "harmonious society" that might sacrifice GDP growth for better environmental protection[8]. Popular grassroots activism is a major driving force pushing the largest emitter on the planet to take concrete climate action - every individual who participated in these 712 "incidents" helped push the central and local governments towards re-prioritizing people and the planet over pure profits.

> ***"Any policy proposals that ignore the market-based approach are inherently prone to these downsides of cost-ineffectiveness."***

Governmental commitment to climate action is not uncharted territory: the PRC's 11th Five Year Plan (2006–2010) successfully reduced energy intensity and increased the renewables energy share according to target. Within this context, the Chinese government's 12th Five Year Plan establishes these targets by 2020: 1) reduce carbon intensity (emissions per unit of GDP) by 40% to 45% compared to 2005 levels, and 2) increase the renewables' share to 15%[9]. Critics often prefer an absolute emissions reduction target as opposed to the carbon intensity goal. At the same time, the US EPA's proposed Clean Power Plan uses this same approach via energy efficiency targets. Moreover, China's 2020 targets represent real amounts of emissions abatement compared to the business-as-usual scenario: the total abatement from 2011 to 2020 is estimated to be 33 gigatons of carbon dioxide equivalent[10].

Emissions Economics

In order to meet these emission reduction commitments as well as long-term sustainability goals, the government faces a choice between what environmental economists classify as "command-and-control" mandates and market-based policies that seek to price in environmental externalities. From the perspective of microeconomic theory, an emissions allowance trading scheme can be the most cost-effective method of dealing with global carbon pollution.

China has had certain success with its command-and-control, which "focuses on regulating the behaviour or performance of individual factories and power plants".[11] For example, the national government launched the Top 1000 Enterprises Energy Conservation Action Program in April 2006, which assigned energy efficiency mandates for industrial enterprises; by the end of 2008 the program had saved 106 million tons of CO2 equivalent (tce) emissions (2 years ahead of schedule). For its 12th five-year plan (2011-2015), the central government expanded this program to the Top 10,000 Enterprises Energy Conservation Low Carbon Action Program; through its first year of operation the program already achieved 69% of its 250 million tce goal[12] for the whole five-year period.[13]

However, there are substantial theoretical reasons to prefer a market-based approach. Whether framed as negative externalities or a Tragedy of the Commons, activities that emit greenhouse gases exemplify negative externalities. For example, a company manufactures cement to gain a profit while releasing carbon dioxide into the atmosphere; these additional gases exacerbate cli-

[8] Leggett, J. (2011, July 18). China's Greenhouse Gas Emissions and Mitigation Policies. Congressional Research Service. Retrieved from http://fpc.state.gov/documents/organization/169172.pdf
[9] Ibid

[10] Ernst & Young. (2015, March 1). Understanding China's Emissions Trading Schemes and Emissions Reporting. Retrieved from www.ey.com/Publication/vwLUAssets/EY-Understanding_Chinas_Emissions_Trading_Schemes_and_Emissions_Reporting/$FILE/EY-Understanding-Chinas-ETS-and-Emissions-Reporting.pdf
[11] Keohane, N. & Olmstead, S. (2007) Markets and the Environment. Island Press. 143.
[12] Chen, K. & Reklev, S. (2014, August 31). China's carbon market to start in 2016 - official. Retrieved from http://www.reuters.com/article/2014/08/31/china-carbontrading-idUSL3N0R107420140831
[13] Zhang, Z. (2014, June). Nota di Lavoro. Fondazione Eni Erico Mattei. Retrieved from http://www.feem.it/userfiles/attach/2014711543244NDL2014-060.pdf

mate change and lead to additional environmental harms, that are spread across the global society rather than remaining borne by the originator company.

How should this public goods problem be resolved? As first introduced by English economist Arthur Pigou in 1920 in The *Economics of Welfare*, levying a price exactly equal to the social cost of this externality would completely eliminate economic deadweight loss - the dreaded triangle of lost social welfare that remains unrecoverable to either consumers or producers. By virtue of supply and demand, a market-based pollution policy must result in the utilization of the least-cost resources on society's marginal abatement curve while minimizing the opportunity cost (which includes anything from private consumption to infrastructure investment). On the other hand, any government pursuing command-and-control has no such guarantee. The reason is simply that humans are fallible: an agency might not exactly estimate the costs of different abatement technologies and end up choosing the relatively more expensive ones as part of the set of pollution solutions. Moreover, these costs may fluctuate over time or change depending on which firm is implementing the technology change. This presents a problem because in order to achieve "cost-effective allocation of abatement… the last unit of pollution control done by every firm must cost the same amount" - otherwise "there would be a way to reallocate abatement at lower cost."[14] So even if a non-market approach achieves some laudable abatement target, the market-based version can achieve the same level at lower opportunity costs. Furthermore, even if they are not explicitly labeled with the not-so-flattering name "command-and-control", any policy proposals that ignore the market-based approach - like China's "Top 1,000" or "Top 10,000" policies - are inherently prone to these cost-ineffectiveness downsides.

