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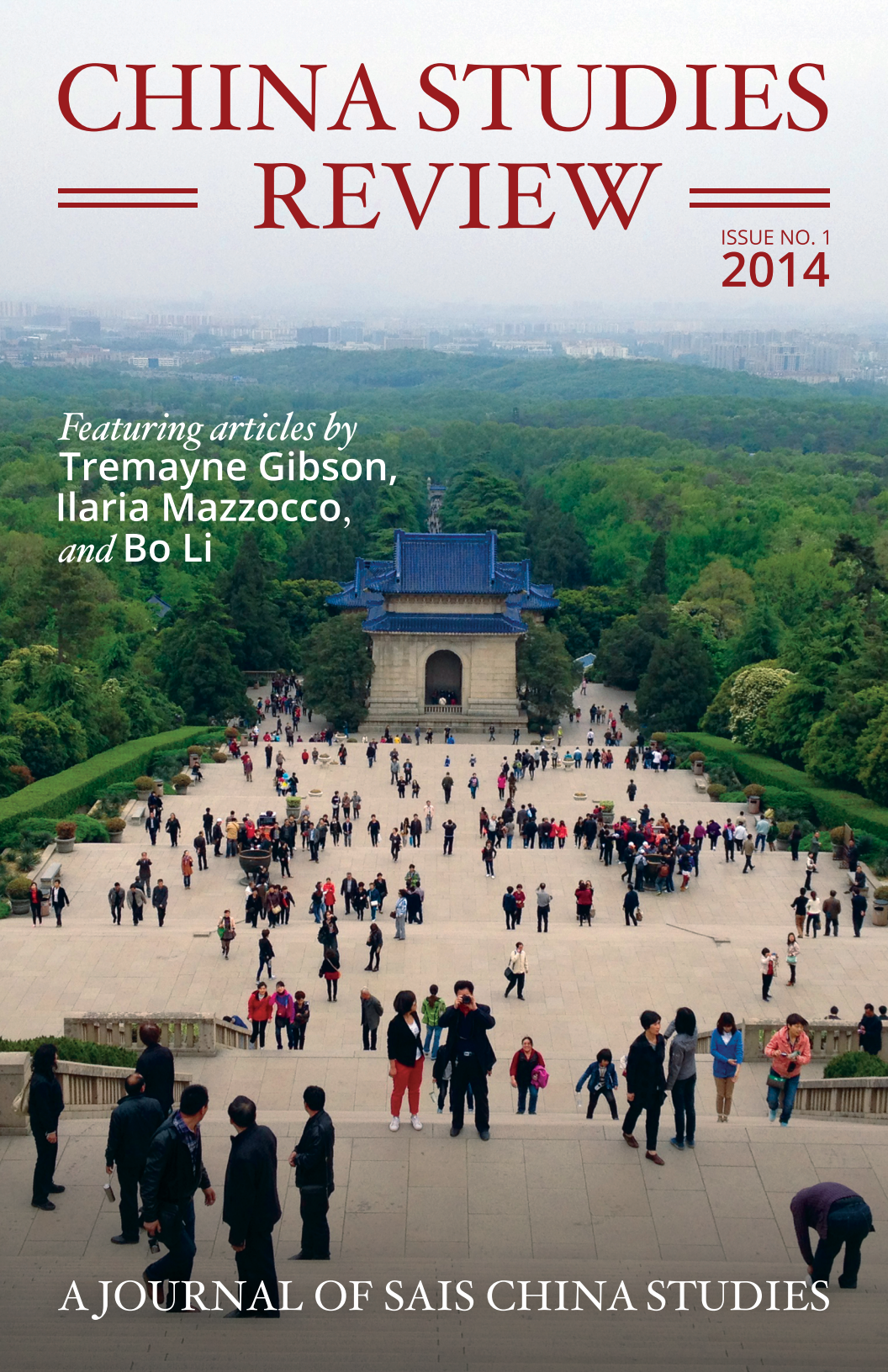
Featuring articles by
Tremayne Gibson,
Ilaria Mazzocco,
and Bo Li



A JOURNAL OF SAIS CHINA STUDIES

The China Studies Review is a publication of the China Studies department at the Johns Hopkins Paul H. Nitze School of Advanced International Studies. The Review publishes interdisciplinary work by graduate students conducting research on China, including history, political science, economics, policy, and area studies projects.

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LETTER FROM THE EDITOR

THE RAPID TRANSFORMATION of Chinese politics and the Chinese economy seems unending. This year brought Xinjiang into mainstream discussions about terrorism, debates over rule of law returned with the fourth plenum, and the anti-corruption campaign picked up steam. But just as important are the ongoing reforms and policy concerns that continue to evolve over years and decades. One of these concerns is environmental protection.

This inaugural issue of China Studies Review is dedicated to environmental regulation and politics. Tremayne Gibson examines the development of Beijing's nuclear policy and finds that the benefits of nuclear power are married to a weak regulatory structure, the vulnerability of inland nuclear plans to natural disasters, and inadequate policy coordination, which cloud the future of nuclear energy in China. Bo Li looks at the role of the cadre evaluation system in environmental management. Applying studies in Chinese bureaucracy, Li investigates the influences of top-down assignments and bottom-up local autonomy on the effectiveness of environmental policies. And finally, Ilaria Mozzocco compares emission trading systems in China and the European Union, identifying lessons for related laws and policies moving forward. She highlights a lack of central planning as the foremost challenge to the long-term success of cap and trade programs.

We at the China Studies department are excited to launch China Studies Review as a platform for graduate students to increase our understanding of China, its domestic challenges and opportunities, and its role in the international order.

Kendrick Kuo
Washington, DC

FOREWORD

Carla Freeman

FOR NEARLY FOUR DECADES China has experienced continuously dramatic transformation. Throughout this period, the China Studies program of the Johns Hopkins School of Advanced International Studies (SAIS) has been a leading center for research and teaching on contemporary China. Training professionals with the historically grounded understanding of contemporary Chinese politics and economy needed to confidently and accurately interpret China's changing domestic and international policies and their outcomes has been a core mission of the program since it was established.

In the early 1980s, the program's first director, A. Doak Barnett, launched a China program that would give students from all over the world, including the United States and China, insights into Chinese politics, economy, and society that would help mitigate a repeat of the destructive estrangement between China and the West of the Cold War. Barnett was a prolific writer on China, whose more than twenty books included first-hand accounts of China in the ferment of revolution and the challenges it faced in making the transition to reforming its economy. Barnett's successor, David M. Lampton, a path-breaking scholar of China's foreign and domestic policy and the former president of the National Committee on US-China Relations, has built on Barnett's foundation to develop a China program that enables students to make sense of the ever-accelerating evolution of China's foreign and domestic policy. Today, the SAIS China Studies program routinely offers 14 to 15 courses on contemporary China. In addition, growing numbers of SAIS students are spending a year in China at the Hopkins-Nanjing Center for Chinese and American Studies, established by John Hopkins University and Nanjing University nearly thirty years ago.

As the United States and China find themselves increasingly

economically interdependent but also more at odds on international issues than at any other time since normalization, being able to explain China's international domestic and foreign policy preferences has potentially profound implications for sustained global economic growth and international peace and security. China Studies Review showcases some of the research and analysis produced by the talented graduate students immersed in China Studies at SAIS and guest contributors from other graduate programs.

I am a graduate of SAIS China Studies, a former Ph.D. student of A. Doak Barnett, who has had the honor and excitement of teaching and doing research at SAIS for much of my career. The launch of *China Studies Review* with its commitment to graduate student research on Chinese politics, history, and economics is overdue. In the spirit of SAIS, the articles in the *China Studies Review* merge academic rigor and policy relevance to provide valuable perspectives on some of the most significant issues confronting China today.

Dr. Carla Freeman is Executive Director of the SAIS Foreign Policy Institute and Associate Director of the China Studies program at Johns Hopkins University's School of Advanced International Studies (SAIS), where she is also an Associate Research Professor.

The Nuclear Option: Boon or Bane for China's Environment?

Tremayne Gibson[1]

The world's largest expansion in recent memory of a civilian nuclear industry is currently underway in China. Official language from Chinese leaders at all levels of government suggest concerns about the environment, which may be an important factor motivating the government to invest heavily in the nuclear sector. While an expanded share for nuclear power in China's energy mix could deliver enormous benefits for China's air quality, efforts to fight global climate change, and even its water shortages, the downsides of nuclear power expansion may have a net negative effect for China's environment. Poor energy and environmental policy coordination, heightened risks associated with inland nuclear plants in areas with frequented natural disasters, and an overburdened and inadequate regulatory structure are getting in the way of a successful roll-out of China's nuclear expansion, not to mention ulterior motivations driving Chinese leaders.

CHINA IS IN THE MIDST OF A NUCLEAR RENAISSANCE the likes of which the world has not seen since the heyday of nuclear power plant construction in the United States in the 1960s and 70s. While the exact figures remain in flux, internal and external studies project China building as many as 200 to 300 reactors by mid-century to satisfy its growing demand for power.[2] This expansion comes amid a struggle within Chinese society between satisfying

[1] Tremayne Gibson is an Associate at the Washington, DC office of Global Risk Advisors. He is a SAIS China Studies alumnus, and a graduate of Harvard College. His areas of professional and academic interests include China's foreign relations and domestic politics as well as general developments in East Asia. In addition to his studies, he has lived and worked in China and has traveled throughout the county and the region extensively.

[2] Ariana Eunjung Cha, "China Embraces Nuclear Future," *The Washington Post,* May 29, 2007, accessed July 11, 2014, http://www.washingtonpost.com/wp-dyn/content/article/2007/05/28/AR2007052801051.html.

the needs for economic development and increasing environmental protection.

There will clearly be benefits from nuclear power for economic development, including the provision of massive sources of reliable energy near population centers, but China's rapid expansion of its civilian industry will also yield unintended negative effects, despite the intended goals outlined by senior policymakers in the Chinese government. An expansion of the civilian nuclear industry is unlikely to yield positive gains for the environment under current conditions, given the various deficiencies within China's environmental protection strategies, the sheer scale of some of its environmental challenges, questionable regulatory structure, and strong competing motivations distracting attention away from safety or environmental priorities.

Nuclear Development in China: A Brief Overview

China's civilian nuclear industry did not really take off until the early 1970s when Premier Zhou Enlai, responding to a report on Shanghai's electricity shortage, made the observation that "from a long-term point of view, nuclear power is the only solution for the shortage of electricity in Shanghai and East China."[3] Zhou ordered the planning of the 728 Project or what would later become the Qinshan nuclear power plant, China's first civilian nuclear reactor. Upon the plant's opening in 1991, Deng Xiaoping gave his blessing to the endeavor by referring to the facility as the "glory of the nation."[4] Under the stewardship of President Jiang Zemin, China began construction on its next ten reactors, most of which began operating in the early 2000s.

The expansion of China's civilian nuclear industry has carefully followed official policy language. Under most of Jiang's tenure the Chinese government endorsed the idea of "small batch

[3] Jianping Cai, "Progress of China's Nuclear Power Programme," (Proceedings of a technical committee meeting on advances in heavy water reactor technology, Mumbai, India, January 29-February 1, 1996), accessed July 11, 2014, http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/29/024/29024315.pdf.

[4] James L. Tyson, "China Turns On to Nuclear Power," *The Christian Science Monitor,* March 25, 1992, accessed on July 16, 2014, http://www.csmonitor.com/1992/0325/25121.html.

development" of nuclear power, later adopting the language of "appropriate development" during the Fifth Plenary Session of the Fifteenth Party Congress in 2000.[5] Under President Hu Jintao, the Chinese government adopted more stimulating language. In March 2005, Premier Wen Jiabao issued directives to adjust China's energy mix and vigorously develop nuclear power.[6] The eleventh Five Year Plan (2006-2010) adopted these directives as policy when it called for the "active development" of nuclear power. Since then twenty-eight reactors have been built and nearly 206 other projects have been proposed, approved or begun construction.[7]

In 2007, the National Development and Reform Commission (NDRC) released the official government position on nuclear power that called for China to increase its total installed nuclear capacity from nine to forty gigawatts (GW) by 2020, roughly increasing nuclear power's share of China's total energy consumption from 2 percent to 4 percent.[8] This target for 2020 fluctuated over time as the pace of new plant proposals outstripped original expectations. By 2008, the government had revised the target upward to sixty GW and 5 percent of the energy mix. In 2009, the number was again revised to seventy GW, with some within the State Council even suggesting pushing the target further to 86 GW.[9] The Fukushima disaster in 2011 led to a temporary halt to all construction and project approvals of nuclear plants and led to a decreased target of 58 GW.[10]

[5] "我国电力发展60年:核电崛起,"*ifeng.com*, September 24, 2009, accessed July 11, 2014, http://finance.ifeng.com/news/industry/20090924/1279506.shtml.

[6] Zhongxiang Zhang, "China in the transition to a low-carbon economy," *Energy Policy* 38 (2010): 6647, accessed July 11, 2014, doi: 10.1016/j.enpol.2010.06.034.

[7] "Nuclear Power in China," *World Nuclear Association*, last modified July 2014, http://www.world-nuclear.org/info/Country-Profiles/Countries-A-F/China--Nuclear-Power/.

[8] China National Development and Reform Commission, 核电中长期发展规划(2005-2020年) (Beijing: October 2007), 8-9, accessed July 11, 2014, http://www.etiea.cn/data/attachment/123(4).pdf.

[9] Ryan Ong, "A Boost for Nuclear Power," *China Business Review*, May 1, 2010, accessed July 11, 2014, http://www.chinabusinessreview.com/a-boost-for-nuclear-power/; Keith Bradsher, "Nuclear Power Expansion in China Stirs Concerns," *The New York Times*, December 16, 2009, accessed July 11, 2014, http://www.nytimes.com/2009/12/16/business/global/16chinanuke.html?pagewanted=all&_r=0.

[10] Zhidong Li, "China's Efforts for Keeping the Safety of Nuclear Power Compatible with Economic Efficiency," *The Institute of Energy Economics*, *Japan*, September 2013, accessed on July 11, 2014, https://eneken.ieej.or.jp/data/5126.pdf.

Even under this latest figure China, between 2010 and 2040, is set to construct nearly 40 percent of the global net increase in nuclear capacity.[11]

Going Nuclear to Go Green?

Environmental concerns motivate China's embrace of nuclear power and plans for its large-scale development. The policy pivot to "active development" of nuclear power came at a time when Chinese leaders confronted the downsides of unbridled economic growth. A year after taking office, President Hu Jintao introduced what would become his administration's guiding philosophy—the "Scientific Outlook on Development"—which at its core was an answer to the host of problems brought about by the previous decade's rapid economic growth, among them: regional developmental imbalances, growing wealth disparities, environmental degradation, and soaring energy demand. During a 2003 trip to Jiangxi, Hu defined scientific development as "coordinated development, all-around development, and sustainable development," the kind that "combines the development of the economy with the protection of resources and the environment."[12] Later that year, on a trip to Hunan, Hu further described scientific development as "faster and better economic and social development."[13]

Hu made it his mission to jumpstart China's economic transition to sustainable growth in which long-term economic interests and other social concerns play a decisive role in decision-making about development. This transition required altering the country's energy policies. By the early 2000s, China's double-digit economic growth placed the country on an unsustainable trajectory. There is a nearly one-for-one relationship between Chinese GDP growth and net increases in electricity consumption between 1990 and 2010

[11] "China set to build 200 nuclear power plants: report," *LiveMint*, September 26, 2013, accessed July 11, 2014, http://www.livemint.com/Politics/3s501RtDktWGT48wbF771K/China-set-to-build-200-nuclear-power-plants-report.html.

[12] Joseph Fewsmith, "Promoting the Scientific Development Concept," China Leadership Monitor 11 (Summer 2004): 2, http://media.hoover.org/sites/default/files/documents/clm11_jf.pdf.

[13] Ibid., 2.

(Figure 1). Chinese growth also correlates with the sudden takeoff of Chinese carbon dioxide emissions beginning in 2000 (Figure 2), continuing on an upward trajectory from 3 billion to 9 billion tons of emissions released annually. China overtook the United States in 2007 to become the world's largest emitter of carbon dioxide.

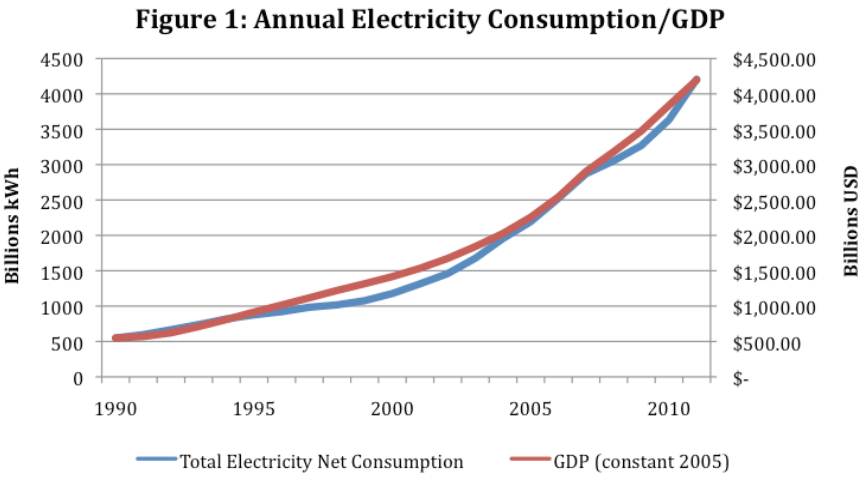
Underlying both sets of data is another trend of steadily increasing consumption of coal. Coal is China's primary energy source, accounting for more than 80 percent of its electricity generation in 2007, and today still dominates over two-thirds of the country's energy mix. China's coal consumption jumped from just under 1.5 billion metric tons in 2002 to nearly 2.9 billion by 2008.[14] Alongside this increase in coal use was a steady rise in sulfur dioxide emissions, which rose 27 percent between 2000 and 2005 to over 25 million tons annually.[15] A natural byproduct of this triad of rapid development, soaring energy demand, and rising emissions was rapidly deteriorating air quality.

