

# **Reforming the Power Sector: How Electricity Sector Reforms Will Impact China's National Emissions Trading Scheme**

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May 10, 2016

## List of Abbreviations

CASS	Chinese Academy of Social Science
CBEEEX	China Beijing Environmental Exchange
DCC	Department of Climate Change
DOE	Department of Energy
DRCs	Development and Reform Commissions
ERI	Energy Research Institute
ETS	Emissions Trading Scheme
FYP	Five-Year Plan
MEP	Ministry of Environmental Protection
MRV	Monitoring, Reporting, and Verification
NCSC	National Center for Climate Change Strategy and International Cooperation
NDRC	National Development and Reform Commission
NEA	National Energy Administration
NEC	National Energy Commission
SASAC	State-owned Assets Supervision and Administration Commission
SERC	State Energy Regulatory Commission
SGCC	State Grid Corporation of China
SOE	State-owned Enterprise
T&D	Transmission and Distribution

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## **I. Executive Summary**

Decades of reliance on coal-generated power coupled with unprecedented economic growth have transformed China into the world's largest emitter of greenhouse gases. Set to be formally launched in 2017, China's national emissions trading scheme (ETS) will be larger in scale and cover more carbon-emitting entities than any current ETS. If designed and implemented well, it has the potential to play an integral role in reducing China's overall carbon emissions.

China's power sector, which accounts for nearly half of the country's carbon dioxide (CO<sub>2</sub>) emissions, will have considerable impact on the design, implementation, and performance of the national ETS. Of the many challenges that Chinese policymakers must overcome to implement an effective national ETS for the power sector, reforming electricity pricing and equal shares dispatch are the most pressing. If China implements a national ETS without adequate reforms to both, the country risks having to meet its climate goals at a greater cost through less-efficient, top-down policies. Given the need for these reforms, our analysis focuses on existing challenges that impede electricity pricing and dispatch reform.

This report first maps out China's ETS and power sector stakeholders. Through interviews with ETS and power sector stakeholders, we clarify the roles of key organizations involved in developing and implementing China's national ETS and power sector policies. Second, the report examines China's power sector, analyzes current electricity pricing and dispatch policies as well as the potential for future reforms. Through research into current electricity pricing and dispatch policies and practice as well as interviews with government and industry stakeholders, we identify short-term and long-term power sector reforms that Chinese policymakers should prioritize.

We conclude that China's current electricity pricing and dispatch policies will constrain the ability of the national ETS to change the behavior of electricity producers and consumers, and as a result, undercut its cost-effectiveness. Chinese leaders' concerns that a liberalized electricity market will lead to unstable prices indicate that China will not establish a competitive market in the short-term. To circumvent the lack of price pass-through, China's national ETS should cover indirect emissions. In the long-term, China should move toward a fully competitive electricity market.

China's equal shares dispatch model played an important role in meeting rapid electricity demand growth in the 1980s and 90s by incentivizing investment in generation. An unexpected consequence of this model has been the proliferation of small, inefficient, and dirty generating units that the central government cannot easily decommission due to stranded assets concerns and provincial dispatch independence. A well-designed national ETS with a reformed pricing methodology will have limited affect on the country's emissions if dispatch is not also reformed. We recommend policymakers adopt two-part pricing that would cover the legacy costs of dirty plants through a capacity tariff, enabling system operators to dispatch cleaner energy that would be compensated through the second stream, a generation tariff.