The Coase Theorem, introduced by the Nobel laureate Ronald Coase in 1960 in The *Problem of Social Cost*, formalizes the foundation for pollution trading, by showing that allocating property rights for pollution allows for private bargaining and transfer payments that lead to the same cost-effective social welfare solution, without having to set a universal pollution price. In the context of carbon dioxide and other greenhouse gases, individual firms that emit pollution can pay for the right to pollute. According to the Stockholm Environment Institute (SEI), the main reason that China is considering market-based approaches is that the currently used "command and control measures to reduce emissions" like "closing down coal plants by fiat" are "less efficient than a market based trading system."[15]

Whether implemented through cap-and-trade or a carbon tax, using the market-based mechanism of a carbon price should achieve the same level of pollution abatement. However, there are important theoretical differences. Since the exact future energy supply and demand functions cannot be perfectly forecasted, a fixed carbon price level leads to uncertainty in the actualized level of abatement if there are unexpected demand shocks or technological shifts. For example, if Chinese oil production suddenly becomes cheaper or if electricity demand exceeds forecasts, then a given carbon price level would lead to more emissions than intended – causing an overrun in the overall target. This can pose a particular challenge for China, which is still experiencing rapid growth in energy demand accompanied by its strong (albeit stabilizing) economic development. Conversely, the uncertainty of market conditions means that setting a fixed carbon cap level leads to uncertainty in the resulting carbon price level. Given China's massive pressures to actualize its ambitious mitigation targets, an uncertain abatement level from a carbon tax is less preferable than a cap-and-trade system, which may employ price control to stabilize prices within a desired range. Keohane summarizes the difference between a carbon tax for which "the regulator must know the aggregate MAC curve in order to attain a particular level of abatement with an emissions tax" versus a cap-and-trade system which "determines the quantity of pollution directly" and requires "no other information than the policy target". Analytically, simulations have found a hybrid system of a cap with price

[14] Keohane, N. & Olmstead, S. (2007) Markets and the Environment. Island Press. 143.

[15] Han, G., Olsson, M. Hallding, K., & Lunsford, D. (2012). China's Carbon Emission Trading: An Overview of Current Development. Stockholm Environment Institute. Retrieved from http://www.sei-international.org/mediamanager/documents/Publications/china-cluster/SEI-FORES-2012-China-Carbon-Emissions.pdf

***Demonsrators** in Kunming protest the siting of a paraxlyene (PX) petrochemical plant.*

***Ronald Coase** provided the theoretical foundations for emissions trading*

> ***"Once launched, China's national trading scheme will become the single largest emissions market by cap size."***

range controls can lead to higher economic efficiency that a pure tax[16]. This may partially explain the central government's strong interest in exploring ETS options.

An additional advantage of a cap-and-trade scheme over a carbon tax is the inherent uncertainty in estimating the social cost of carbon. To implement an efficient carbon price, it is necessary to use some integrated climate-economy model to project future damages from climate change and obtain a discounted present value of a marginal unit of carbon pollution[17]. For example, policymakers may utilize economist William Nordhaus's Dynamic Integrated model of Climate and the Economy (DICE). This social cost then informs what the economically efficient abatement level is globally or regionally. However, in practice, a national government faces many other pressures and stakeholders, such as international climate negotiation and domestic grassroots protests, which can impact the ability to implement an efficient solution. These other equity and political factors are exogenous to any models computing the social cost of carbon. In the case of cap-and-trade policies, governments are able to a priori determine the desirable level of abatement, and the market price will follow through according to supply and demand. This ability for a cap-and-trade system to bypass any limitations and inaccuracies in social carbon cost models represents another theoretical advantage of an ETS.

Of course, a main benefit of a carbon tax is that it is much easier to implement since there are fewer administrative complexities, once a carbon price level is decided and industry coverage is finalized. The legal and administrative infrastructure for taxation already exists in China. In practice, there are many policy design considerations that complicate the theoretical elegance of an "ideal" emissions trading system, including cap size, industry coverage, and initial permit allocation.