It comes as no surprise then that official talk about the expansion of civilian nuclear power in China is littered with language linking the expansion to environmental concerns. Producing virtually zero carbon emissions, nuclear power is in the eyes of many Chinese policymakers an excellent resource to simultaneously satisfy national energy needs and also curb pollution. Such logic is featured most prominently in the 2007 NDRC report outlining the official government line on nuclear power. In the report, the powerful economic planning commission lists environmental protection as an important advantage of nuclear power development. It describes the country's increasing reliance on coal for energy generation as a burden and nuclear power as a "clean energy" (*qingjie nengyuan*) that is "an effective way to reduce emissions of pollutants, but also an important measure to mitigate global warming."[16]

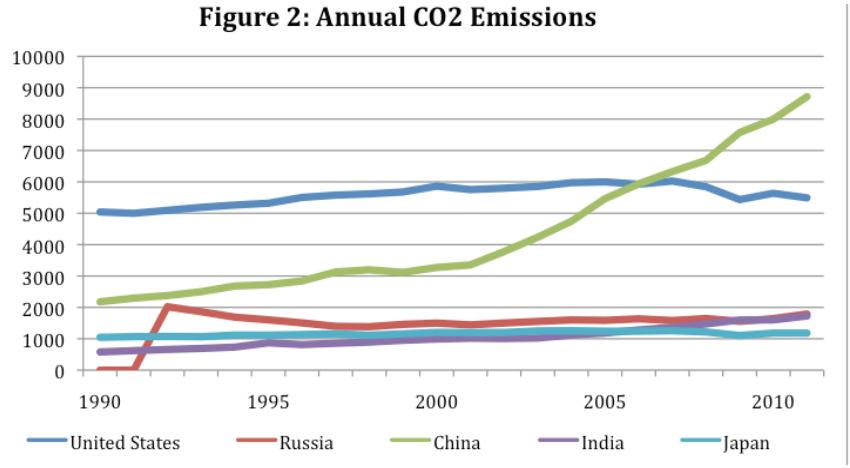
Adding weight to this thinking was President Hu himself, who in a 2009 address before the United Nations General Assembly pledged to fight climate change by taking forceful measures to

[14] Yun Zhou, "Why is China going nuclear?," *Energy Policy* 38 (2010): 3755, accessed July 15, 2014, doi: 10.1016/j.enpol.2010.02.053.
[15] "China's Sulfur Dioxide Discharge Tops World List," *Xinhua*, August 3, 2006, accessed July 15, 2014, http://www.china.org.cn/english/2006/Aug/176872.htm.
[16] China National Development and Reform Commission, 8-9.

"vigorously develop renewable energy and nuclear energy" and "to



Source: U.S. Energy Information Administration, "International Energy Statistics" and The World Bank, "Date: GDP (constant 2005 US$)".



Source: U.S. Energy Information Administration, "International Energy Statistics".

increase the share of non-fossil fuels in primary energy consumption to around 15 percent by 2020."[17] Hu reinforced his message a year later while inspecting the Daya Bay nuclear facility in Shenzhen

[17] "Hu Jintao's Speech on Climate Change," *The New York Times,* September 22, 2009, accessed July 16, 2014, http://www.nytimes.com/2009/09/23/world/asia/23hu.text.html?_r=0.

where he reportedly said that "nuclear power is a world-recognized clean energy, which is an important way for China to optimize the country's energy structure and cut greenhouse gas emissions."[18]

Professor Gu Zhongmao, an official at the China Institute of Atomic Energy, was quoted in 2007 as saying China's "irrational energy structure is causing serious pollution and greenhouse problems," a thought he later followed up on in 2014 by saying that "[t]o completely get rid of smog, nuclear power is the only option. If we build as many nuclear power stations as there are in France and Japan, we will also enjoy blue skies and clean air like they do."[19] Professor Li Zhong, who is involved in a Chinese Academy of Sciences research project to design a new thorium-fueled nuclear reactor, also spoke candidly about the links between China's nuclear and environmental policies. Earlier this year he was quoted as saying:

> In the past, the government was interested in nuclear power because of the energy shortage. Now, they are more interested because of smog . . . . The problem of coal has become clear, if the average energy consumption per person doubles, this country will be choked to death by polluted air. Nuclear power provides the only solution for massive coal replacement and thorium carries much hope.[20]

The idea of nuclear energy potentially reducing the country's dependence on coal was shared by Zhang Guobao, former chief of the National Energy Administration and vice-director of the Subcommittee of Economy under the Chinese People's Political Consultative Conference (CPPCC) National Committee. In a China Daily report he explained that China's "strategy of accelerating the

[18] "President Hu calls for more innovation, use of clean energy during Shenzhen tour," *Xinhua*, September 7, 2010, accessed July 16, 2014, http://news.xinhuanet.com/english2010/china/2010-09/07/c_13482588.htm.

[19] Cha; Stephen Chen, "Chinese scientists urged to develop new thorium nuclear reactors by 2024," *South China Morning Post*, March 18, 2014, accessed July 15, 2014, http://www.scmp.com/news/china/article/1452011/chinese-scientists-urged-develop-new-thorium-nuclear-reactors-2024?page=all.

[20] Jennifer Duggan, "China working on uranium-free nuclear plants in attempt to combat smog," *The Guardian*, March 19, 2014, accessed on July 15, 2014, http://www.theguardian.com/world/2014/mar/19/china-uranium-nuclear-plants-smog-thorium; Chen.

development of [nuclear] technology" was a part of "efforts to reduce China's reliance on coal."[21] Zhang Huazhu, former director of the China Atomic Energy Authority and member of the CPPCC National Committee, couched the link between environmental protection and nuclear expansion as a natural extension of the leadership's guiding philosophy of scientific development. Speaking before an assembly of the International Atomic Energy Agency (IAEA) in Paris in 2005, Zhang described the government's decision to "to positively promote the development of nuclear power" as a "requirement of the harmonious development of economy, society and ecological environment and the demand of sustainable development."[22]

Beyond the Dream: Practical Impacts of Nuclear Power

Environmental concerns are, at least in part, motivating the push by Chinese policymakers at all levels for an expansion of the civilian nuclear industry. Given public statements by Chinese leaders, it is clear that at the heart of this concern is a desire to improve China's air quality by reducing the nation's consumption of coal. While nuclear power has the potential to greatly reduce air pollution, poor coordination between China's environmental and energy policies is inhibiting the realization of that potential.

Given the technology being developed and plans for vast numbers of nuclear facilities in inland areas, the future impact of nuclear power on China's water systems should be an equally important environmental consideration. The immensity of the water challenges facing China precludes the possibility of nuclear power providing any substantial environmental gains in this regard. Moreover, nuclear power plants in China's inland provinces may threaten China's fragile water supplies, given the dangers inherent

[21] Wu Jiao, "Govt eyes nuclear energy as oil price rises," *China Daily,* March 11, 2011, accessed July 15, 2014, http://www.chinadaily.com.cn/china/2011npc/2011-03/11/content_12152749.htm.

[22] Huazhu Zhang, "Nuclear Energy Development in China: From the Prospective of National Energy Strategy" (address to the Conference on Nuclear Power for the 21st Century in Paris, France, March 21, 2005), accessed July 15, 2014, http://www.chinesemission-vienna.at/eng/hplyhnyfks/t210152.htm.

in nuclear facilities far from the sea and in areas prone to natural disasters.

Air Quality Problems Will Persist

Given the official government language and numerous quotes from mid-level policymakers, it seems that China expects its nuclear strategy to yield positive dividends for its environment, primarily through improved air quality from reduced coal consumption and lower greenhouse gas emissions. To that end there are various projects computing actual measurements of how these goals are being achieved. A 2009 report by Cong Weike of China National Nuclear Corporation's Geology Bureau equated the 68.4 terawatt-hours of electricity generated from nuclear facilities in 2008 with a reduction of over 80 million tons of carbon dioxide and 400,000 tons of sulfur dioxide. The report went on to describe China's original plans to construct forty GW of installed nuclear capacity by 2020 as leading to a 296 million ton reduction in carbon dioxide emissions and a 1 million ton drop in sulfur dioxide emissions per year.[23] A similar report by Professor Chen Shaofeng of Peking University's School of International Studies attributed a saving of 25 million tons of coal and a reduction of 73 million tons of carbon dioxide emissions each year to the operation of thirteen reactors, which in 2010 generated about 2 percent of national electricity.[24]

It remains unclear exactly how building more nuclear power plants is supposed to impact China's air quality. Are policymakers expecting nuclear power to be the only new source of power added in the future, thus obviating the need for any future coal plants? Or are they planning to replace existing coal plants with new nuclear facilities as they come online? If the former, then all China's nuclear strategy may lead to is a freeze in the current abysmal environmental

[23] Weike Cong, "Nuclear Industry in China" (presentation by China National Nuclear Corporation to IAEA in 2009), accessed July 21, 2014, http://www-pub.iaea.org/mtcd/meetings/PDFplus/2009/cn175/URAM2009/Session%201/8_33_Cong_China.pdf.
[24] Shaofeng Chen, "Impact of Fukushima Accident on China's Nuclear Energy Development" (Keynote speech in Workshop "What Fukushima nuclear disaster brought about in Asia?," Graduate School of Public Policy, The University of Tokyo Policy Alternatives Research Institute, Tokyo, Japan, February 13, 2013), accessed July 15, 2014, http://pari.u-tokyo.ac.jp/eng/event/smp130213_info.html.

situation. If the latter, then China's nuclear strategy may improve its air quality, but will not be able to keep up with growing power demand in the future. Only by adopting a combined strategy will China be able to both reduce its coal consumption and meet its energy needs and environmental goals. New nuclear facilities must be built with capacities large enough, and at a pace fast enough, to not only replace existing coal plants but to also lessen the need to build new coal plants. In this way coal's share in China's energy mix may gradually be reduced giving way for increasingly larger contributions from nuclear power.

Evidence suggests that none of the above strategies are being implemented. As of 2012, China has plans to construct 363 new coal plants across the country totaling 557 GW in capacity, a 75 percent increase on its coal-fired generating capacity.[25] While Beijing has numerous goals to shutdown small scale coal plants and those near the "key-three city clusters" of Beijing, Shanghai, and Guangzhou, the reality is these facilities are merely being replaced by larger plants in the country's interior provinces.[26] Nuclear power is thus not preventing new coal facilities from coming online.

New nuclear plants are also not necessarily replacing existing coal plants. One could logically deduce that an intention to boost the share of non-fossil fuels and reduce the share of coal in the national energy mix would mean simply replacing one with the other. The most promising clean energy sources are wind and nuclear power, due to stagnant growth in the solar industry and a reluctance to further pursue hydropower on a large scale. One would therefore expect to see the share of wind and nuclear power in China's energy mix rise as that of coal fell. China, however, has engaged in a sleight of hand in which many of the coal plants it has "shuttered" have simply been converted into gas-fired plants. If China had abundant supplies of natural gas this would be an improvement (natural gas is

[25] Tianyi Luo, Betsy Otto, and Andrew Maddocks, "Majority of China's Proposed Coal-Fired Power Plants Located in Water-Stressed Regions," *World Resources Institute,* August 26, 2013, accessed July 15, 2014, http://www.wri.org/blog/majority-china%E2%80%99s-proposed-coal-fired-power-plants-located-water-stressed-regions.
[26] Ailun Yang, "Can China's Air Pollution Action Plan Slow Down New Coal Power Development?," *World Resources Institute*, October 17, 2013, accessed July 15, 2014, http://www.wri.org/blog/can-china%E2%80%99s-air-pollution-action-plan-slow-down-new-coal-power-development.

a far cleaner source of energy than coal), but China is a net importer of natural gas and has increasingly relied upon the conversion of coal into synthetic gas to meet its energy needs. The government's plan to reduce the share of coal in the country's energy mix to below 65 percent by 2017 is thus a misleading policy.[27]

The process of converting coal into synthetic gas is actually far dirtier than burning the coal itself, producing 36 to 82 percent more greenhouse gas emissions when the entire process is taken into account. The process is also incredibly water-intensive, requiring fifty to one hundred times more water than it would take to extract an equivalent cubic meter of shale gas. Yet dozens of conversion facilities are being planned across the country.[28] Ambitious targets have the country on course to produce 15 to 18 billion cubic meters of syngas annually by 2015, up from virtually zero capacity in 2013. Nearly half of Beijing's gas demand will be met in 2017 by a massive industrial complex in Inner Mongolia.[29]

For this and other reasons, including the fact that China's continued growth will fuel continued increases in energy demand, experts like Jonathan Sinton, a China specialist at the International Energy Agency in Paris, believe that even if China meets its targets for nuclear expansion, total emissions will still rise 72 to 88 percent by 2020.[30]

Water Scarcity Will Persist

Though not widely discussed, a massive expansion in nuclear power plants could also open up huge sources of desperately needed potable water in some of China's most water scarce regions. China's struggles with water shortages are well known. A nation with 20

[27] China Ministry of Environmental Protection, *The State Council Issues Action Plan on Prevention and Control of Air Pollution Introducing Ten Measures to Improve Air Quality* (Beijing: September 12, 2013), accessed July 15, 2014, http://english.mep.gov.cn/News_service/infocus/201309/t20130924_260707.htm.

[28] Chi-Jen Yang and Robert B. Jackson, "China's synthetic natural gas revolution," *Nature Climate Change* 3 (2013): 852-854, accessed July 15, 2014, http://people.duke.edu/~cy42/SNG.pdf.

[29] Colin Shek, "China coal project risks environmental crisis," *Al Jazeera,* November 28, 2013, accessed July 15, 2014, http://www.aljazeera.com/indepth/features/2013/11/china-coal-project-risks-environmental-crisis-20131125101710278305.html.

[30] Bradsher.

percent of the world's population, China holds only 7 percent of its fresh water resources. Heavy use of those limited resources has caused over 27,000 rivers to dry up since the 1950s. Beijing in particular faces an acute water shortage, having only 235 cubic meters of water per capita. The United Nations recognizes anything below 1,000 cubic meters as a water shortage.[31]

Nuclear power plants offer a partial solution to this problem through desalination technology. The desalination process, normally powered by fossil fuels, can be driven by the intense heat released by the nuclear reactor and done on a scale that makes the desalinated water far cheaper than water diverted from distant regions via canals. For example, water from nuclear desalination could be produced for as little as $0.12 per ton versus the expected cost of $2.41 per ton water from the North South Water Diversion Project.[32] The government has already announced plans to produce 2.2 million cubic meters of desalinated water per day by 2015 through the regular fossil fuel-driven process.[33] If this drive to boost the output of desalinated water is paired with China's planned expansion of nuclear power plants, millions of tons of potable water could be produced each year.

There are obvious limitations, however, to nuclear desalination, which disqualifies it from being the answer to China's water problem. First, this technology has yet to be deployed on a large scale or incorporated into official policy. To date only a handful of facilities have been built with this capacity, including the Hongyanhe nuclear plant in Liaoning Province, which is now capable of producing nearly 10,000 cubic meters of potable water each day.[34] Second, of the hundreds of plants being built, constructed, or proposed, the majority is in the water-rich south. Of the approximately 254 plants

[31] "Desperate measures," *The Economist*, October 12, 2013, accessed July 15, 2014, http://www.economist.com/news/leaders/21587789-desperate-measures.
[32] Using 2001 exchange rate of 8.2674 RMB per 1 USD. "Seawater Desalination by Using Nuclear Power," *China Education and Research Network,* January 1, 2001, accessed July 15, 2014, http://www.edu.cn/20010101/22349.shtml.
[33] "China names regions for seawater desalination," *China Daily,* March 15, 2013, accessed July 15, 2014, http://www.chinadaily.com.cn/china/2013-03/15/content_16311979.htm.
[34] "Commercial operation at Hongyanhe 2," *World Nuclear News*, February 28, 2012, accessed July 15, 2014, http://www.world-nuclear-news.org/NN-Commercial-operation-at-Hongyanhe-2-2802144.html.

in operation, under construction, or proposed, seventy-nine are in the four provinces of Guangdong, Fujian, Jiangsu, and Zhejiang, while only twenty-seven will be located in the water scarce regions of Shandong, Liaoning, and Hebei.[35] Third, nuclear desalination will offer no direct impact on the water scarce regions in China's interior, and may at best result in less water being diverted away to cities like Beijing. Finally, China's average annual per capita water supply is 652 cubic meters below the U.N. threshold for water shortages.[36] To close that gap would require nearly a trillion cubic meters of water to be introduced, and even if every single reactor along the coast ran at full capacity every day they would produce nowhere near that amount. So at best, if this technology is ever seriously implemented, it could offer only minor relief to select areas.