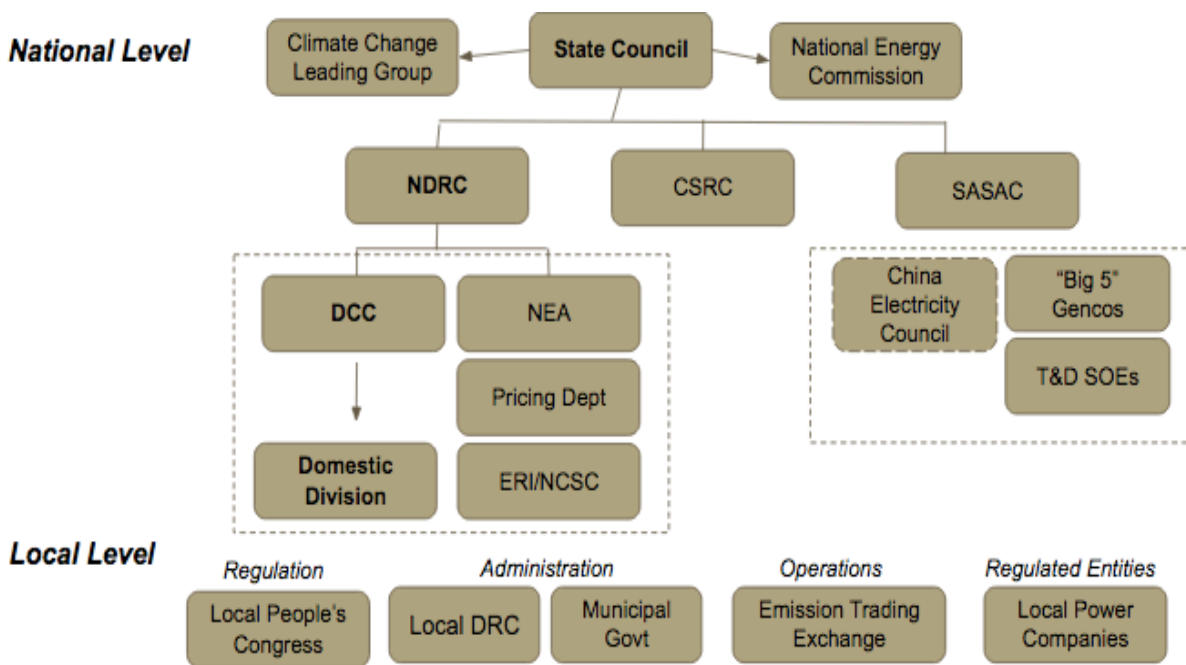
The report is structured as follows: **Section 2** maps out China's ETS and power sector stakeholders, highlighting those with the greatest influence over policymaking. **Section 3** provides an overview of China's seven pilot emissions trading schemes, offers a preliminary assessment of the pilots' performance, and identifies key challenges for the national ETS. **Section 4** examines current electricity pricing and dispatch policies and highlights key challenges that policymakers will have to overcome in order to implement an effective national

ETS. **Section 5** summarizes our research findings and policy recommendations for Chinese policymakers.

## II. Mapping China’s ETS and Power Sector Stakeholders

Though ongoing power sector reforms will have an outsized impact on the national ETS, Chinese policymakers largely have not linked the two issues, and as a result, stakeholders on each side coordinate infrequently.<sup>1</sup> It is important to note that power sector decisionmakers have more institutional clout than ETS decisionmakers. While power sector decisionmakers are able to influence ETS policymaking, the national ETS ranks low on their list of priorities.<sup>2</sup> ETS stakeholders, on the other hand, have little sway over power sector reforms.

**Figure 1: ETS and Power Sector Stakeholders**



### a. ETS Stakeholders: Institutional Arrangements and Dynamics

<sup>1</sup> CBEEEX official, interview, March 14, 2016; NDRC official, interview, March 15, 2016

<sup>2</sup> ERI researcher, interview, March 15, 2016

The State Council, China's highest governing body, manages the development of the Five-Year Plan (FYP), a blueprint for the country's social and economic development. FYPs are important for highlighting government priorities and setting the direction for key policies, including climate and energy policies. The 12<sup>th</sup> FYP (2011-2015) was the first FYP to address climate change as well as the first official government document to identify emissions trading as one of the principal tools for achieving national energy and carbon intensity goals.<sup>3</sup>