Regional to National

In order to determine how to approach these nuances, the Chinese government has initiated seven regional pilot programs: in Shenzhen, Shanghai, Beijing, Guangdong, Tianjin, Hubei, and Chongqing. The success of a comprehensive national emissions trading scheme hinges on the experiences with these pilots; lessons learned should be applied to the national implementation.

Amidst drastically different policy designs, these seven pilots share some major characteristics. Each one has about 40 to 60% coverage of the jurisdiction's overall emissions: their coverage of emitters includes the power and heavy industry (e.g. steel, cement, and petrochemical) sectors, as well as large electricity end-users[18]. For each of the pilots, the initial permit allocation starts off as mostly free permits, mostly through grandfathering of historical benchmark emissions.[19]

The biggest policy design challenge for both the pilots and the eventual national system is the current regulatory backwardness of China's electricity system. Compared to other countries' restructured electricity markets (as in Europe or most American states like California) where market mechanisms determine the prices for both wholesale and retail markets, China's power sector is heavily regulated. Retail electricity prices in China are strictly regulated by NDRC, with infrequent retail price adjustments, meaning generators cannot easily pass on increased carbon costs to end consumers[20]. Moreover, China's electrical dispatch system uses an "equal capacity factor" approach – meaning the grid operator tries to use electricity from all generation plants at roughly equal capacity utilizations in order to assist capital cost recovery – as opposed to "economic dispatch" which maintains a merit order in order to minimize marginal costs at the moment[21]. This implies that the carbon price would not fully translate to higher-emissions generators being used less and vice versa, since the dispatch remains impervious to marginal cost.

To address the power sector problem, the Chinese government (or NDRC as a policy designer) can try to reform the electricity market to fit an ETS or vice versa. Within the theme of China's recent institutional reforms, restructuring the electricity market

[16] Pizer, W. (1997, October). Prices vs. Quantities Revised: The Case of Climate Change. Resources for the Future. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.474.2521&rep=rep1&type=pdf

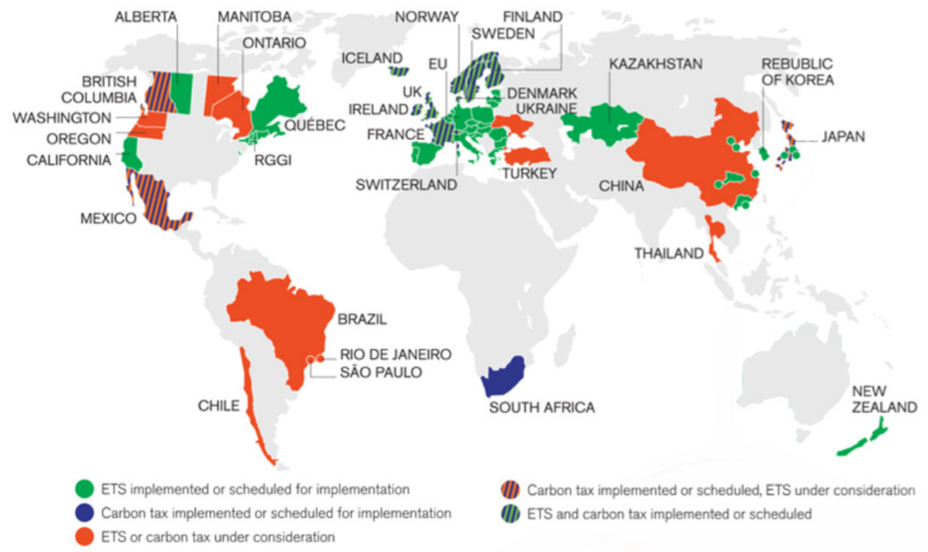
[17] In other words, the incremental amount of environmental cost we would attach

[18] Song, R. & Lei, H. (2014, January 24). Emissions Trading in China: First Reports from the Field. World Resources Institute. Retrieved from http://www.wri.org/blog/2014/01/emissions-trading-china-first-reports-field

[19] Jotzo, F. (n.d.). Emissions Trading in China: Principles, Design Options and Lessons from International Practice. Ideas. Retrieved April 5 from https://ideas.repec.org/p/een/ccepwp/1303.html

[20] Teng, F., Wang, X., & Zhiqiang, L. (2014, December). Introducing the emissions trading system to China's electricity sector: Challenges and opportunities. Energy Policy, 75, 39-45. doi:10.1016/j.enpol.2014.08.010

[21] RAP. (2013, October). Recommendations for Power Sector Policy in China: Practical Solutions for Energy, Climate, and Air Quality. Retrieved from www.raponline.org/document/download/id/6869