Not only is nuclear technology unable to substantially relieve China's water problems, but nuclear power also poses a risk to the quality of its already limited water supplies. The risk stems from potential inland nuclear plants. While coastal plants can rely on the oceans to cool themselves, inland plants will need to tap into strained rivers and lakes. Nearly 28 percent of China's rivers and 38 percent of China's lakes and reservoirs contain water that is unsafe for human contact and unfit for industrial use. Siting these plants in inland provinces near the remaining potable water supplies may stir resentment among locals.[37] Under ideal conditions in which nothing goes wrong, nuclear plants could damage nearby river and lake ecologies, as heated water from the reactors is recycled back to its source.[38] This would not only hurt the environment but also local economies dependent on inland fisheries. Inland nuclear plants will also be in areas prone to flooding, drought, and earthquakes. Poor designs in the plants or unpredictable natural events could easily cause a disaster exposing inland water supplies to a possible leak of

[35] "Nuclear Power in China."
[36] "Desperate measures," *The Economist,* October 12, 2013, accessed July 15, 2014, http://www.economist.com/news/leaders/21587789-desperate-measures.
[37] "2013 State of Environment Report Review," *China Water Risk*, July 9, 2014, accessed on July 24, 2014, http://chinawaterrisk.org/resources/analysis-reviews/2013-state-of-environment-report-review/.
[38] "Cooling power plants," *World Nuclear Association*, September 2013, http://www.world-nuclear.org/info/current-and-future-generation/cooling-power-plants/.

radioactive material.[39]

The incident in 2011 at the Fukushima Daiichi plant in Japan demonstrated to the world the catastrophic consequences for nuclear facilities that can unfold in the face of unpredictable natural disasters. Consequently, approvals for all inland nuclear power plants in China have been frozen until 2015 by State Council decree. Pressure from lower levels of government have already surfaced calling for an early removal of the moratorium or at the very least a quick resumption of approvals and constructions in early 2015. Examples include the Chinese Academy of Social Sciences, which in 2014 recommended that China "vigorously develop nuclear energy and restart the plan to build nuclear power stations inland."[40] While the risks associated with these plants will remain, they will likely be mitigated by the new simplified passive safety systems of Toshiba-Westinghouse AP1000 Generation III+ reactor that China purchased in 2007 and potentially intends to use as the design model in future projects.[41] For instance, fewer pipes and pumps and gravity-driven circulation for cooling would prevent another Fukushima-type disaster from occurring in China in the event that a flood disabled a plant's power.

There May Not Be Safety in Numbers

Any limited, environmental gains from nuclear power would be wiped out by a single catastrophic event wherein radioactive material is uncontrollably released from one of these plants. Such accidents occur due to unpredictable events akin to those at Fukushima, poor regulation and substandard operation like that at Chernobyl, or

[39] Wang Yi'nan, "Drought and earthquakes pose 'enormous risk' to China's nuclear plans," *China Dialogue*, February 27, 2013, accessed July 15, 2014, https://www.chinadialogue.net/article/show/single/en/5746-Drought-and-earthquakes-pose-enormous-risk-to-China-s-nuclear-plans; "Experts disagree on China's plans for inland nuclear plants," Want China Times, May 6, 2014, accessed July 15, 2014, http://www.wantchinatimes.com/news-subclass-cnt.aspx?id=20140506000061&cid=1105.

[40] Wu Wencong, "Report calls for building inland nuclear power stations," *China Daily*, June 27, 2014, accessed July 24, 2014, http://usa.chinadaily.com.cn/business/2014-06/27/content_17618759.htm; Lyu Chang, "Experts: Inland nuclear projects should resume," China Daily, May 15, 2014, accessed July 24, 2014, http://www.chinadaily.com.cn/bizchina/greenchina/2014-05/15/content_17508414.htm.

[41] "Westinghouse AP1000 Nuclear Plants, China," *Power Technology,* accessed July 24, 2014, http://www.power-technology.com/projects/westinghouseap100/.

some combination of both. Deficiencies within China's regulatory structure and an inadequate pool of human capital to operate its expanding fleet of nuclear facilities, combined with the sheer scale and pace at which these facilities are being built, increases the likelihood of an event similar to Chernobyl. Numerous officials in China have expressed this possibility, including He Zuoxiu, a professor who helped develop China's first nuclear bomb. He was quoted as saying, "Are we really ready for this kind of giddy speed [of nuclear development]? I think not—we're seriously underprepared, especially on the safety front."[42]

Ineffective Regulation

In the twenty-six years since breaking ground at Qinshan, Chinese leaders have tried and failed three times to draft and pass an Atomic Energy Law. Such a law would provide an overarching legal framework to govern all aspects of the country's nuclear activities. It would establish a clear division of responsibilities among nuclear-related agencies, standardize construction, safety, and operational practices, and make provisions for dealing with nuclear accidents, including establishing proper liability guidelines.[43] While China has no nuclear laws on the books (except one governing waste disposal), it has a litany of less legally binding provisions of varying strength including seven State Council regulations, thirty-six departmental rules, eighty-six safety guides, and 180 technical documents.[44] China experts Bo Kong and David Lampton describe three key problems hampering efforts to pass a nuclear law: 1) an overworked top-level leadership unable to steward the process; 2) the lack of a champion among the mid-level bureaucracies able to forge consensus among the various stakeholders; and 3) infighting between competing

[42] Jonathan Watts, "Wikileaks cables reveal fears over China's nuclear safety," *The Guardian*, August 25, 2011, accessed July 15, 2014, http://www.theguardian.com/environment/2011/aug/25/wikileaks-fears-china-nuclear-safety.

[43] Bo Kong and David Lampton, "Whither the Atomic Energy Law in China?," GEEI *China Nuclear Series 6*, (February 2012), 1-8.

[44] Yang Bo, "China Nuclear Energy Development," China Nuclear Energy Association, June 13, 2012, accessed May 2014, http://www.iaea.org/nuclearenergy/nuclearknowledge/schools/NEM-school/2012/Japan/PDFs/week1/3-3_Yang_ChinaNuclearEnergyDevelopment.pdf.

bureaucratic agencies.[45]

In part a result of this failure to legislate China's nuclear regulatory structure is a fragmented mess with multiple agencies sharing responsibility to police the nuclear industry. For example, while the National Energy Administration (NEA) governs the development, planning, and approval of nuclear projects, the National Nuclear Safety Administration (NNSA) oversees plant licensing, siting, and also governs safety. Although the NNSA's jurisdiction for policing safety only extends throughout the interior of power plants, the China Atomic Energy Authority (CAEA) handles trouble occurring outside the plants. Despite their role in regulating the nuclear sector, neither the NNSA nor NEA are permitted to interact with the international community or the IAEA with respect to nonproliferation issues—that job is reserved for the CAEA. At any given time, these agencies also have to interact with other ministries with stakes in the nuclear industry, including the Ministry of Foreign Affairs, Ministry of Health, Ministry of Commerce, Ministry of Science and Technology, and State Assets Supervision and Administration Commission. The lack of a clear division of labor has led to much confusion among these agencies in their everyday work, and especially in their interactions with outside parties. Internal debates among nuclear officials from the CAEA and NEA over which agency should lead which working group during the U.S.-China Peaceful Use of Nuclear Technology dialogue is only one such example.[46]

Another weakness is the lack of regulatory independence for China's nuclear watchdogs. The NEA, CAEA, and NNSA are all housed within larger ministries, but there is a clear imbalance of power among those ministries. The NEA sits in the powerful NDRC and therefore there are strong bureaucratic pressures backing up its decisions to approve new nuclear projects. The two agencies responsible for ensuring the safety of those projects, however, are housed within ministries with much less power. The CAEA is housed within the Ministry of Industry and Information Technology and the NNSA is the largest office within the Ministry of Environmental Protection (MEP). A further complication for the NNSA is its power struggles

[45] Bo Kong and David Lampton, "Whither the Atomic Energy Law in China?"
[46] Bo Kong and David M. Lampton, "China's Nuclear Governance," GEEI *China Nuclear Series*, No.1 (2009).

with its own mother agency at MEP, which, plagued with worries that the NNSA may soon eclipse its own power and influence, constantly struggles to assert its authority and constrain the activities of the NNSA.[47]

A final problem is that all of these agencies are understaffed and underfunded. Former NNSA director and Vice Minister of MEP Li Ganjie confirmed these concerns by noting that beneath China's trend in nuclear development "there are lots of hidden worries . . . . The training for professional staff is inadequate . . . we are short of specialized talent and also short of experience."[48] For instance, the internationally recognized standard for adequate regulatory staffing is a ratio of about thirty to forty regulatory staff to every one GW of installed nuclear capacity. Even after its post-Fukushima expansion, the NNSA only has a staff of eighty-five members in its national office, plus 330 across regional offices and 600 at their technical support center. Just to keep pace with the official target of fifty-eight GW of installed capacity by 2020, the NNSA's staff would have to double in size to be on par with global standards.[49] In terms of finances, nuclear regulators also face a challenge. In 2011, the NNSA's budget was a mere 150 million RMB, less than 8 percent of MEP's total budget.[50]

Unskilled Personnel

China also faces a severe deficit in human capital able to operate its nuclear plants. China has only six leading universities with programs preparing college students for work in the nuclear industry. As of 2004, retention in nuclear engineering programs proved challenging, as less than a third of students who enrolled in these programs remained in the field after graduation. An estimate by the CAEA in

[47] Ibid.
[48] Chen Aizhu, "China's nuclear sector faces shortage of specialists," *Reuters*, September 20, 2010, accessed July 15, 2014, http://www.reuters.com/article/2010/09/20/china-nuclear-safety-idAFTOE68J04920100920.
[49] Jane Nakano, "The United States and China: Making Nuclear Energy Safer," *Brookings Institution*, July 2013, http://www.brookings.edu/~/media/events/2014/2/06%20china%20clean%20energy/uschina%20making%20nuclear%20energy%20safer_jnakano.pdf.
[50] Bo Kong and David M. Lampton, "China's Nuclear Governance."

2009 reported as many as 25,000 nuclear experts will be needed by 2020. With plans to expand to as many as 200 to 300 reactors by mid-century, China will struggle to find adequately skilled personnel to safely operate its nuclear power plants.[51] Whether incentives from nuclear power companies, such as competitive wages and benefits, will be enough to recruit the requisite talent remains to be seen.

The Varied Interests and Competing Motivations for Nuclear Expansion

Thus far the environment has been treated as one of the principal forces guiding China's expansion of its civilian nuclear industry. While it may be an important factor, it is certainly not the only factor. There are myriad personal and professional interests held by Chinese leaders with respect to nuclear power, some complementary, others competing, and still others completely unrelated. From these myriad interests one can glean several major motivating factors, independent of environmental concerns, each offering a plausible explanation for what is driving China's nuclear policy. Which motivations dominate the decision-making of policymakers will ultimately decide the scale and quality of any impact China's nuclear power plants will have on its environment.

Strategic and Economic Motivations

The 2007 NDRC report on nuclear power lists energy security as the number one benefit of nuclear power, the environment ranks second, and right behind that is the promotion of industry and technological development (i.e., economic development).[52]

When it comes to energy security Chinese economic planners see nuclear power as a reliable and increasingly homegrown source of energy. Though China has depended heavily upon its abundant coal reserves for decades, increasingly severe transportation bottlenecks and sharpening realizations that such reserves are finite have

[51] Nakano.

[52] China National Development and Reform Commission, 核电中长期发展规划（2005-2020年）(Beijing: October 2007), accessed July 11, 2014, http://www.etiea.cn/data/attachment/123(4).pdf.

convinced many in China of the need to find an alternative, or at the very least a supplement. To put things in perspective, China's coal use in 2008 exceeded 2.91 billion tons, well above the cap of 2.7 billion tons by 2010 set by the Eleventh Five-Year Plan on Energy Development.[53] While production grew at a rate of 13.7 percent between 2000 and 2008, rail capacity grew only 8.8 percent, with total capacity in 2008 standing at only 1.17 billion tons annually, well below production levels.[54] Further complicating the picture is the fact that 80 percent of China's coal reserves are buried in its mountainous inland provinces, hundreds of miles away from the primary consumers along the coast.[55] Nuclear power avoids most of these problems. Nuclear power plants can be built close to population centers, generating tremendous amounts of energy from relatively small amounts of uranium fuel that only needs to be replaced about once a year. Additionally, nuclear power is becoming an increasingly indigenized industry, with Chinese scientists and manufacturers developing the capability to undertake the design, construction, fuel supply, and operation of power plants without international involvement.

With respect to economic development, China's massive investments in its civilian nuclear sector may also help transform it into a world-leading exporter of nuclear technology and services. With plans to build as many as 200 to 300 reactors by midcentury, China will eventually obtain economies of scale in the manufacture of reactors and accessory components, making it a competitive seller internationally. Furthermore, having adapted the Toshiba-Westinghouse AP1000 reactor design into their own domestic CAP1400 and invested billions into researching alternative technologies such as the pebble-bed reactor, China will be exporting high-value technology that will be completely made in China.

Evidence of China's global ambitions with respect to the nuclear industry is already apparent. A memorandum of understanding penned last year between the United Kingdom and China opened the doors for China General Nuclear Power Group (CGN)

[53] Yun Zhou, "Why is China going nuclear?," *Energy Policy* 38 (2010): 3755, accessed July 15, 2014, doi: 10.1016/j.enpol.2010.02.053.
[54] Ibid.
[55] Ibid.

and China National Nuclear Corporation (CNNC) to begin investing in and building nuclear power stations in the U.K. and to have their reactor designs approved by British regulators.[56] Last year CGN and CNNC purchased a combined stake of about 30 to 40 percent in the consortium led by Électricité de France (EDF) to build the $28 billion Hinkley Point C power plant in southwest England.[57] The civil nuclear agreement, signed in June 2014 by Premier Li Keqiang and Prime Minister David Cameron, broadened bilateral cooperation by allowing Chinese firms to also own and operate Chinese designed plants inside the U.K.[58] Early reports in British press also suggest EDF's Chinese partners are seeking to purchase one of its development sites in the coastal village of Heysham to construct their own plant.[59]

China has much to gain from the advancement of its nuclear industry, independent of any environmental considerations. If these strategic and economic considerations dominate nuclear policymaking there is the possibility that short-term economic interests and parochial energy concerns could eclipse longer-term and broader safety and environmental interests. For example, as was already feared to be the case in the years leading up to the post-Fukushima slowdown, the NDRC in its zeal to promote growth could speed the approvals of new plants over the objections of rival departments like MEP or its subordinate agency the NNSA, opening the door to rushed construction, deficient plant designs, and an overwhelmed

[56] Guy Chazan, Anousha Sakoui and Jim Pickard, "George Osborne to give China go-ahead to build nuclear power stations," *The Financial Times*, October 12, 2013, accessed July 24, 2014, http://www.ft.com/intl/cms/s/0/44ad0ee4-3295-11e3-91d2-00144feab7de.html#axzz38GLg2oPh.

[57] Equivalent to £16 billion pounds under current exchange rates. Geert De Clercq and Karolin Schaps, "UK gives unprecedented support to £16 billion nuclear deal," *Reuters*, October 21, 2013, accessed July 24, 2014 http://uk.reuters.com/article/2013/10/21/uk-britain-nuclear-hinkley-idUKBRE99J03X20131021.

[58] "Multimillion boost to UK economy as China and UK government sign civil nuclear agreement and sign agreement to deepen cooperation on climate change," United Kingdom Department of Energy & Climate Change, June 17, 2014, https://www.gov.uk/government/news/multimillion-boost-to-uk-economy-as-china-and-uk-government-sign-civil-nuclear-agreement-and-sign-agreement-to-deepen-cooperation-on-climate-change.

[59] Danny Fortson, "China in talks to build new nuclear plant in Britain," *The Sunday Times*, July 6, 2014, accessed on July 24, 2014, http://www.thesundaytimes.co.uk/sto/business/dealsandflotations/article1430826.ece.

regulation staff.

National vs. Local Motivations

Another important dimension to consider when thinking about China's nuclear policy is the often-competing interests of local officials and those at the center. It is possible for these two groups to have joint aspirations for the future of nuclear power in China; for example, to use less coal for cleaner air. However, this is usually not the case because officials at the center and those in localities operate on different time horizons.

In Beijing, policymakers are charged with strategic and long-term decision-making. They also are mindful of international norms and obligations. The NDRC, for example, may see approvals of nuclear facilities as an instrument to fulfill national energy demands, improve air quality, and meet climate change promises made by the top leadership in international agreements. The members of the Politburo Standing Committee may view a greater role for nuclear power as an indirect way of controlling growing social unrest, the majority of which is now motivated by discontent over environment issues.[60] They may also be seeking to uphold and expand China's international image as a technologically advanced and responsible world power.