The State Council's National Leading Group on Climate Change, Energy Conservation and Emissions Reduction, an ad hoc supra-ministerial coordinating and consulting body, provides top-level planning and guidance on climate change. Premier Li Keqiang leads this influential body, and its membership includes the heads of all major agencies. The group meets infrequently, but provides a forum for top decisionmakers to exchange views and build consensus on climate policy.<sup>4</sup>

The National Development and Reform Commission (NDRC), China's top economic planning agency and the most powerful administrative body in the central government, is responsible for climate change policy. NDRC plays an important coordination role among ministries and its departments cover functional responsibilities that overlap with those of other government bodies.<sup>5</sup> Within NDRC, the Department of Climate Change (DCC) owns the climate portfolio. Established in 2008, DCC has approximately 30 employees within five divisions; it

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<sup>3</sup> Ranping Song, Wenjuan Dong, Jingjing Zhu, Xiaofan Zhao, and Yufei Wang, "Assessing Implementation of China's Climate Policies in the 12th 5-Year Period," World Resources Institutes Working Paper, September 2015, 27, [http://www.wri.org/sites/default/files/15\\_WP\\_China\\_Climate\\_Policies\\_final-v2\\_0.pdf](http://www.wri.org/sites/default/files/15_WP_China_Climate_Policies_final-v2_0.pdf)

<sup>4</sup> Craig Hart, Zhu Jiayan, and Ying Jiahui, "Mapping China's Climate Policy Formation Process," November 2015, 15, <http://www.chinacarbon.info/wp-content/uploads/2015/11/Mapping-Chinas-Climate-Policy-Formation-Process.pdf>

<sup>5</sup> NDRC department heads ("vice chairman") hold ministerial rank and the chairman of the NDRC "is [thus] half a rank above the ministers of China's other ministries." (Hart et al, "Mapping China's Climate Policy Formation Process," 2015, 13.)

analyzes the impacts of climate change, formulates policies in response to climate change, and takes the lead in international climate negotiations.<sup>6</sup>

DCC's Domestic Policies and Compliance Division, a team of three, oversees the ETS pilots and the development of the national ETS.<sup>7</sup> Interviewees stressed that the Domestic Division is greatly understaffed and under-resourced for the role. Moreover, DCC does not wield a lot of influence within NDRC despite the importance NDRC leadership has accorded the ETS. Other departments can be expected to play important roles in the implementation of a national ETS. Chief among them is the powerful Department of Pricing, which controls pricing for a significant portion of the economy.<sup>8</sup> In addition, DCC often coordinates with the Department of Resource Conservation and Environmental Protection, which handles energy conservation and emission reduction issues.<sup>9</sup>

To address its capacity constraints in the short term, DCC has drawn upon semi-governmental and university experts for support, including experts from the Energy Research Institute, National Center for Climate Change Strategy and International Cooperation, and Tsinghua University.<sup>10</sup> DCC recently set up the National Carbon Trading Advancement Center to coordinate ETS implementation with the local-level counterparts of NDRC, local Development and Reform Commissions (DRCs). The office will also allow DCC to draw upon

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<sup>6</sup> NDRC, "Department of Climate Change," Accessed March 4, 2016, [http://en.ndrc.gov.cn/mfod/200812/t20081218\\_252201.html](http://en.ndrc.gov.cn/mfod/200812/t20081218_252201.html)

<sup>7</sup> NDRC official, interview, March 15, 2016

<sup>8</sup> Wen Wang, "Overview of Climate Change Policies and Prospects for Carbon Markets in China," CDC Climat Information and Debates Series, no. 18, July 2012, 30-31, <http://www.chaireeconomieduclimat.org/wp-content/uploads/2015/06/12-07-10-Cahier-ID-n18-Wang.pdf>

<sup>9</sup> NDRC official, interview, March 15, 2016

<sup>10</sup> Of these players, NCSC, a high-level think tank under NDRC is particularly influential. NCSC assists NDRC with crafting policies and positions for international climate negotiations, and provide technical and professional support for the establishment of the national ETS. It has expanded rapidly since its founding in 2012 and its personnel are drawn heavily from NDRC's Energy Research Institute and China's top research universities. (ERI researcher, interview, March 15, 2016; NDRC official, interview, March 15, 2016; Jost Wubbeke, "China's Climate Change Expert Community—principles, mechanisms, and influence," *Journal of Contemporary China* 22, no. 82 (2013): 717-718.)