Map of market-based climate policies *around the world. Australia's ETS was abolished in 2014 by the Abbott administration.*

for pricing mechanisms and merit dispatch is hugely beneficial for overall economic welfare. While there have been local pilots for this "deregulation", comprehensive restructuring probably will occur in the longer term compared to the urgency of China's carbon mitigation needs. Thus, there are efficient workarounds within an ETS that are already being tested through the Chinese pilot programs. Specifically, the pilots deliberately cover both electric generators as well end consumers for the embedded emissions in their electric consumption. Rather than "double-counting" emissions, this method of demand-side carbon pricing helps to efficiently achieve the desired amount of carbon abatement[22]. An example of a successful demand-side carbon policy is Tokyo's municipal ETS launched in 2010[23]. Of course, there is a tradeoff of more transaction costs due to the larger number of downstream consumers - something that can be resolved with comprehensive power sector reform.

There are other policy design concerns, including setting a cap size that is stringent enough to avoid a price collapse as happened in the EU ETS or the Northeast's Regional Greenhouse Gas Initiative (RGGI). Some of the pilots are already experimenting with market stability reserves similar to the one currently being proposed for the EU system[24]. Furthermore, once the national system is launched, the central authorities must establish a strong legal enforcement infrastructure at all local government levels to ensure compliance, especially because these regional pilots are so different. With lessons learned from the pilot programs, the NDRC and other central agencies all well poised to design an effective carbon trading mechanism.

Going Out

In the spirit of China's Go Out Policy for increasing business investment overseas, there are large benefits from extending China's ETS to the international realm. Fundamentally, the theoretical underpinning of cap-and-trade's effectiveness is that it allows society to take advantage of heterogeneous abatement costs across different firms. In the same way that global free trade without protectionism makes everybody better off (at least in the scheme of microeconomics) by encouraging production according to comparative advantages, a global emissions trading system has the potential to make use of different countries' comparative carbon abatement abilities. More international coverage means more economic welfare. From an operational standpoint, a larger volume of carbon permits also means more trading liquidity and hence a better realization of the theoretically correct price of carbon.

Once launched, China's national trading scheme will become the single largest emissions market by cap size, surpassing the EU ETS. However, it will not only contribute to global carbon-economic efficiency by sheer size alone, it also has the potential to serve as a platform to link other regional cap-and-trade systems and thus improve cost-effectiveness and market liquidity. The government proposal includes plans to for the Chinese system to become a hub for other national emissions markets in Asia-Pacific, such as those in New Zealand (launched 2008), Kazakhstan (launched 2013), and South Korea (launched 2015)[25]. Other countries in the region, including Indonesia, Thailand, and Vietnam, are also deliberating emissions trading policies.

From the perspective of the global climate system, national boundaries are arbitrary and their existence will not prevent the laws of physics to act on the ever-increasing atmospheric carbon dioxide concentrations. Alas, we do not live in libertarian or anarchist utopia: nation-states exist and the wisdom of their respective climate policies will determine the fate of humanity. The emissions trading in China, if properly designed, will lead to significant efficiency benefits from an economic standpoint and lead towards a lower carbon future — the impacts of Chinese cap-and-trade will eclipse in magnitude any single corporate sustainability initiative (which inherently ignores optimizing market efficiency). Undoubtedly, China's commitment to a market-based solution to climate change can teach us all a lesson, especially the U.S. (whose Senate somehow still does not believe in anthropogenic climate change, based on its recent scientifically-illiterate vote on the Keystone XL Pipeline amendment). When future generations look back at how we resolve the most urgent environmental crisis faced by our species right now, it is ultimately the citizen activists - who are risking arrest to speak out and protest for systematic change in a country not known for its free speech protection - who will have made history.

[22] Jotzo, F. (n.d.). Emissions Trading in China: Principles, Design Options and Lessons from International Practice. Ideas. Retrieved April 5 from https://ideas.repec.org/p/een/ccepwp/1303.html

[23] Bureau of the Environment. Tokyo Metropolitan Government. (2010, March). Tokyo-Cap-and-Trade Program: Japan's first mandatory emissions trading scheme. Retrieved from https://www.kankyo.metro.tokyo.jp/en/attachement/Tokyo-cap_and_trade_program-march_2010_TMG.pdf

[24] European Commission. (2014). Proposal for a Decision of the European Parliament and of the Council. Retrieved from http://ec.europa.eu/clima/policies/ets/reform/docs/com_2014_20_en.pdf

[25] Chen, K. & Reklev, S. (2014, August 31). China's carbon market to start in 2016 - official. Retrieved from http://www.reuters.com/article/2014/08/31/china-carbontrading-idUSL3N0R107420140831