Local officials, however, operate on much shorter time frames with far narrower interests. With thousands of new rural migrants flowing into cities each year as China continues to urbanize, local officials are under mounting pressure to keep growth rates up, unemployment numbers down, and brownouts and blackouts as infrequent as possible. To a mayor then, a nuclear power plant represents a multiyear multibillion-dollar construction project that could be the answer to many economic woes. Since local cadres are usually evaluated for promotion every five years, and almost entirely on the basis of economic performance, they are under pressure to get as

[60] "Chinese Anger Over Pollution Becomes Main Cause of Social Unrest," *Bloomberg*, March 6, 2013, accessed July 25, 2014, http://www.bloomberg.com/news/2013-03-06/pollution-passes-land-grievances-as-main-spark-of-china-protests.html; Jonathan Watts, "China blames growing social unrest on anger over pollution," *The Guardian*, July 5, 2007, accessed July 25, 2014, http://www.theguardian.com/environment/2007/jul/06/china.pollution.

much done as quickly as possible. If something goes wrong once they have moved on to their next post, it is the successor's problem.

Reforms under the new Xi Jinping administration that seek to broaden the criteria upon which local cadres are evaluated for promotions may help narrow the gap between central and local interests. Nevertheless, with the powers of approval, licensing, and oversight of operations unequally divided between three regulatory agencies and a fragmented bureaucracy that often stymies efforts by the center to control local activities, Beijing will rely heavily upon local officials to roll out the expansion of China's nuclear industry. Whether or not this is done with environmental concerns in mind will depend largely upon local cadres.

Personal Motivations

A final motivation influencing the decisions of Chinese leaders with respect to nuclear power is personal gain. This includes blatantly illegal dealings that can be categorized as corruption, and other activities that while suspect may not be in actual violation of the law.

As with all major construction projects, the future development of hundreds of new nuclear power plants is rife with opportunities for exploitation by corrupt leaders. The case of Kang Rixin, former general manager of CNNC and member of the Communist Party Central Committee, is a perfect example. Sentenced to life in prison in 2010, Kang was convicted of accepting bribes totaling $970,000 between 2004 and 2009 and suspected of bid rigging in nuclear power plant construction during his tenure.[61] With corruption under the administration of Hu Jintao reaching unprecedented heights, it is likely that Kang was not alone in his shady dealings, merely the most prominent offender. Such an atmosphere of corruption raises obvious concerns about nuclear power plant safety.

Patronage and nepotism may also be fueling the support of Chinese leaders for nuclear power. The most conspicuous example involves former National People's Congress Standing Committee Chairman Wu Bangguo, then ranked as the Communist Party's

[61] "Former China nuclear head jailed for life over bribes," *BBC News*, November 19, 2010, accessed July 24, 2014, http://www.bbc.com/news/world-asia-pacific-11794199; Bradsher.

second most powerful member, whose son-in-law Wilson Feng was appointed the general manager of CGN's $1.46 billion Nuclear Power and New Energy Industry Investment Fund in 2009.[62]

Though having no direct ties with the nuclear power industry, Hu Haifeng, son of former President Hu Jintao, also has questionable connections. The junior Hu became the Party Secretary of Tsinghua Holdings in 2009 following corruption allegations leveled at one of its subsidiaries Nuctech, a producer of security scanning equipment that Hu led as president after receiving his master's degree from Tsinghua University.[63] Tsinghua Holdings controls more than 30 different companies, one of which is Chinergy, a joint venture with China Nuclear Engineering and Construction Corporation (CNEC), which was tasked by the government to build China's first commercial modular high-temperature gas-cooled reactor.[64] The experimental reactor will be installed in the $300 million Shidaowan nuclear power plant being constructed in Weihai, Shandong by China Huaneng Group, CNEC, and Tsinghua Holdings.[65]

Jiang Mianheng, son of former President Jiang Zemin who is known to have wielded great influence over Hu Jintao's government, though having no business interests in the nuclear industry, has nonetheless developed a personal stake in the future of China's nuclear policy. As President of the Shanghai branch of the Chinese Academy of Sciences and a Vice President of the national Chinese Academy of Sciences (CAS), Dr. Jiang has developed a deep professional and academic interest in the field of nuclear technology. Dr. Jiang heads the $350 million five year CAS Thorium Fuelled Molten Salt Reactor program launched in January 2011.[66] Prior to

[62] George Chen, "UPDATE 1-Ex-Merrill banker heads China nuclear fund –sources," *Reuters*, July 6, 2009, accessed July 24, 2014, http://www.reuters.com/article/2009/07/06/merrill-china-banker-idUSHKG5510020090706.
[63] Wu Zhong, "Nepotism row threatens Wen's legacy," *Asian Times*, February 29, 2012, accessed July 24, 2014, http://www.atimes.com/atimes/China/NB29Ad01.html.
[64] "China plans to build 25 nuclear plants in the next five years," *Engineer Live*, February 21, 2013, accessed July 24, 2014, http://www.engineerlive.com/content/16741.
[65] "Shidaowan High Temperature Gas Cooled Reactor in Shandong Province" *CNEEC*, October 22, 2011, http://www.cnecc.com/Default.aspx?tabid=639&ctl=InfoDetail&mid=1471&InfoID=9813&language=zh-CN.
[66] Robert Hargraves, "LFTR Leader Jiang Mianheng Addresses ITHEO," *Energy From Thorium*, November 4, 2012, accessed July 24, 2014, http://energyfromthorium.com/2012/11/04/lftr-leader-jiang-mianheng-addresses-itheo/.

that he led a Chinese delegation to the American Oak Ridge National Laboratory in 2010 to help Chinese researchers learn more about molten salt reactor technology.[67] In 2012, he addressed a gathering of experts in Shanghai at the Thorium Energy Conference offering a strong defense of continued investments in nuclear energy even after the 2011 Fukushima incident.[68]

The above-mentioned examples are just three instances of high-ranking officials with personal interests in seeing a successful roll-out of an expanded civilian nuclear sector. There are, no doubt, many more to be found both throughout Hu Jintao's tenure and even now under Xi Jinping's administration. These personal motivations, whether influencing leaders' decisions to begin the expansion of the nuclear industry or their later decisions to continue supporting the policy are, like short-term bureaucratic or local interests, troublesome in that they may distract attention away from important issues such as safety, quality construction, and proper regulation.

Conclusion

China's massive expansion of its nuclear power sector has the potential to at least have a tremendously ameliorating effect on its air quality and may even help in the fight to combat global warming. Thus far, however, a reluctance to wean itself off coal and a lack of specific policy prescriptions defining the future relationships between coal and nuclear power has squandered any chance of meaningful reductions in pollution or greenhouse gas emissions. Given the poor state of China's nuclear regulatory authorities and its severe talent deficit, the risk of future inland power plants experiencing some failure is undoubtedly much higher than it should be. Barring a catastrophe, the certain disruptive ecological effects such plants will have on inland rivers and lakes may come to outweigh the limited gains stemming from increased potable water supplies

[67] Richard Martin, "China Takes Lead in Race for Clean Nuclear Power," *Wired,* February 1, 2011, accessed July 24, 2014, http://www.wired.com/2011/02/china-thorium-power/.

[68] Jiang Mianheng, "Why Nuclear Power in China? Thorium & the Energy Outlook of China" (address given at the Thorium Energy Conference 2012 [ThEC12] in Shanghai), accessed July 24, 2014, https://www.youtube.com/watch?v=iLX8jCKL9I4.

from nuclear desalination. Worsening matters are the other motivating factors potentially driving China's nuclear expansion. Narrow bureaucratic and local interests, corruption, and the pursuit of personal gain threaten to distract attention away from and complicate important dimensions of a growing civilian nuclear industry, such as safety and proper regulation. Nuclear power may therefore, in the near- to medium-term, result in a net loss for the environment.

That prognosis notwithstanding, China's civilian nuclear industry will almost certainly see tremendous growth over the next few decades. There is ample support for more nuclear plant construction emanating from localities throughout China and high-ranking members of the central leadership continue to endorse the idea of future expansion. As recently as June 2014 President Xi Jinping, in a meeting of the Central Leading Group for Financial and Economic Affairs, expressed his support saying "[b]y adopting top international standards and ensuring safety, China should lose no time in constructing nuclear power projects in eastern coastal regions."[69] This shared desire for further growth has also been transmitted into official policy, and will include both coastal and inland projects. In March 2014 Wang Yumin, deputy director of the NEA, affirmed this by announcing that construction on inland projects already included in the thirteenth Five Year Plan (2016-2020) would commence after coastal projects are completed.

The only thing likely to derail China's plans to build 200 to 300 reactors by midcentury is the perfection of the technology necessary to properly exploit its enormous shale gas reserves. According to the U.S. Energy Information Administration, China's shale gas reserves are bigger than those of the United States and Canada combined—about 1,275 trillion cubic feet.[70] Holding back a Chinese shale revolution is the lack of adequate water supplies and the fracking technology needed to tap those reserves. Despite the doubts of industry experts, the NEA has ambitious plans for China's shale gas, namely to produce 2.2 trillion cubic feet annually by

[69] "China to accelerate nuclear power development," *Xinhua*, June 16, 2014, accessed July 24, 2014, http://news.xinhuanet.com/english/china/2014-06/16/c_126627560.htm.
[70] "Shale Gas: China's Untapped Resource," *Forbes*, June 13, 2013, accessed July 24, 2014, http://www.forbes.com/sites/jackperkowski/2013/06/13/shale-gas-chinas-untapped-resource/.

2020. It has already enlisted the help of some of the world's largest energy companies to do it, awarding exploratory drilling rights to companies like Chevron, Shell, and Conoco Phillips.[71] If the Chinese can somehow make shale gas a reliable source of energy, this cheaper and safer alternative might slow the pace of nuclear expansion.

In any case, the pace at which new nuclear projects are approved is likely to remain moderate and not approach the runaway speed seen in the years leading up to the Fukushima incident in 2011. Following the Japanese nuclear accident, CNNC chairman Sun Qin stated that China's slowdown in approvals had "nothing to do with technological deficiencies or safety risks," only the need to gain the public's trust. Two years later, according to Zhang Zhuhua, general director of the China Nuclear Energy Association, China's nuclear industry is still recovering from the bad press that followed Fukushima.[72] Though supportive of a resumption of nuclear expansion, China's top leadership is mindful of this reality and likely to proceed more cautiously in the near future. This was reflected in Premier Li Keqiang's comments on nuclear power at a meeting of the National Energy Commission in April 2014 where he said that China would "embark on new major nuclear power plant projects in the eastern coastal area *at an appropriate time*," stressing the need for all projects to meet the highest safety standards.[73] Whereas between 2005 and 2011 China had over eighty-eight active projects, either approved or under construction, only three new projects were given the green light in 2013 and only six to eight are expected to go through this year.[74]

Lastly, China's landmark civil nuclear agreement with the United Kingdom this year is a signal of China's determination to develop its civilian nuclear industry into a major new source of exports, both in terms of high-value technology and services. China's two major nuclear corporations, CGN and CNNC will grow to rival other international nuclear brands like Toshiba-Westinghouse,

[71] Ibid.

[72] Chang.

[73] Emphasis added. Luna Lin, "Concerns over China's nuclear power expansion," *China Dialogue*, accessed July 24, 2014, https://www.chinadialogue.net/blog/6932-Concerns-over-China-s-nuclear-power-expansion/en.

[74] Ibid.

Areva, and Rosatom. There is evidence that China is already seeking to expand its nuclear operations to yet another continent. In his recent trip to Argentina in July 2014, President Xi Jinping signed a number of trade and investment agreements with his Argentine counterpart, and also announced plans for cooperation in the construction of Argentina's fourth nuclear power plant.[75]

Given the likely trajectory of China's civilian nuclear sector, it would be advantageous for public safety, environmental protection, and even future business interests if several reforms were adopted by China's leaders: nuclear regulatory reform, government subsidized nuclear staff, and coordinated effort between energy and environmental policies.

Nuclear regulatory reform: Since the idea of a truly independent agency in China's government would probably never get off the ground, the next best arrangement for China's nuclear regulators (NEA, NNSA, and CAEA) would be removal from their parent organizations and a subsequent merger. There seems to be no logical explanation for the awkward division of authority and responsibility metered out between these three agencies, so to simplify bureaucratic fragmentation they should be combined. At the very least, control over licensing and oversight of operations, responsibilities held by the NNSA and CAEA, should be bundled together. This new super regulator should be given the rank of a ministry and its director should report directly to the Premier. All staffing appointments and funding should come directly from Beijing. This would create a regulator as independent as possible in China, empowered to carry out its mandate to uphold public safety. Such an agency is necessary to counterbalance the influence of pro-growth agencies like the NDRC and the narrow interests of local officials.

Government subsidized nuclear staff: Given the estimated deficit in qualified nuclear regulatory and power plant staff, the government should act to boost interests among China's youth in pursuing careers in the nuclear industry. The number of universities offering

[75] "Gov't seeks to build fourth nuclear power station with giant," *Buenos Aires Herald*, July 19, 2014, accessed July 24, 2014, http://www.buenosairesherald.com/article/164945/gov%E2%80%99t-seeks-to-build-fourth-nuclear-power-station-with-giant; "China's Xi hails 'new horizons' in ties with Argentina," *Yahoo! News,* July 19, 2014, accessed July 24, 2014, http://news.yahoo.com/china-announces-heavy-investments-argentina-071608537.html.

majors in nuclear related subjects should be increased. Programs focusing on the daily operations of nuclear facilities should be made more widely available at technical schools while those meant to nurture the talents of future researchers and policymakers should be made available outside of China's top-tier colleges. Fast track internship-to-work programs should also be established, with local schools partnering with nearby nuclear facilities to prepare students for future work. Monetary incentives and benefits should be subsidized by the government, including college scholarships, internship stipends, and career compensation competitive with the market. The goal would be to prime the pump for qualified nuclear personnel, creating an eventually self-sustaining interest among China's future students in pursuing careers in the nuclear industry.

Coordinated effort between energy and environmental policies: The expansion of nuclear power should be explicitly paired with a real reduction in the use of coal. Major urban areas in China's coastal provinces should adopt "no coal" policies akin to Beijing's. Nuclear facilities of sufficient size should be built to provide the majority of their energy needs, with natural gas-fired plants acting as supplementary sources of power. Gas supplies should not come from converted coal, but rather from natural sources through either imports or pipelines.

Done the right way, the risks and downsides of China's civilian nuclear expansion can be greatly reduced. Moreover, the three main benefits of nuclear power noted by the NDRC—energy security, environmental protection, and economic development—can all become concurrent goals rather than mutually exclusive possibilities.

China's Transitional Environmental Management System: Evolution and the Cadre Evaluation System

Bo Li[1]

Although China, starting in the 1970s, gradually established its environmental management system, environmental protection was not regarded as a priority until the beginning of the eleventh Five-Year Social and Economic Development Plan. Chinese leaders have recently reformed the system to reflect the importance of environmental protection in the government's policy agenda and amended the environmental law to empower the environmental protection authorities. The cadre evaluation system (CES) assigns targets to local leaders to guide and measure their performance on environmental management, and it operates in both top-down and bottom-up channels. Environmental governance in China will remain heavily dependent on the CES despite the employment of several market-based tools and the amendment of the environmental protection law. Bottom-up local autonomy can also play an important role in environmental governance and serve as a positive complement to the top-down approach.

AS CHINA'S ECONOMIC GROWTH HAS SKYROCKETED in the past thirty years, this achievement has come at the expense of increasing energy and resource consumption as well as environmental degradation. Deforestation, water scarcity, water pollution, and air

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pollution have major economic and health costs. The depletion of natural resources also poses major challenges to China's sustainable development.[2] Having long been giving priority to economic growth, Chinese leaders did not take environmental efforts seriously until the eleventh Five-Year Plan (FYP). From 2006 to 2010, Chinese leaders designated environmental protection as a policy priority, setting 10 percent binding targets on the reduction rates of both sulfur dioxide (SO2) and chemical oxygen demand (COD). With tremendous environmental investment in infrastructure and pollution control, China outperformed on both targets during the eleventh FYP. This success further encouraged Chinese leaders to add the pollutants nitrogen oxides (NOX) and ammonium (NH4) to the environmental binding targets in its twelfth FYP (2011-2015).

Since the eleventh FYP, the implementation of China's policies on environmental protection and energy efficiency is driven by the cadre evaluation system (*ganbu kaohe zhidu*) (CES)—"China's system for top-down bureaucratic personnel evaluation"—rather than by the legal system.[3] Literature about China's environmental management system discusses the CES separately while little work has been done regarding the dynamics of the CES in terms of environmental protection.[4] Although China has introduced market-based tools to address the environment, reformed its environmental law to provide legal support, and encouraged more public participation to engage more stakeholders, China's environmental management performance will remain largely rely on the effectiveness of the CES. This article refers to the application of CES in environmental management as the environmental cadre evaluation system (ECES). The ECES is based on target responsibility in which environmental targets are allocated from the central government to local governments and the performance of the targets can be directly linked to the

[2] Lingxuan Liu, Bing Zhang, and Jun Bi, "Reforming China's Multi-Level Environmental Governance: Lessons from the 11th Five-Year Plan," *Environmental Science & Policy* 21 (2012): 106.

[3] Alex L. Wang, "The Search for Sustainable Legitimacy: Environmental Law and Bureaucracy in China," *Harvard Environmental Law Review* 37, no. 2 (2013): 368.