the expertise of local DRC staff from the ETS pilots, which can further alleviate DCC's capacity constraints.<sup>11</sup>

Beyond NDRC, the State-owned Assets Supervision and Administration Commission (SASAC)—a special commission under the State Council that manages the country's largest SOEs—will play a key role in the national ETS. SOEs are major sources of carbon emissions and will be included in the national ETS.<sup>12</sup> However, as SOEs outrank local DRCs, it is unclear whether local DRCs will have the regulatory authority to punish SOEs for not complying with carbon trading rules. Resistance from SOEs could threaten a national ETS, in which case SASAC will need to ensure their cooperation.

Emission exchanges are important in any carbon market, bringing together buyers and sellers of emissions credits and providing trading services. The local exchanges have played an influential role in the design process of the pilots, in some cases leading the formulation of local ETS proposals.<sup>13</sup> NDRC still needs to clarify the exact role and responsibilities of the exchanges, but it is expected that the pilot exchanges will be retained and opened up to companies across the country.<sup>14</sup> China's securities and banking regulators—respectively, China Securities Regulatory Commission and the China Banking Regulatory Commission—are expected to figure prominently in the oversight of the financial products and trading practices of the exchanges.<sup>15</sup>

The Ministry of Environmental Protection (MEP), the country's national environmental policy and enforcement body, has not traditionally been involved in climate policy, as its

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<sup>11</sup> Chinese carbon trading expert, interview, March 17, 2016

<sup>12</sup> Jeff Swartz, "A User Guide to Emissions Trading in China," IETA, September 2013, 18, [http://www.ieta.org/Resources/Reports/ieta\\_emissionstrading\\_china\\_usersguide\\_sept2013\\_draft\\_a4\\_sf.pdf](http://www.ieta.org/Resources/Reports/ieta_emissionstrading_china_usersguide_sept2013_draft_a4_sf.pdf)

<sup>13</sup> Wang, "Overview of Climate Change Policies and Prospects for Carbon Markets in China," 2012, 20

<sup>14</sup> NDRC official, interview, March 15, 2016

<sup>15</sup> Christopher Tung, "Reflections on the Chinese Carbon Market," in *Research Handbook on Climate Change Mitigation Law*, ed. Geert Van Calster, Wim Vandenberghe, and Leonie Reins (Elgar Publishing, Inc., 2015), 94.

mandate is to prevent and control pollution.<sup>16</sup> But as fighting air pollution becomes a higher priority for the central government, it will become increasingly difficult to exclude MEP from climate change policymaking.<sup>17</sup> While MEP will not be directly involved in ETS implementation, it will likely be involved in coordinating with NDRC on relevant environmental policies.<sup>18</sup>

At the subnational level, local DRCs will be responsible for ETS implementation. During the pilot phase, NDRC took a largely hands-off approach to allow the pilots to develop in their own way. In the pilots, local DRCs were responsible for ETS design and drafting implementation plans for their administrative jurisdiction. NDRC and local DRCs periodically hold workshops to share best practices from the pilots.<sup>19</sup>

Given the significant number of players involved, coordination—within NDRC, between NDRC and other national government bodies, and between the national and subnational levels—will be a key challenge for the successful implementation of a national ETS.

### ***b. Power Sector: Institutional Arrangements and Dynamics***

There is no Chinese ministerial equivalent to the United States Department of Energy (DOE) in size or scope. Instead, responsibilities for governing the national energy system are spread among disparate stakeholders including the State Council, National Energy Commission, various departments within NDRC with different mandates, and even provincial governments. This decentralized structure can make it difficult to enact clear regulations in an efficient manner.<sup>20</sup> Despite the wide breadth of stakeholders, fewer than 1,000 people across the central government are employed to work on energy issues compared to roughly 13,000 federal

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<sup>16</sup> CO<sub>2</sub> is not classified as a pollutant in China.