[4] Zhen Wang, "Who Gets Promoted and Why? Understanding Power and Persuasion in China's Cadre Evaluation System" (paper presented at the annual meeting for the American Political Science Association, Washington, DC, 2013); Thomas Heberer and René Trappel, "Evaluation Processes, Local Cadres' Behaviour and Local Development Processes," *Journal of Contemporary China* 22, no. 84 (2013): 1048-1066.

evaluation of local officials. Therefore, understanding how targets work within the ECES is key to Chinese environmental governance. First, I examine the general evolutionary trends of China's environmental management system since the 1970s. Second, I discuss how the ECES works from both top-down and bottom-up channels in environmental governance. Finally, I study how Chinese leaders are fixing the problems with the ECES.

Evolution of China's Environmental Management System

China began to take environmental management seriously when it first attended the Stockholm Conference on Human Development in 1972.[5] According to Dr. Bao Maohong, a Peking University professor, three milestones paved the way for environmental consciousness.[6] In 1973, the National Environmental Protection Agency (NEPA) was established under the Ministry of Rural and Urban Construction. In the same year, the State Council convened the first national environmental protection conference and decided to draft national environmental protection plans. In 1976, China released a Ten-Year Environmental Protection Plan, which put forward goals of controlling environmental pollution within five years and reducing pollution to an acceptable level in ten years.[7] The goals obviously underestimated the complexity of environmental protection, especially in the context of economic development, and were not achieved.

Since the reform and opening policy of the late 1970s, China, motivated by this burgeoning environmental consciousness, has taken a number of important steps in environmental protection. The Environmental Protection Law of the People's Republic of China was introduced in 1979 for trial implementation and more

[5] Guizhen He, Yonglong Lu, Arthur P.J. Mol, and Theo Beckers, "Changes and Challenges: China's Environmental Management in Transition," *Environmental Development* 3 (2012): 29.

[6] Maohong Bao, "The Evolution of Environmental Policy and its Impact in the People's Republic of China," *Conservation and Society* 4, no. 1 (2006): 36.

[7] Rongqing Sun, "The Development of Five-Year Plans on Environmental Protection," *Sina*, August 9, 2012, http://gongyi.sina.com.cn/greenlife/2012-08-09/100536596.html.

pieces of environmental legislation on various subjects including water, forest, and air were developed later. Environmental protection was for the first time included as a chapter into the national FYP in the sixth FYP in 1982. In 1986, an independent Five-Year Plan on Environmental Protection was drafted based on the seventh FYP. The NEPA was elevated to a vice-ministerial governing agency independent from the Ministry of Rural and Urban Construction in 1988. A year later, the Environmental Protection Law of the People's Republic of China was amended and formally established, and remains widely used.[8]

Since the 1990s, Beijing developed more policies and institutions to address environmental protection. In 1992, China became the first developing country to officially pursue sustainable development when it published "China's Ten Strategic Policies on Environment and Development" (zhongguo huanjing yu fazhan shida duice). Later, in 1994, the Chinese government published Agenda 21, which laid out the main strategic frameworks and goals for China's sustainable development in the twenty-first century. In 1998, the NEPA was upgraded and renamed the State Environmental Protection Administration (SEPA), accruing more power and responsibility.[9] Market-based tools were introduced in the late 1990s. In 1999, China initiated its first emission-trading scheme.

Chinese leaders began to recognize the strategic relationship between economic development and environmental protection in the twenty-first century. The tenth FYP on Environmental Protection put forward six main pollutant control targets, but the targets were not completely achieved.[10] The biggest transition came in 2005 when top leaders began to regard environmental protection as an important national policy priority. The Chinese Communist Party (CCP) Politburo and the State Council, the top decision makers in China, reviewed and commented on the eleventh national FYP, which, following the "Scientific Approach to Development," listed environmental targets as binding targets that are closely related to the local CES.[11] In 2008, SEPA was again upgraded, renamed

[8] He, Lu, Mol, and Beckers, 30.
[9] Ibid., 30.
[10] Sun.
[11] Ibid.

the Ministry of Environmental Protection (MEP), and given more political power and responsibilities. China made further efforts toward a green economy in the twelfth FYP, designating one third of the total targets as resource and environment targets.[12]

China has made huge progress on environmental governance through various administrative reforms in environmental planning, infrastructure investment, the ECES, and institutional support. Environmental protection work evolved from pollution control before the twenty-first century to currently integrating economic development and environmental protection. Environmental protection has matured from a side effect of economic development to one of the key policy priorities. Environmental targets have become more comprehensive and realistic within the context of economic growth. In addition to the target-based mandates on environmental protection, China has also made progress on the reform of environmental laws. Since 1979, the National People's Congress and its Standing Committee have passed twenty-nine pieces of environment-related legislation, accounting for about 10 percent of total pieces of legislation in the same period.[13] Nevertheless, the weak enforcement prevents the legal system from having a large impact on the ground.

Although environmental planning has evolved significantly in the past four decades, the implementation of environmental policies at the sub-national level is widely recognized as a big problem in China.[14] The new Environmental Protection Law passed in April 2014 strengthened the capacity of environmental protection bureaus and allowed more social organizations to file lawsuits against polluters; however, the law still does not allow lawsuits against authorities who enforce the environmental law. How to supervise the environmental protection bureaus and make sure they enforce the law effectively remains unclear. Therefore, to reduce

[12] Mark Fulton, *12th Five Year Plan – Chinese Leadership Towards a Low Carbon Economy* (Deutsche Bank Group, April 4, 2011), 1, http://wwww.blah.com/cr/en/docs/China_12th_Five_Year_Plan.pdf.

[13] Jin Wang, "China's Green Laws Are Useless," *China Dialogue*, September 23, 2010, https://www.chinadialogue.net/article/show/single/en/3831--China-s-green-laws-are-useless-.

[14] Organization for Economic Cooperation and Development, *OECD Environmental Performance Reviews: China 2007* (OECD, 2007), 17; Wang, "The Search for Sustainable Legitimacy," 367.

the implementation gap in environmental regulations, the current ECES may be one of the few solutions in China's environmental management system.

The Environmental Cadre Evaluation System in China

The CES is an important government personnel management system in which lower level government officials are evaluated using performance targets determined by government officials one level above them.[15] For example, the provincial government is fully responsible for evaluating the municipal level government officials; approval from the central government is not necessary.[16] Local cadres take the system seriously since it is closely related to their career advancement and salary.[17] It is also an important tool to address the principal-agent problem in Chinese politics, serving as an "instrument of higher level to control lower-level agents and to regulate central-local relations."[18] There have been many studies on the CES in China; however, few of them have focused on the environmental aspect of the system.[19] In the past forty years of environmental protection reform, instead of turning to the legal system, Chinese leaders have decided to elevate environmental priorities in the CES.[20] The discussion of China's ECES in this article is based both on current literature and twenty-six interviews with local government officials in one municipality, one district, and two counties in Hunan Province in 2012.

The most important way to develop the ECES is to assign hard environmental targets to local government officials and incorporate environmental targets into local cadres' evaluations. Starting

[15] Wang, "Who Gets Promoted and Why," 4.
[16] Ibid., 5.
[17] Carl F. Minzner, "Riots and Cover-Ups: Counterproductive Control of Local Agents in China," *University of Pennsylvania Journal of International Law* 31 (2009): 57.
[18] Maria Edin, "State Capacity and Local Agent Control in China: CCP Cadre Management from a Township Perspective," *The China Quarterly* 173 (2003): 36.
[19] Heberer and Trappel, 1048-1066; Minzner, 53-123; Susan Whiting, "The Cadre Evaluation System at the Grass Roots: The Paradox of Party Rule," in Barry Naughton and Dali Yang, eds., *Holding China Together: Diversity and National Integration in the Post-Deng Era* (New York: Cambridge University Press, 2004), 101; Wang, "Who Gets Promoted and Why," 1-49.
[20] Wang, "The Search for Sustainable Legitimacy," 368.

from the eleventh FYP, environmental and energy targets first became the binding (*yueshu xing*) targets that would have a large impact on their performance evaluation.[21] In December 2013, China also reformed its CES to include more comprehensive standards including environmental protection, energy conservation, and local government debt to meet the changing environmental target priorities, which incentivized local cadres to value environmental efforts and hence marked major progress in the development of the ECES.

Past literature studying the ECES focuses more on top-down channels to guarantee that local cadres are in line with the policy priorities determined by the higher levels of government than on bottom-up local autonomy.[22] Local autonomy is often regarded as the principal-agent problem generated from the top-down approach. I argue, however, that bottom-up local autonomy can play an important role in the ECES and serve as a positive complement to the top-down approach.

Top-Down Control

Higher levels of government design environmental targets before they are allocated down to the lower levels through official plans and regulations. This suggests a heavy reliance on the target-based approach, which has certain benefits. First, environmental protection can quickly become the policy priority of local governments.[23] Lower level governments will not only integrate all the important targets set by the central government into their own plans, but also prioritize different targets depending on whether they are binding or expected targets. As a consequence, it is relatively easy for leaders in the higher-level government to enforce their ideas in practice by setting binding targets within the ECES. The tremendous environmental achievements made by local governments during the eleventh FYP is a good example of how much local cadres can achieve in terms of environmental protection when they treat environmental

[21] Binding targets are "hard" targets that officials must achieve; expected targets are "soft" targets. Local officials will get punished if they do not achieve the binding targets; however, not achieving the expected targets is acceptable in the CES.
[22] Wang, "The Search for Sustainable Legitimacy," 367-438. Minzner, 53-123;
[23] Genia Kostka, "China's Evolving Green Planning System: Are Targets the Answer?" Frankfurt School of Finance & Management, Working Paper No. 201 (2013): 9.

protection as a policy priority.

Second, the reporting of environmental target achievements can serve as an important way for the CCP to deliver performance legitimacy.[24] The CCP has long been using rapid economic growth to justify its rule; with the increasing demand for a clean environment, environmental management can be an important new source of legitimacy.[25] The OECD's 2007 report on China's environmental performance concluded that "since the early 1990s, the public has been increasingly expressing its desire to influence public policies" as the Chinese media cover public environmental protests and petitions.[26] According to a report from China Dialogue, "the number of environmental protests has increased by an average of 29% every year since 1996."[27] Over 300,000 environmental petitions were received during the eleventh FYP period.[28] To meet the increasing demand for a cleaner environment, the reporting of environmental target achievements can help ease social unrest.

Third, the top-down control of the ECES also suggests a heavy reliance on leaders' disposition towards the environment, which can boost environmental protection in cities fortunate enough to have an environmentally-minded mayor. For example, in cities like Dalian and Shaanxi, mayors have made the environment a top priority and, thus, "their EPBs (Environmental Protection Bureaus) possess enough clout to persuade other bureaus to engage in cooperative activities."[29] An interview with local officials in one municipality in Hunan Province reveals this:

> Our party secretary used to say this during one meeting with all the mayors in Hunan Province about environmental protection: "If the mayor of a municipality in Hunan cannot reach the environmental targets, he should be sent to be the

[24] Ibid., 10; Wang, "The Search for Sustainable Legitimacy," 398.
[25] Wang, "The Search for Sustainable Legitimacy," 395.
[26] OECD, 15.
[27] Jie Feng and Tao Wang, "Official Struggling to Respond to China's Year of Environment Protests," *China Dialogue*, June 12, 2012, https://www.chinadialogue.net/article/show/single/en/5438-Officials-struggling-to-respond-to-China-s-year-of-environment-protests-.
[28] Feng and Wang.
[29] Elizabeth C. Economy, *The River Runs Black: The Environmental Challenge to China's Future* (Ithaca, NY: Cornell University Press, 2011), 119.

leader of the sewage treatment plant.[30]

The heavy reliance on the dispositions of local leaders towards the environment, however, can also play a negative role in environmental management if local leaders are not highly supportive of environmental protection.

Fourth, at the central level, the implication of top-down control on environmental protection is more obvious. Before the eleventh FYP, there was a paradox: the expansion of environmental laws and regulations and the increasing power of Chinese environmental protection bureaus occurred simultaneously as centrally-mandated environmental policies were poorly implemented at the local level. Inadequate resolve at the central level to solve the principal-agent problem in the environmental field created implementation gaps. Although the central government perceived environmental protection as a growing threat, its unwillingness to make a real move through the ECES has led to the implementation gap before the eleventh FYP.

Once the central government began to take environmental protection seriously and set environmental targets through the ECES, the outcomes of environmental work significantly changed. From 2006 to 2011, China reduced the emissions of CO2 and SO2 by 12.45 percent and 14.29 percent respectively, outperforming the 10 percent targets for both pollutants. More cleaning equipment was installed in factories and the rate of urban sewage treatment rose from 52 percent to 72 percent.[31] Therefore, the top-down approach in the ECES could help to address the principal-agent problem in environmental governance if the central government is determined to make the environment one of its top priorities.

Bottom-Up Local Autonomy

Local autonomy can be defined as both lower level governments' "right to interpret" and their bottom-up feedback process to superior levels of government.[32] Current literature tends to focus more on

[30] Interview with municipality-level local official in Hunan Province, May 28, 2012.

[31] The Central People's Government of the People's Republic of China "National 12th Five-Year Plan on Environmental Protection," December 15, 2011, http://www.gov.cn/zwgk/2011-12/20/content_2024895.htm.

[32] Wang, "Who Gets Promoted and Why," 33.

the top-down aspect of the CES while considering the impact of bottom-up local autonomy as part of the principal-agent problem.[33] While local autonomy generates problems, including deviations and goal displacement in environmental policy implementation,[34] local autonomy can also be a necessary complement to top-down control and should also include public feedback about environmental issues through complaints, petitions, and protests.

The "right to interpret" means that the higher tier governments usually dictate more general topics and agendas and the lower levels government can interpret the general guidelines, taking into account the specific local challenges. Local governments are often given sufficient flexibility to maintain social and political stability through rapid economic growth.[35] Sometimes, local governments may address environmental issues even though they are not listed as binding targets by the upper level. For example, the Hunan provincial government set a binding target of a 15 percent reduction rate in lead emissions during the twelfth FYP period (2011-2015), though the FYP does not list such a target.[36] This is also the case from the provincial to municipal level. One municipality may not necessarily prioritize all the tasks in the provincial twelfth FYP related to environmental protection, but they will prioritize according to their own urgent environmental problems when designing the municipal twelfth FYP on environmental protection.

The bottom-up feedback process is the other important aspect of local autonomy. Lower levels of government have the right to negotiate with higher levels of government, especially concerning the allocation of environmental targets. Interviews with county officials who did not meet the targets of energy conservation in the eleventh FYP (2006-2011) demonstrate this:

> The municipal government introduced a large power plant in 2007; therefore there was no way we could achieve the

[33] Kenneth Lieberthal, "China's Governing System and its Impact on Environmental Policy Implementation," *China Environment Series* 1 (1997), 3-8.
[34] Xueguang Zhou, "The Institutional Logic of Collusion among Local Governments in China," *Modern China* 36, no. 1 (January 2010): 47.
[35] Lieberthal, 3.
[36] Hunan Provincial Environmental Protection Bureau, "The 12th FYP on Environmental Protection of Hunan Province," June 5, 2012, http://www.hbt.hunan.gov.cn/new/ghcw/zhgh/content_29314.html.

> energy conservation targets. Although most of the taxes of the enterprise went to the municipal government, we have to be responsible for their energy consumption. This was unfair to us. Our leaders talked to the municipal government and they reached an agreement that as long as the municipality as a whole achieved its energy conservation target assigned by the provincial government, we would not be punished by the municipal government.[37]

In another county, the county government originally assigned all the township governments with the same energy conservation targets to "test their responses." After receiving comments from different township governments, the county government revised the target allocation to reflect the different economic situations in various towns. Towns with more industries ended up receiving higher targets.[38] Local governments are intentionally taking advantage of the bottom-up feedback process to influence their superiors.

Bottom-up local autonomy also involves feedback from the public. In the past, there was an underlying political and economic deal to maintain social stability through economic growth;[39] however, over the years, leaders in China have observed the shift that the environment has become a top concern fueling the increasingly frequent environmental protests. An interview with the EPB at one municipality in Hunan Province confirms this trend:

> Starting from last year [2011], the provincial statistic bureau would conduct a survey about the satisfaction of the environment in different cities in Hunan province. The survey is conducted mainly through a statistics company randomly calling people in different cities. There are a number of indicators measuring people's satisfaction and awareness about the environment. Last year, our target for the environmental satisfaction rate was over 70 percent. This target would be included in our evaluation (kaohe) system and is also a fair and

[37] Interview with county official, May 21, 2012.
[38] Ibid.
[39] Lieberthal, 4-5.

> convincing target to reflect the environmental situation in different cities. However, this new target has also brought us a lot of pressure since it was set last year.[40]

Nationwide, the environmental complaints from the public can upgrade to protests if not managed well. There have been more environmental demonstrations in recent years. Environmental incidents in 2005 took the form of repeated mass petitioning over environmental pollution in Dongyang, eastern China.[41] Later in 2007, citizens in Xiamen made their voices heard all over the country by protesting over a plant using paraxylene (PX)—a chemical used to make polyester products. In 2011, there was another protest against PX in Dalian, northeastern China. Environmental protests have escalated since 2012. Within the span of four months, three massive protests erupted in Ningbo, Shifang, and Qidong. Protests can also devolve into physical clashes with the government and police and lead to social disorder.[42] These environmental petitions and protests reflect the increasing demand for a clean environment; and most importantly, have pushed the Chinese leaders to accelerate the reform of the ECES.

Current Challenges

Although the ECES plays an important role in environmental policy implementation in China, it has a number of limitations and drawbacks. It is important to recognize what the system cannot achieve in environmental governance. The ECES today still faces principal-agent problems including data collection issues and cyclical behavior, the weakening of top-down control, and the lack of punishment for underperformance.

First, the reliance on the ECES may give rise to a number of undesirable principal-agent problems including unscientific and inflated targets, as well as the cyclical behavior of local officials.[43]

[40] Interview with Environmental Protection Bureau official at the municipal level, May 28, 2012.
[41] Feng and Wang.
[42] Liu, Zhang and Bi, 109.
[43] Kostka, 14-17.

The design of environmental targets is essential to environmental protection work, as the targets guide the fundamental directions of local environmental policy. The unscientific allocation of environmental targets has huge implications for local environmental efforts. One official from a county EPB reported that despite achieving more COD reduction than their target during the eleventh FYP, they chose not to report it to upper government in order to leave some room for the twelfth FYP.[44] Target allocation can be inflated when passing down from a higher level to a lower level. Instead of setting their own targets, lower level governments are often assigned higher targets by their superiors to allow for potential failure of environmental efforts or the potential for investigations by national inspection teams.[45] One local official admitted that, "when the upper level government has a certain target, the lower level will most likely end up with a target higher than the upper level."[46]

Local officials' cyclical behavior means that they tend to adopt a loose environmental policy while the implementation becomes stricter as the deadline of the environmental targets are approaching. Given five-year environmental targets in the FYP, local officials tend to achieve less of the targets in the beginning and more at the end of the period. This is partly because many local officials know that they may only stay in the same position for one or two years before a promotion or relocation. The short-term mindset has created incentives for local cadres to leave the pressure of environmental target achievement to their successor.[47] The achievement of the energy consumption target during the eleventh FYP is a perfect example. Zhang Ping, the head of the National Development and Reform Commission, admitted during the National People's Congress in 2011, that some local governments cut off electricity and shut down industries at the last minute in order to achieve their

[44] Interview with Environmental Protection Bureau official at the county level, May 21, 2012.
[45] Kostka, 14.
[46] Interview with Development and Reform Commission official at the county level, May 21, 2012.
[47] This political logic affects not only environmental policies, but local governance more broadly. For examples, refer to Joseph Fewsmith, *The Logic and Limits of Political Reform in China* (New York: Cambridge University Press, 2013).

energy targets.[48]

Second, there are negative impacts of the local autonomy of the ECES. One problem is that local autonomy may undermine the effectiveness of the top-down control of the ECES. For example, local cadres may still consider a high economic growth rate as their top priority at the local level, rather than environmental protection. This is especially true when the CES fails to address the sequence of policy priorities correctly and local cadres have no real incentives to follow the priorities proposed by the central leaders. Another issue is that the high flexibility of the ECES may allow local cadres to disregard some environmental targets with impunity. My interviews in Hunan province found that no local officials received punishment for not achieving the environmental targets, even though some of them did fail to meet the binding targets. This incentivizes local cadres to relegate environmental management to a lower priority.

Third, since the ECES relies on target achievement metrics, some environmental problems can be ignored if they are not included in the environmental targets. The ECES urges local officials to follow the agenda set by the central government, but many environmental problems are not listed as binding targets in the FYP. A county EPB official talked about PM2.5 (Particulate Matter up to 2.5 micrometers in size) as an example:

> The requirements of certain environmental targets should be updated with the economic development. The national level EPB is working on PM2.5 while the county level could hardy make its voice heard on this topic. Only when the national level began to promote this, then our county level could follow its instruction. Now we do not have the technology to measure PM2.5, but the equipment might be added at the end of this year.[49]

The ECES may not include all the important environmental issues,

[48] Zhaojun Zhou and Yan Shi, "Zhang Ping Reviewed the Implementation of Energy Saving and Emission Reduction during the 11th Five Year Plan," *China Climate Chang Info-Net*, March 8, 2011, http://www.ccchina.gov.cn/Detail.aspx?newsId=30047&TId=87.

[49] Interview with Environmental Protection Bureau official at the county level, May 28, 2012.

which is also why public supervision is needed to promote the bottom-up channel to reflect urgent environmental problems that are not listed on the government's environmental agenda.

Recent Environmental Reforms in China

Reforming the CES into a more sustainable system that addresses current environmental challenges in China has been discussed for at least a decade. In order to address new problems emerging from the rapid economic growth in recent years, Chinese leaders further reformed the local CES in December 2013.[50] It was the first time that official regulations explicitly said that GDP performance should not be used as the only criterion in cadre evaluation. Central leadership called for a more comprehensive evaluation system that would increase the weight on local cadres' performance in energy consumption, environmental protection, safe production, and local government debt in order to meet the changing environmental target priorities.[51]

One important reason for the reform of the CES is that the original CES failed to support the changing policy priorities. Environmental management had become a policy priority since the eleventh FYP, but the CES was not updated to reflect this policy change. As the Chinese environmental management system is largely based on the ECES, it is therefore important to reform the CES in order to keep up with the policy shift. In addition, other problems, including government debt and safe production, are also drivers of the recent CES reform.

Another important reform is the updated Environmental Law passed by the Standing Committee of the National People's Congress in April 2014. The new law allows more organizations to bring a public interest lawsuit against polluters and gives environmental protection agencies more administrative power to punish polluters. For example, now "around 300 green NGOs that are

[50] See "关于改进地方党政领导班子和领导干部政绩考核工作的通知," http://renshi.people.com.cn/n/2013/1210/c139617-23793409.html.

[51] Organization Department of the CPC Central Committee, "Notice on Improving the Local Cadre Evaluation System," CPC News, December 10, 2013, http://renshi.people.com.cn/n/2013/1210/c139617-23793409.html.

registered at city level, and aren't known to have breached any laws or regulations for the past five years, are given the right to bring public interest lawsuits."[52]

Chinese leaders are also trying to fix problems embedded in the target-based approach within the ECES, particularly finding ways to reconcile short-term and long-term interests of local cadres. For example, in order to address local officials' cyclical behaviors, local governments have begun to divide the five-year binding targets into annual targets. This can prevent local leaders from underperforming in the early years in the FYP period and catching up later.

The reform of the CES, together with the new environmental law, seems to have had an obvious impact on China's environmental governance. Since 2014, a number of local cadres have been punished for misbehavior in environmental governance. In February, a township party secretary in Hebei Province was dismissed from his position because of public complaints about the inferior environment from poor garbage disposal.[53] In May, the MEP announced that a number of government officials at a country environmental protection bureau in Jiangsu Province were punished because of the local environmental pollution.[54]

Conclusion

Over the past four decades, China has made remarkable achievements on economic growth; environmental management in China started before the economic reform in the 1970s and slowly grew with the reform of environmental protection institutions. The strategy evolved from controlling pollution in the early years to integrating economic development and environmental protection in recent years. The performance of environmental management, however,

[52] Jiangqiang Liu, "China's New Environmental Law Looks Good on Paper," *China Dialogue*, April 24, 2014, https://www.chinadialogue.net/blog/6937-China-s-new-environmental-law-looks-good-on-paper/en.

[53] "A Party Secretary was Dismissed because of Environmental Issue in Heshui, Hebei Province," *Hebei News*, February 19, 2014, http://www.chinanews.com/gn/2014/02-19/5856932.shtml.

[54] Biao Li, "MEP Released the Black List of Environmental Protection," *Sina Fiance*, May 13, 2014, http://finance.sina.com.cn/chanjing/gsnews/20140513/012819082939.shtml.

did not start to catch up with the huge economic achievements until the eleventh FYP, when environmental governance became a policy priority.

Chinese leaders have used the ECES as an important way to address the implementation gap in environmental management. The system operates through both top-down control and bottom-up local autonomy. The top-down approach allocates targets from higher levels of governments to lower levels and implies a heavy reliance on leaders' dispositions towards environmental protection. At the same time, the top-down approach can prioritize environmental work on local governments' agendas. Moreover, the reporting of achieved targets can be a tool to demonstrate the CCP's performance legitimacy. The bottom-up local autonomy includes both the local governments' right to interpret general policies and the feedback process from lower levels of government to higher levels of government. The current ECES, however, still faces a lot of challenges from principal-agent problems, such as unscientific and inflated targets, the cyclical behavior of officials, and the declining effectiveness of the top-down approach.

There are many avenues of research regarding China's environmental management system yet to be explored. Although the beginning of 2014 witnessed some local officials—especially officials in EPBs—being held accountable for environmental issues, the overall trend of China's environmental management is still unclear. What is the potential relationship between the CCP's anti-corruption campaign and the current round of environmental accountability reforms among local officials? Can environmental policies implemented in eastern China be transplanted to central and western provinces? This article discusses environmental protests in recent years, but how will the role of public participation cause the evolution of China's future environmental governance system? Even though the new environmental law allows more public participation in environmental management, there persists a lack of supervision in the environmental agencies that actually enforces the law. How effectively Chinese leaders use the ECES to address the lack of supervision is another question.

Recent reforms of China's environmental management

system, including the reform of the CES and the introduction of new environmental law, have tried to solve the implementation gap in environmental governance. The recent reform of the CES creates more incentives for local cadres to treat environmental management as a priority. The recent amended environmental law granted the EPBs more responsibilities and powers and strengthened the EPB's capacity to enforce laws and regulations. With both the incentive and the capacity, China could be expected to make a change in environmental management in the coming thirteenth FYP.

Learning by Doing: A Comparative Analysis of EU and Chinese Emission Trading Systems

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Over the course of 2013 and 2014, seven pilot emission trading systems (ETSs) were launched in various cities and regions in China. This represents a huge potential testing ground for market-based solutions to pollution, both in China and internationally. In aggregate, the pilot markets represent the second largest cap and trade program in the world by emissions—second only to the EU ETS, which has been in place since 2005. Lax enforcement, limited technical expertise, and gaps in the legal and institutional framework could, however, undermine the project. By comparing the evolution of the ETS, relevant laws and policies, as well as institutional capacity for China's ETS and the EU ETS, the paper identifies challenges and opportunities facing policymakers. In particular, the lack of central planning could have potentially damaging effects in the long-term even as it facilitates experimentation in the initial phase. Further collaboration between the EU and China on climate change and specifically ETS could improve the long-term prospects of both systems.

AS GOVERNMENTS COME UNDER INCREASING pressure to address environmental issues without undermining economic growth, they are turning to policy tools such as emission trading systems (ETSs), which are seen as more efficient than pure regulation and more business-friendly than taxation. The development of

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emission trading over the past few decades has been largely shaped by the interaction between academia, policy-making, and environmental activism. In many ways, its intellectual foundations lie in Ronald Coase's writings on property rights, developed in reaction to theories proposing to eliminate negative externalities from economic production through taxation.[2] According to Coase's argument, the most efficient allocation of resources and level of output—including social costs such as pollution—can be obtained by clearly establishing property rights and a functioning market. Some economists throughout the 1960s and 70s, including John Dales, applied Coase's insights to the environmental field, which eventually led to a more formal conception of an ETS.[3] In very simple terms, an ETS requires a functioning market where polluting companies can trade the pollution licenses they were originally allotted according to their need. The US became an early testing ground for cap and trade, which was used to minimize sulfur dioxide emissions and lead fuels starting in the 1980s. At around the same time, several European countries began to implement tax-based solutions to emissions.

Unlike a tax, an ETS ensures optimal allocation of pollution allowances and a market-driven price for emissions; its effectiveness, however, depends on the total number of licenses available on the market and the market conditions, something that has created significant challenges in practice. The tensions between tax-based, purely regulatory, and market-based policies in controlling carbon emissions continue to exist and inform the debate on climate change action. While most national policies involve a mix of different approaches, cap and trade has gained increasing popularity internationally since the Kyoto Protocol (1998), which among other things led to the establishment of the European Union ETS (EU ETS) in 2005. In fact, while emission markets may have originated in the United States, the EU became one of the strongest backers for carbon trading as it moved away from carbon taxes, which were found politically inexpedient. The EU ETS now represents the largest greenhouse gas (GHG) market in the world, providing, for better or worse, a

[2] Coase largely reacted to the work of British economist A.C. Pigou and those who followed his views on taxation (Pigouvian tax).

[3] Tom Tietenberg, "Cap-and-Trade: The Evolution of an Economic Idea," *Agricultural and Resource Economics Review* 39, no. 3 (October 2010): 359–60.

model for other countries. If China were to succeed in establishing a nation-wide ETS, the two markets would be the largest in the world.

The Significance of China's ETS Program

China's unprecedented economic growth since the late 1970s has led to extraordinary social and environmental imbalances, which the government has become increasingly concerned with. Air quality is especially problematic from a political point of view due to its immediate impact on urban dwellers' living standards, placing intense pressure on the state to find solutions. China first experimented with pilot ETS programs on a limited scale in the 1990s. This was the first step towards introducing a market system to monitor environmental degradation and had no noticeable impact in the short term. It would take two decades for the country to move towards implementing a true carbon market. In 2011, the Chinese leadership announced in its twelfth five-year plan (2011-2015) the launch of seven pilot markets in an effort to set the foundations of a nation-wide scheme. Between late 2013 and early 2014, six of the seven Chinese ETS pilots opened to trading.

China's high profile shift toward using market-driven instruments to reduce environmental degradation and pollution has significant implications domestically and internationally. At home, the recently established pilot carbon markets could serve as a model for a national ETS and help alleviate China's air pollution and limit emissions. It could also drive institutional reforms in other sectors, such as law and finance. From an international perspective, if successful, the Chinese carbon dioxide (CO2) markets would incentivize other countries, like the United States, to accelerate the development of national or regional ETSs. China could also offer a model for other emerging economies struggling to contain high levels of carbon emissions and inject new life in those existing systems whose future depends on the prospective of an integrated global market, like the European Union's. Lastly, the carbon markets could play a significant role in Chinese diplomatic negotiations at the upcoming twenty-first session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC),

scheduled for 2015 in Paris.

Conversely, if the pilots are deemed a failure, the future of carbon markets will be at risk. Many factors, ranging from corruption to low institutional capacity and bad enforcement, could prevent the scheme from successfully reducing emissions. Insufficient liberalization in the energy markets, finance, and law could also hinder the adoption of carbon markets. Additionally, Beijing's strategy of encouraging experimentation at the local level to develop skills, build political support, and find best practices could have negative repercussions insofar as it will lead to the establishment of isolated markets with distinct rules.

Given the magnitude of the challenge, looking at experiences abroad could help Chinese policymakers avoid pitfalls and adopt best practices in developing emission markets. The EU's cap and trade program traded 7.903 millions of tones in 2012.[4] Analyzing the EU ETS and comparing it to the Chinese ETS pilots can provide a framework to identify challenges and define expectations for the future of emission markets globally.

While the EU ETS encompasses thirty-one countries, its aggregate volume of emissions is lower than China's, which in 2008 accounted for 23 percent of carbon emissions worldwide (by comparison that same year the EU27 countries excluding Estonia, Lithuania and Latvia accounted for 13 percent).[5] In 2008, Shanghai's emissions alone were estimated to be higher than those of Italy, the second largest manufacturing country in Europe. By the same estimate, the most industrialized economy in the EU ETS, Germany, was a smaller polluter than the city of Guangdong.[6] The pilots are operating in geographic areas that account for approximately 42 percent of China's carbon emissions in 2008, which make them aggregately the second-largest ETS in the world after the EU ETS.[7]

[4] European Commission, *The EU Emissions Trading System (EU ETS) Factsheet* (Publications Office of the European Union, October 2013), 6. http://ec.europa.eu/clima/publications/docs/factsheet_ets_en.pdf.

[5] United States Environmental Protection Agency, *Global Greenhouse Gas Emission Data*, last updated September 9, 2013, http://www.epa.gov/climatechange/ghgemissions/global.html.

[6] Kong Bo and Carla Freeman, "Making Sense of Carbon Market Development in China," *Carbon & Climate Law Review* 7, no. 3 (September 2013): 195.

[7] Ibid.

The latter regulates about 45 percent of EU GHG emissions and aims to cover 65 percent of emissions by 2020.[8] Whatever the long-term achievements of the Chinese and EU ETSs, they represent some of the most ambitious experiments in reducing carbon and GHG emissions.

I will first analyze the history and current status of the EU ETS and then provide an overview of the seven Chinese carbon market pilots, followed by a comparative analysis. The comparison will focus on the institutional dimension and the challenges that the Chinese pilots face due to low coordination and bureaucratic capacity. Finally, I will provide suggestions for cooperation.

The European Union Emissions Trading System

The EU is a supranational institution and regulatory giant that was slowly built through an intricate web of laws and agreements between sovereign nations. This means that while implementation is generally left to the individual country, there is a common framework negotiated at the top. The Commission, the top executive agency led by national appointees, acts as a harmonizer by issuing directives that guide domestic policies in the member states. As a consequence, the EU countries' laws and policies are converging overall, particularly in those areas under the Commission's jurisdiction. Governments, however, still have strong incentives to favor their domestic businesses when it comes to handing out permits and issuing fines, especially where they feel that other states are doing the same. Each country has to pass proposed EU regulation through its national political system, adapting it to its specific bureaucratic structure, which leads to differences in implementation. In the case of common targets, the tools through which these are achieved are left to the individual states, meaning that very different policies may be adopted toward the same ends. These competing forces and multiple layers of bargaining are essential to understanding EU gove nance and the development of the EU GHG emission market.