<sup>17</sup> Williams, “China’s Climate Change Policies: Actors and Drivers,” Lowy Institute, July 2014

<sup>18</sup> ERI researcher, interview, March 15, 2016; NDRC official, interview, March 15, 2016; Chinese carbon trading expert, interview, March 17, 2016

<sup>19</sup> NDRC official, interview, March 15, 2016; Huw Slater (China Carbon Forum), interview, March 16, 2016

<sup>20</sup> Erica S. Downs, “China’s ‘New’ Energy Administration,” 42.

employees in the U.S. DOE, at least 4,000 of which work on energy issues directly.<sup>21</sup> Consequently, adequate human capital can be lacking given the sheer size of China's energy sector, giving SOEs an opportunity to fill capacity gaps and shape how they are governed.

The single most important player in China's power sector is the NDRC, the state economic planner with the authority to set electricity tariffs through the Department of Pricing.<sup>22</sup> Another body established in 2008, the National Energy Administration (NEA), plays a guiding role through its mandate to draft energy policy and develop strategic plans for NDRC and the State Council to adopt.<sup>23</sup> However, NDRC's overall goal of economic development can be at odds with NEA's more narrow scope, and its pricing authority limits NEA's ability to enact its own initiatives.<sup>24</sup>

Playing a policy development and coordination role, the National Energy Commission (NEC) was formed in 2010 largely in response to NEA's inability to carry out its key functions. With 21 members from high-ranking ministries, including the NDRC, that guard their role in energy governance from NEA influence, the NEC attempts to bring all stakeholders to the table under the leadership of premier Li Keqiang.<sup>25</sup> However, NDRC and influential energy SOEs have played an active role in minimizing the amount of power any new government body might have.<sup>26</sup> Indeed, with executives in politically powerful places, industry expertise, and extensive financial resources, SOEs can be more influential than government bodies in developing China's energy policy.<sup>27</sup>

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<sup>21</sup> Edward A. Cunningham, "The State and the Firm: China's Energy Governance in Context," 9, <http://ash.harvard.edu/files/chinas-energy-working-paper.pdf>; "Agency Report," Department of Energy, <http://bestplacetowork.org/BPTW/rankings/detail/DN00>; Downs, 44.

<sup>22</sup> Downs, 42, 44.

<sup>23</sup> Gert Brunekreeft et al, *Regulatory Pathways for Smart Grid Development in China* (Springer Vieweg, 2015), 32.

<sup>24</sup> *Ibid*, 33.

<sup>25</sup> "China Unveils New National Energy Commission," January 2010, <http://china-wire.org/?p=4704>

<sup>26</sup> Downs, 45.

<sup>27</sup> *Ibid*, 42.

The most significant electricity SOEs were created in 2002 when China broke up its State Power Corporation. A single government entity that had provided 46% of the country's generation and 90% of its transmission became five power generation companies and two transmission and distribution (T&D) companies, but all remained owned by the state.<sup>28</sup> The "big five", China Huaneng Group, China Datang Corporation, China Guodian Corporation, China Huadian Corporation, and China Power Investment Corporation still generate roughly half of China's electricity.<sup>29</sup> While not all power generation companies outside the "big five" are state-owned, the state (often in the form of the provincial government) has a majority stake in 90 percent of the more than 4,300 firms with capacity over 6 GW.<sup>30</sup>

The two T&D SOEs are State Grid Corporation of China (SGCC), and China Southern Power Grid, which together serve the entire Chinese market.<sup>31</sup> SGCC is the largest utility and 7<sup>th</sup> largest company in the world, with operations covering 88% of the country and 83 percent of its customers.<sup>32</sup> Although the "big five" and T&D firms are under the supervision of SASAC, they nevertheless possess considerable lobbying power; for instance, in 2008 they blocked the creation of a Ministry of Energy.<sup>33</sup> Further illustrating this influence is the fact that the State Electricity Regulatory Commission (SERC), equivalent in theory to the U.S. Federal Energy Regulatory Commission, had its headquarters on the grounds of SGCC and was considered "subservient" to State Grid.<sup>34</sup> In 2013 it was dissolved and its responsibilities were taken over by

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<sup>28</sup> The Regulatory Assistance Project, "China's Power Sector: a Backgrounder for International Regulators and Policy Advisors," February 2008, 3-4.