The EU ETS covers over 11,000 power stations and industrial plants across Europe as well as airlines flying within the

[8] European Commission, The EU Emissions Trading System (EU ETS) Factsheet, 1.

European Economic Area (EEA).[9] The system was developed as a policy tool to facilitate compliance with the Kyoto Protocol commitments undertaken by the original EU member states (EU-15). In aggregate, the EU-15 countries committed to reduce emissions by 8 percent compared to the 1990 levels by 2012.[10] With the EU accession rounds of 2004, 2008, and 2013 the new EU member states were also integrated into the ETS and the low-carbon targets, along with Iceland, Liechtenstein, and Norway.

While the EU ETS was established to help EU member states meet their commitments under the Kyoto protocol, it functions as one of four legislative instruments developed to achieve the so-called 20-20-20 targets set by EU leaders in 2007 and enacted in 2009 with the climate and energy package. The targets provide a common framework for member states to pursue low-carbon development. More specifically they consist in: reducing GHG emissions by 20 percent from levels in 1990, raising the share of renewable energy resources consumed in the EU to 20 percent, and improving of energy efficiency by 20 percent by 2020.[11] The climate and energy package includes national targets for reducing and monitoring emissions not included in the ETS, national targets for increasing renewable energy sources, and legislation setting the bases for developing of carbon capture and storage facilities.[12] The EU energy efficiency directive, which EU member states were required to implement by June 2014 (with some limited exceptions), was drafted separately, but is also considered instrumental to the achievement of the 20-20-20 goals. EU planning also takes into consideration the wealth and base level of member states, requiring countries with better environmental infrastructure to commit to higher targets (this is consistent with the approach used for the Kyoto protocol commitments).

The EU GHG emission market has been implemented in three distinct phases. Phase I (2005-2007) was officially launched the same year the Kyoto protocol entered into effect. This initial

[9] European Commission, *The EU Emissions Trading System (EU ETS) Factsheet*, 1.
[10] Pew Center on Global Climate Change, *The European Emissions Trading Scheme (EU-ETS) Insights and Opportunities* (Center for Climate and Energy Solutions, 2005), 2. http://www.c2es.org/docUploads/EU-ETS%20White%20Paper.pdf.
[11] "The 2020 Climate and Energy Package," *European Commission*, last updated July 9, 2014, http://ec.europa.eu/clima/policies/package/index_en.htm.
[12] Ibid.

phase served as a testing ground to help develop necessary institutions and provide an adjustment period to firms and human capital.[13] The system was adopted by all the twenty-five EU member countries at the time and covered only CO2 emissions from combusting installations.[14] Permits applied to the plants themselves instead of the company.[15] The national governments allocated most of the allowances for free.

Member countries were entirely responsible during this period for permit allocation and emission monitoring. National governments submitted National Allocation Plans (NAP) to the Commission for review, describing how they intended to implement the ETS and meet the country's commitments under the Kyoto protocol. The Commission could request changes to some of the plans. In practice, the few revision requests related to scenarios where the volume of allowances exceeded projected emissions and when member states planned to redistribute permits after the initial allocation.[16] Beyond the design of the system, the Commission's role was limited to ensuring that all countries followed its directives and developed responses to issues as they emerged. Each member country was responsible for identifying the right number of allowances to issue and establishing proper monitoring and enforcement mechanisms.[17]

The EU ETS Phase I has been mostly criticized for the over allocation of permits by member states despite the Commission's recommendations and subsequent windfall profits for companies with excess allowances.[18] Lack of reliable data and harmonized practices meant that national governments were allowed to use various methods to distribute emission allowances, leading to their

[13] Peter Sopher and Anthony Mansell, "European Union" in *The World's Carbon Markets: A Case Study Guide To Emissions Trading* (Washington, DC: Environmental Defense Fund and International Emission Trading Association, March 2014), 2.
[14] Richard Mao et al., *Environomist: China Carbon Market Research Report 2014* (Beijing: Environomist Ltd., 2014), 11-12.
[15] Ibid.
[16] "National Allocation Plans," *European Commission*, last updated July 9, 2014, http://ec.europa.eu/clima/policies/ets/pre2013/nap/index_en.htm.
[17] Ibid.
[18] Tim Laing et al., *Assessing the Effectiveness of the EU Emissions Trading System* (Centre for Climate Change Economics and Policy, January 2013), 23.

over allocation.[19] To counter this trend, the Commission rules that licenses from the 2005-2007 period could not be used in the second phase.[20] The Commission's own assessment highlighted the lack of transparency and the time-consuming procedures involved with the NAP.[21] It also concluded that firms need clear signals from institutions in order to adjust production accordingly before new rules are put into place.[22]

Phase I of the EU ETS was always designed to be a trial test to identify flaws and develop institutional competencies. The Commission expected Phase II (2008-2012) to correct issues that emerged in previous years in order to target emissions more effectively. The changes in the ETS Directive—the legal basis for the cap and trade program—strengthened the system by streamlining procedures, improving transparency, and reducing the number of allowances.[23] The global financial crisis, however, created several unforeseen challenges for policymakers. First of all, the recession dampened some governments' commitment to implement a program that might place a burden on producers and significant exemptions were introduced to aid struggling industries throughout Europe. Even more importantly, as economic activity slowed down so did emissions. The fall in emissions not only lowered the market price for carbon, it made it significantly harder to assess the effectiveness of the program.[24] While the Commission reduced the volume of allowances by 6.5 percent compared to 2005, the demand fell even faster; the result was that many installations held on to unused permits, suppressing the market price.[25] Part of the problem was that projected emissions were based on reported emissions from the

[19] Lucas Merrill Brown, Alex Hanafi, and Annie Petsonk, *The EU Emissions Trading System: Results and Lessons Learned* (Washington, DC: Environmental Defense Fund, 2012), iiv. http://www.edf.org/climate/eu-emissions-trading-system-report.
[20] "EU ETS 2005-2012," *The European Commission*, last updated July 9, 2014, http://ec.europa.eu/clima/policies/ets/pre2013/index_en.htm.
[21] "National Allocation Plans."
[22] Ibid.
[23] Peter Zapfel and Vicky Pollard, "The EU ETS: A Review of the Back-Loading Debate," in *Emissions Trading Worldwide ICAP Status Report 2014*, eds. Constanze Haug et al. (International Carbon Action Partnership, 2014), 8. https://icapcarbonaction.com/news-archive/209-emissions-trading-worldwide-icap-status-report-2014.
[24] Laing et al., *Assessing the Effectiveness of the EU Emissions Trading System*, 9.
[25] "National Allocation Plans"; Merrill Brown, Hanafi, and Petsonk The EU Emissions Trading System, 11-12.

previous periods, meaning that the early over allocation by national government persisted into the second phase as well.

The most visible changes during Phase II were the expansion to twenty-seven countries (to include the new EU members Bulgaria and Romania) and the inclusion of nitrous oxide (N2O) in the system. The Commission also established a series of directives to standardize the NAP and provide more information to the public to promote transparency. To this end, in 2012, it launched a public European Union Transaction Log (EUTL), an online database that collects all information on permits and installations participating in the ETS. The EUTL replaced the national registries to ensure consistency, prevent double accounting and fraud, and systematize permit registration across countries.[26] This was also a preliminary step in shifting permit issuance from the individual member states to the Commission.

After 2008, fines were raised from forty euros per ton of carbon to one hundred euros per ton.[27] Single member states remained responsible for monitoring, reporting, and verification (MRV). Given the EU bureaucratic structure, the Commission cannot directly enforce regulation in the member countries nor can it carry out large-scale MRV activities directly. Since the different member countries have very different budgets and environmental policies, the Commission found it significantly more challenging than anticipated in early feasibility studies to ensure a homogeneous level of compliance with its directives on the ETS across countries.[28]

The EU ETS entered Phase III in 2013 and is planned to last through 2020. The new system includes a set of more stringent rules, including the shift from national to EU-level permit approval.[29] The Commission is now directly responsible for auctioning and allocating permits and the NAP has been discontinued. This allows the Commission to reduce the number of allowances and to coordinate the inclusion of new sectors into the scheme. Among those permits

[26] "Union Registry," *European Commission*, last updated July 9, 2014, http://ec.europa.eu/clima/policies/ets/registry/index_en.htm.
[27] Mao et al., *Environomist*, 11.
[28] Braden Smith, "Transnational Carbon-Trading Standards: Improving the Transparency and Coordination of Post-Kyoto Carbon Trading Markets," *Pace Environmental Law Review* 30, no. 1 (Fall 2012): 368.
[29] Mao et al., *Environomist,* 12.

that are being approved, more are being auctioned rather than allocated in a gradual move toward a fully market-driven system.

With regard to MRV, the Commission continues to play an important role in harmonization and oversees the so-called compliance cycle. Operators are required to self-report using electronic templates and are verified by an accredited third party by March 31 every year; they must then submit the appropriate number of allowances by the following April 30.[30]

Overall, the system relies heavily on the presence of a central regulator that can ensure common standards, consistency over time, and credibility. This is especially the case when differences in national policies, budget allocations, and laws create regional discrepancies. As a consequence the Commission is becoming increasingly important, and its role is crucial in a market that is still developing. In addition to monitoring pricing, the standards it sets help bolster operators' confidence by ensuring low corruption and credible accreditation for third party verifiers. On the other hand, the lack of credible institutions has created some controversy in the approval of offsetting investments, or the credits earned by GHG emitters through the funding of projects in developing countries, particularly in the case of the Clean Development Mechanism (CDM).

Whatever its effectiveness in offsetting global GHG emissions, the CDM has been one of the main channels through which the EU has influenced China's emission reduction strategies. The CDM as established in the Kyoto protocol is aimed at promoting emission-reduction investments in developing countries. It was hoped that this mechanism would reduce overall emissions while introducing low-carbon technology and market-driven tools for environmental management in lower income countries.[31] There has also increasing scrutiny of these projects due to what has become known as the question of "additionality." This refers to a foreign company funding projects abroad to offset its domestic emissions

[30] "Monitoring, Reporting and Verification of EU ETS Emissions," *European Commission*, last updated July 9, 2014, http://ec.europa.eu/clima/policies/ets/monitoring/index_en.htm.

[31] Lucas Merrill Brown, Alex Hanafi, and Annie Petsonk, *The EU Emissions Trading System: Results and Lessons Learned* (Washington, DC: Environmental Defense Fund, 2012), 23. http://www.edf.org/climate/eu-emissions-trading-system-report.

that would have been carried out built regardless—undermining the very idea of a carbon emission-offsetting project. For example, the government of a given country may have already scheduled to build a renewable energy power plant, but by making it appear as though this project was designed for the CDM it can obtain external funding in this way. The problem with this is that if the CDM recipient country would have carried out the project anyway then the mechanism is not bringing any benefit—and EU companies are not truly offsetting their emissions, and there is no additional emission reduction taking place. Until 2013 China was the largest recipient of CDM projects, and the country where the issue of additionality was allegedly most common. As a consequence the EU in 2011 announced that starting in 2013 it would accept only offsets from projects carried out in least developed countries, making BRIC countries like China ineligible.[32]

The European firms funding the CDM projects established a market and local stakeholders with strong interests. The latter have become players in the Chinese ETS debate as they hoped to receive domestic funds to replace the European ones to fund their renewable projects after the latter are phased out.[33] It is no secret that the Commission hopes to link the EU ETS to other carbon markets to ensure the long-term sustainability of the project and make the program more effective.[34] An agreement was made with Australia to link its ETS with the European one by 2015, but the new government in Canberra repealed the legislation for carbon pricing, effectively dismantling its carbon markets, in July of this year.[35] The EU Climate Action Commissioner Connie Hedegaard was quick to express regret and clarify that the dialogue over linking the EU ETS

[32] Bo and Freeman, "Making Sense of Carbon Market Development in China," 198.
[33] Ibid.
[34] "International Carbon Market," *European Commission*, accessed March 21, 2014, http://ec.europa.eu/clima/policies/ets/linking/index_en.htm.
[35] Michelle Innis, Stanley Reed, and Coral Davenport, "Australia Tax Repeal Is Big Blow to Fight Against Emissions," *The New York Times*, July 17, 2014, http://www.nytimes.com/2014/07/18/business/international/australia-tax-repeal-is-big-blow-to-fight-against-emissions.html; Lenore Taylor, "Australia Kills off Carbon Tax," *The Guardian*, July 17, 2014, http://www.theguardian.com/environment/2014/jul/17/australia-kills-off-carbon-tax.

to Australia's would be discontinued.[36] Thus, China, a new player in this field, may have already become one of the EU ETS' best hopes for the future.

China's Emission Trading System

Since 2013, six pilot markets started operating in Guangzhou, Beijing, Shanghai, Hubei, Tianjin, and Shenzhen. Chongqing was the last market to start trading in July 2014, while the city of Hangzhou is also in the process of developing its own market.[37] The current Director General of Climate Change at the National Development and Reform Commission (NDRC), Su Wei, recently declared that emissions from heavy polluters such as Hebei, as well as Inner Mongolia and Shanxi, could be regulated through a carbon market in the near future, signaling the powerful agency's commitment to a nation-wide scheme.[38] There are already agreements among other administrative units that are considering developing their own ETS, including Hangzhou and Suzhou. Hebei, Inner Mongolia, Shanxi, and Shandong signed an agreement for future cooperation with Beijing in developing their ETS.[39] These trends point to a strategy of gradual expansion of individual systems rather than creating a top-down regulatory framework like the European one.[40]

The Chinese government's decision to launch several pilots at the same time in 2011 reflects the NDRC's aggressive push to find more effective, market-driven systems to manage pollution control, coupled with a well-established approach of testing policies at the

[36] "Connie Hedegaard: 'The EU Regrets the Repeal of Australia's Carbon Pricing Mechanism'," *European Commission*, July 17, 2014, http://ec.europa.eu/commission_2010-2014/hedegaard/headlines/news/2014-07-17_01_en.htm.
[37] "International Carbon Action Partnership (ICAP)," *International Carbon Action Partnership*, accessed May 2, 2014, https://icapcarbonaction.com.
[38] Kathy Chen and Stian Reklev, "China Says Could Add Big-Polluting Regions to Carbon Market," *Reuters*, May 1, 2014, http://www.reuters.com/article/2014/05/01/us-china-carbon-idUSKBN0DG0AG20140501.
[39] "Beijing Starts China's Third Carbon Exchange With First Trades," *Bloomberg*, November 29, 2013, http://www.bloomberg.com/news/2013-11-29/beijing-starts-china-s-third-carbon-exchange-with-first-trades.html.
[40] While it is true that Denmark and the UK already had voluntary markets in place, which did provide some inspiration for the EU ETS, they were not established through a EU-wide effort and did not have as large of an impact as the phase I in the development of institutions beyond those individual countries.

local level before implementing them at the national level.[41] China has been remarkably successful in creating regulatory frameworks ex facto, legitimizing practices that emerged at the local level (usually in response to broad directives at the central level). This is meant to mitigate political risk tied to establishing a nation-wide system, identify a successful model, and rectify problems on a smaller scale.

There are however some risks tied to the ground-up policy: a successful ETS requires a sophisticated bureaucratic apparatus and technology to guarantee market mechanisms, as well as administrative capacity to carry out MRV activities and enforce punishments and compliance. It is unclear if local governments can muster the resources needed for this kind of project. In the case of the EU, the Commission's directives function within a highly regulated legal framework aimed at standardizing national policies. In China, the NDRC will also be important as a harmonizing force in what remains a very fragmented system, ranging from the highly regulated and splintered energy and financial markets to decentralized decision-making by local governments. Allowing each pilot to experiment with very different rules will undoubtedly create problems in creating a single market. While the UK and Denmark already had voluntary ETS, which provided models for the EU ETS, the union-wide market itself was developed separately. It remains to be seen if the benefits of promoting creativity and testing will outweigh the problems in coordination that will emerge. A plan for a countrywide ETS is likely to be announced in the next five-year plan in 2016, and NDRC officials have made public statements setting 2018 as the launch date for a national ETS.[42]

It is still early to assess the successes and failures of the individual schemes, which are still in an experimental phase. All of the pilots' initial trading periods, however, are scheduled to end in 2015, which means that policymakers are already analyzing achievements and failures.[43] The main traits of the programs already reveal some of

[41] Bo and Freeman, "Making Sense of Carbon Market Development in China," 196-197.
[42] Gerard Wynn, "China Expects to Launch National Carbon Market in 2018-Govt Official," *RTCC*, May 30, 2014, http://www.rtcc.org/2014/05/30/china-expects-to-launch-national-carbon-market-in-2018/.
[43] "Diving into the Details: Planned and Operating Emissions Trading Schemes Around the World," in *Emissions Trading Worldwide ICAP Status Report 2014*, eds. Constanze Haug et al. (International Carbon Action Partnership, 2014), 47-53.

the issues that might emerge in the future. All pilots report emissions and comply with monitoring yearly, although allowances are issued annually in some systems and for the entire period in others.[44] So far CO2 is the only emission traded on any of the markets although government officials have indicated that, similarly to the EU ETS, more types of emissions may be included in the future.

All pilot markets in force at the time of writing monitor emissions by firm; this is different from the EU ETS, which targets single installations.[45] Because all Chinese pilots require compliance from firms that emit above a certain threshold, companies could potentially evade restrictions by breaking up into smaller legal entities. This would create an even larger number of polluters that can evade controls more easily due to their size. On the other hand, firm-level monitoring reduces the burden on local governments, whose resources dedicated to the ETS MRV are likely to be spread thin already. This practical consideration may have played a role in the decision to opt for firm-level monitoring.

The ETS pilots vary in terms of the industries and sectors covered. For example, Shanghai's ETS includes airlines and key service industries, Beijing and Tianjin require compliance from large public buildings, and Guangdong and Shenzhen are considering incorporating the transportation sectors.[46] This diversity in requirements may facilitate in the long run the extension of the ETS to a wider variety of players, something that the EU cap and trade program has struggled with—as proved by the controversies surrounding the expansion to include flight emissions.[47] This remains speculative, as it is still unclear what a nation-wide ETS would look like in China.

The expansion of the ETS to include a broader number of polluters is likely to take place at the local level before we even see a national scheme. Already, all ETS pilots require a broad number of

[44] Ibid.

[45] Mao et al., *Environomist*, 49.

[46] "Diving into the Details: Planned and Operating Emissions Trading Schemes Around the World," 47-53.

[47]Smith, "Transnational Carbon-Trading Standards," 334; Susanna Twidale and Barbara Lewis, "EU Compromise on Airline Emissions Faces Opposition," *Reuters*, March 13, 2014, http://uk.reuters.com/article/2014/03/13/eu-ets-aviation-idUKL6N-0MA2CM20140313.

firms in different sectors to report on their emissions on several types of GHG.[48] The Shenzhen leadership has already announced its plans to gradually expand the ETS to those sectors that are currently only being monitored.[49] In all cases, an expansion in the next couple of years would represent an ambitious goal; challenges include highly regulated markets that prevent energy companies from passing costs to consumers, low local government capacity to enforce compliance, and the trading of allowances between different markets that have non-harmonized standards.[50]

The Development and Reform Commissions (DRCs), the local branches of the NDRC, are the main institutions responsible for developing and implementing the ETS pilots. This ensures some level of coordination through the NDRC and the State Council. Even if the NDRC is not imposing standards at this time, it will be more able to do so by acting through the DRC rather than other, less powerful, local agencies.

The involvement of other actors in the design of the ETS, including universities, research centers, and exchange platforms could also produce a positive spillover effect in terms of developing human capital and institution building. This will be very important to establish a nation-wide system, especially given the need to strengthen overall technical capacity, MRV, and enforcement mechanisms. Some international institutions like the Asian Development Bank and the World Bank (through its Partnership for Market Readiness initiative) have already provided financial and technical support for the development of the ETS pilots and other low-carbon projects.[51] The EU-China Partnership on Climate Change, established in 2005, provides a framework for collaboration between the two regions and EU institutions have already been cooperating with China on

[48]Mao et al., *Environomist*, 6.

[49] China Emissions Exchange, "China's First ETS: A Brief Introduction to the Shenzhen Carbon Market," in *Emissions Trading Worldwide ICAP Status Report 2014*, eds. Constanze Haug et al. (International Carbon Action Partnership, 2014), 18, https://icapcarbonaction.com/news-archive/209-emissions-trading-worldwide-icap-status-report-2014.

[50] Bo and Freeman, "Making Sense of Carbon Market Development in China," 196-197.

[51] More information on the projects funded by the Asian Development Bank and the World Bank are available on the organizations' websites: "Advancing Shanghai Carbon Market through Emissions Trading Scheme," *Asian Development Bank*, 2012, http://www.adb.org/projects/46054-001/details; "China," *Partnership for Market Readiness*, 2013, https://www.thepmr.org/country/china-0.

developing more sustainable paths to urban development, particularly for the low-carbon city project in Tianjin.[52] Recent reports indicate that cooperation on GHG market development may soon increase; the Directorate-General for Development and Cooperation (EuropeAid) has hired an American consulting firm to help it specifically on this issue.[53]

Challenges

While it is difficult to evaluate the current challenges faced by policymakers implementing the pilots without qualitative and quantitative data, it is possible to assess them on the basis of the fundamental requirements for any ETS. For a carbon emission market to function there is a need for an emission cap, permits (allowances), a market platform for the trading of permits, enforcement, and monitoring mechanisms.[54] Without effective enforcement and monitoring, permits will loose value. Similarly, if there is no way to effectively trade the allowances, then the whole system is bound to fail. Finally, a cap is necessary to achieve an actual reduction of emissions. Overall, the experience of the EU ETS suggests that strong institutions with significant central coordination are important in establishing a cap and trade system that is sustainable in the medium-term. Given the current level of decentralization it will be interesting to see whether linking independent local schemes—the current trend in China—will lead to the development of an effective national cap.

Hard Cap

The advances made in developing institutions by the NDRC and

[52] "Joint EU-China Climate Statement: Chief Executive of EU Climate Initiative Responds," *Climate-Kic*, April 2, 2014, http://www.climate-kic.org/press-releases/joint-eu-china-climate-statement-chief-executive-of-eu-climate-initiative-responds/.
[53] "US Consultancy ICF Wins Bid to Help Plan China Carbon Market," *Reuters*, January 30, 2014, http://www.reuters.com/article/2014/01/30/china-carbon-idUSL3N0L412J20140130; "ICF International Wins €5 Million European Commission Contract to Support Development of Emissions Trading Systems in China," *ICF International*, January 29, 2014, http://www.icfi.com/news/2014/01/icf-wins-european-commission-contract.
[54] Bo and Freeman, "Making Sense of Carbon Market Development in China," 200-202.

the local DRCs over the past three years are remarkable, especially in developing mechanisms for monitoring and enforcing fines for non-compliant firms. However there is still much more to be done.[55] For example, at the moment only one pilot—Chongqing's—has established a hard cap (for the year 2013 it was set at 125 Mt CO2; annual reduction factor: 4.13%), and since the program only started in June 2014 it is too early to assess its effectiveness.[56] Other pilots are opting instead for carbon emissions per GDP reduction targets.[57] In recent statements, He Jiankun, chairman of China's Advisory Committee on Climate Change, announced that a hard cap on carbon emissions would be announced in the next five-year plan (2016-2020).[58] However, the modalities through which the cap would be implemented—for example if this would be announced along with a national system or for individual markets—have so far not been addressed.

The EU adopted a hard cap approach for its ETS from the beginning, even though during Phase I national governments allocated enough allowances to make the cap effectively null. Similarly, overestimating emissions for the 2008-2012 period also led to low carbon permit prices and to some plants holding excess allowances. The rules were, however, already in place and firms were aware of the inevitability of having to eventually have to reduce their emissions overall. Providing firms with good information that can help them make the right decisions to improve efficiency is key to ensuring the success of a carbon market. With the centralization of EU ETS permit auctioning and approval, now handled directly by the Commission, there has been a renewed push to control emissions through permit scarcity.

Monitoring and Enforcement

Monitoring and information are also important factors to the success

[55] Ibid., 196.
[56] "Chongqing Pilot System," *International Carbon Action Partnership*, accessed July 22, 2014, https://icapcarbonaction.com.
[57] Mao et al., *Environomist*, 10-28.
[58] Kathy Chen and Stian Reklev, "China Plans Absolute CO2 Cap from 2016," *Reuters*, March 6, 2014, http://uk.reuters.com/article/2014/06/03/china-climatechange-idUKT9N0NH02W20140603.

of an ETS; the Chinese government has a poor track record when it comes to enforcing environmental regulation, especially at the local level. If the ETS permits were revealed to be worthless due to the lack of effective monitoring and enforcing this would have serious repercussions on the credibility of the system as well as its effectiveness. This is already one of the major challenges in international trading, especially for middle income and developing countries; it has also been an issue for CDM projects.[59]

In the EU, credibility of the system depends on strict guidelines on how member states implement monitoring and reporting regulation and third party accreditation and verification. Emissions must be reported using the standard templates available on the Commission's website; the report then has to be verified by accredited third party agencies that comply with the guidelines and ISO standards.[60] Reports must be made available to the public to ensure transparency and promote oversight from civil society. Key to the success of the system is the credibility of the accreditation system of the third party verifiers, who ensure that firms are up to the Commission's standards. The reliance on external verification also allows the Commission to collect information without overextending its capacity. Without such mechanisms or the capacity to collect data on emissions and compliance, policymakers have a limited ability to assess the effectiveness of the program and the need to adjust permit prices.

The challenges the EU ETS faces in coordinating national allowance allocation and reporting are a poignant reminder that a system is only as effective as its implementation. Chinese policymakers are already wary of the danger posed by pressure on local governments to protect domestic industry. The cozy relationship between the business sector and local governments, especially in the case of State Owned Enterprises (SOEs), has been a big obstacle to enforcing environmental protection regulation in China in general. It would not be unthinkable for local governments to overestimate emissions and suppress the price of carbon in the short term to benefit local SOEs, following the EU pattern. The best solution is to ensure access to reliable information regarding emissions at the local level

[59] Smith, "Transnational Carbon-Trading Standards," 329-335.

[60] "Monitoring, Reporting and Verification of EU ETS Emissions."

to the authorities managing the ETS so that they can act upon it to adjust the number of permits and monitor emissions. In addition to ensuring effective monitoring, policymakers will have to consider establishing a unified register as they explore the possibility of links with other markets.

In creating a fully integrated national carbon market, the NDRC will also have to harmonize enforcement and monitoring practices, and ensure that a strong certification system for third-party verifiers is put into place. All the pilots allow between 5 percent to 10 percent or less of emissions to be offset through domestic carbon reduction projects certified through the China Certified Emission Reduction (CCER), which is the modeled after the CDM. There will be a need to ensure high national standards in the CCER projects as well to boost the credibility of the program.

Financial and Legal System

A whole other set of problems arises when looking at the underdeveloped financial markets in China. While the EU is composed of sovereign countries and has no real central executive power, its financial markets are both sophisticated and highly integrated. Property rights are also well protected and investors and firms have access to a broad array of credible legal instruments. China's highly controlled capital markets and still-transitioning legal system thus could pose an obstacle in establishing a resilient carbon permit exchange.[61] Opening the financial system and encouraging financial innovation as announced during the Third Plenum of the Eighteenth Central Committee in November 2013 will be key to the success of emission trading.[62]

Any changes to the financial and legal system would have to be centrally mandated, with the possible exception of the Shanghai Free Trade Zone (FTZ). This creates a problem for local governments that do not have the power to make this kind of reform on a

[61] Bo and Freeman, "Making Sense of Carbon Market Development in China," 202.
[62] "CCP Central Committee Resolution Concerning Some Major Issues in Comprehensively Deepening Reform," *China Copyright and Media*, trans. Rogier Creemers, November 15, 2013, http://chinacopyrightandmedia.wordpress.com/2013/11/15/ccp-central-committee-resolution-concerning-some-major-issues-in-comprehensively-deepening-reform/.

local level. Similarly, the central government would have to remove price caps to achieve deregulation in the energy market. This will be crucial for the success of those ETS pilots that include emissions from heating and electricity (for example, Beijing and Shanghai). If utility companies are to achieve higher efficiency in the long term they will need to be able to pass some of the rising costs posed by the cap and trade program to consumers.[63]

Without a nation-wide ETS, polluting firms may find it less costly to move to less populated and regulated areas in the western part of the country rather than invest in research and development to reduce emissions. Policies such as subsidies and tax-breaks that encourage companies to relocate to western provinces to promote economic growth in the less developed areas of the country have already been in place for over a decade. There is growing evidence that the government is now pursuing such policies with the further objective of reducing environmental pressure on the densely populated eastern cities, for example by establishing large coal bases in northwestern China that include coal mines, power plants and chemical plants.[64] Moving polluting industries away from urban centers would do nothing to reduce overall emissions or to improve efficiency, but it might slightly improve air quality in the short term for some cities. The lack of public plans for emissions trading schemes in western, poorer regions of the country could thus indicate a lack of commitment to cutting GHG emissions.

The Way Forward

One of main differences in the development of carbon markets in China and the EU observed so far has been the top-down approach of the latter versus the ground-up method of the former. While differences in the two political systems and institutional experience

[63] Bo and Freeman, "Making Sense of Carbon Market Development in China," 202.
[64] "China Outsourcing Smog to West Region Stirs Protest," *Bloomberg News*, March 7, 2014, http://www.bloomberg.com/news/2014-03-06/china-outsourcing-smog-to-west-region-stirs-protest.html; Richard Martin, "The Great Coal Migration," *Fortune* 170, no. 1 (July 21, 2014): 14–16; Edward Wong, "China's Energy Plans Will Worsen Climate Change, Greenpeace Says," *The New York Times*, July 23, 2014, http://www.nytimes.com/2014/07/24/world/asia/greenpeace-says-chinas-energy-plans-exacerbate-climate-change.html.

in conducting reform and consolidating power explain the relative advantages to a decentralized approach for creating ETSs in China, there are significant risks as well. In addition to the challenges posed by market reform, budgets, monitoring capacity, and standardization, there is also the question of what role the ETS will play in the broader environmental protection strategy.

Without a broader environmental policy framework, an ETS can only achieve limited results. The EU system is part of a set of tools aimed at placing incentives for firms and households to reduce carbon consumption and improve efficiency. Even so, there is an ongoing debate over the actual impact that the ETS has had on curbing emissions. A 2013 working paper published by the UK-based Centre for Climate Change Economics and Policy and The Grantham Research Institute on Climate Change and the Environment Several surveyed several studies and found that most agreed that the reduction in total capped emission due to the ETS (as opposed to other policies and the economic crisis) has been between 2 and 3 percent, or about 40–80 MtCO2.[65] Can China do better?

Enforcement mechanisms and technical expertise do not emerge from a vacuum. While Beijing, Tianjin, and Shanghai have run voluntary trade exchanges since 2008, there is still an institutional and human capital gap to be filled.[66] The National People's Congress adopted a new environmental protection law last April that offers a legal framework for pursuing more aggressive environmental policies and seems to demonstrate renewed commitment to ensuring energy independence.[67] There may still be, however, a learning curve facing China's policymakers and enforcement agencies, which will need a larger staff and budget as well as enhanced legal instruments. Incentive structures will also have to be put in place, for example by making officials accountable for the performance of the ETS, which could provide a tangible, measureable standard to ensure local governments' commitment. The central government has used the cadre evaluation system to prioritize policies promoting

[65] Laing et al., *Assessing the Effectiveness of the EU Emissions Trading System*, 25.
[66] Peter Sopher and Anthony Mansell, "China," in *The World's Carbon Markets: A Case Study Guide to Emissions Trading* (Washington, DC: Environmental Defense Fund and International Emission Trading Association, March 2014).
[67] "China's Legislature Adopts Revised Environmental Protection Law," *Xinhua*, April 24, 2014, http://news.xinhuanet.com/english/china/2014-04/24/c_133287570.htm.

GDP growth at the local level for decades. The top leadership has already signaled that it intends to reform it to include environmental targets as well. This will be important also because the DRCs rather than Environmental Protection Bureaus (EPBs) that answer to the Ministry of Environmental Protection (MEP), are managing the pilots,. The DRCs are generally considered more powerful than the EPBs and are more likely to have the resources and leverage to overcome the gaps in enforcement however they are responsible for economic development as well as the ETS.

The Chinese leadership appears to be invested in establishing an effective national ETS; this does not mean that all the ETS pilots must be successful. The European experience suggests that an initial pilot period is likely to be more useful in identifying design flaws and building political and institutional support than reducing emissions per se. Continued central government involvement, however, is important to ensure the emergence of a functioning ETS, leading to an actual reduction in emissions.

The EU has already provided significant technical and financial support to China's environmental programs. It should continue to do so, but with an eye to developing better relations between China, the EU, and its member states. An ETS would be a powerful way to mobilize China's green investment capability—something that could have a massive impact globally. Given the EU and several of its member states' expertise in this field, there is a great potential for mutually beneficial collaboration. Developing common standards for future trading and third party monitoring could be a possible joint research topic for the DRCs and the Commission. It could also provide a basis for dialogue ahead of the UNFCCC Paris conference next year, especially given the history of mistrust between European countries and China in climate change diplomacy over the past few years. Similarly, building on the experience with previous CDM projects, private investors could be encouraged to work with the Chinese local governments to develop new environmentally friendly infrastructure.

In conclusion, the future of the Chinese ETS pilots remains hard to read. The schemes are still in what can be defined as a "learning-by-doing" phase, comparable to the EU ETS's Phase I. To

avoid some of the pitfalls experienced by the EU system, Chinese policymakers will have to ensure that good monitoring and verification systems are in place. These may hinge on the credibility of third party accreditation. More central coordination and comprehensive financial, legal, and pricing reform will also be needed at some point in order for the schemes to succeed. It is likely that in this process, pressure on the central leadership to demonstrate progress on air pollution and climate change will be crucial. It will be the central leadership's responsibility to ensure that economic, legal and administrative reforms continue to support efforts at the local and national level to establish successful carbon markets throughout the country.