<sup>29</sup> Brunekreeft et al, 34.

<sup>30</sup> Lack Perkowski, "Cracking China's Power Sector," January 2011, <http://www.forbes.com/sites/jackperkowski/2011/01/12/cracking-chinas-power-sector/#791029a04fb0>

<sup>31</sup> Brunekreeft et al, 34.

<sup>32</sup> Ibid.

<sup>33</sup> Downs, 45; Brunekreeft et al, 34.

<sup>34</sup> David Stanway and Benjamin Kang Kim, "Exclusive: China Mulls New Energy "Super-ministry," January 2012, <http://www.reuters.com/article/us-china-energy-ministry-idUSTRE8050AE20120106>; Russel Pittman and Vanessa Yanhua Zhang, "Electricity Restructuring in China: the Elusive Quest for Competition," April 2008, <https://www.justice.gov/atr/electricity-restructuring-china-elusive-quest-competition#img1>

the NEA to eliminate overlap, but also in recognition of its weaknesses.<sup>35</sup> It, like the NEA itself, lacked key tools that NDRC guards, rendering it unable to fulfill its mandate.<sup>36</sup>

Provincial governments are also integral players in China's power sector. The big five are owned by the central government, but roughly half of China's power generation companies are under the jurisdiction of local governments who have played a dynamic role in electricity "planning, financing, and operation since the mid-1980s."<sup>37</sup> Outside Beijing, priorities and incentives can differ from those of the central government, and provincial independence has contributed to a "regulatory impasse" that can stymie the implementation of national laws.<sup>38</sup>

In summary, China's power sector is dominated by the NDRC and SOEs at the central level. There is no single body that reconciles conflicts of interest, nor is it likely that one will be created in the near future. The central government's energy policy agenda differs from that of provincial governments, and implementation of any national electricity policy at the provincial level can be difficult given the independence of local governments.

### **III. Examining China's Experience with Emissions Trading**

#### ***a. China's ETS Pilots: Experience and Evolution***

China has relied heavily on command-and-control measures to control its carbon emissions, achieving reductions in energy intensity largely through energy efficiency measures and shutting down inefficient power plants and factories. The 11<sup>th</sup> Five Year Plan period (2006-2010), however, underscored the inadequacy and poor cost effectiveness of relying on these

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<sup>35</sup> "China's NEA Gains New Regulatory Powers," Kreab Gavin Anderson. <http://www.kreab.com/wp-content/uploads/sites/17/2013/07/National-Energy-Administration.pdf>

<sup>36</sup> Downs, 44.

<sup>37</sup> James H. Williams and Fredrich Kahrl, "Electricity Reform and Sustainable Development in China," *Environmental Research Letters* 3, no. 4 (December 2008), <http://iopscience.iop.org/article/10.1088/1748-9326/3/4/044009/fulltext/>

<sup>38</sup> Ibid.

blunt measures.<sup>39</sup> With low-hanging fruits already plucked, Chinese policymakers began to recognize that additional, aggressive policies were necessary to ensure continued energy and carbon intensity reduction, and started placing more emphasis on market-based mechanisms.

In weighing different carbon pricing approaches, the Chinese government considered both carbon tax and carbon trading. Carbon trading won out, in part, due to a bureaucratic tug-of-war between competing ministries—the powerful NDRC favored carbon trading while the Ministry of Finance preferred carbon taxes—and because China had prior experience with carbon markets via the Clean Development Mechanism and voluntary emissions trading during the 11<sup>th</sup> FYP period.<sup>40</sup> China currently does not administer any carbon tax, although policymakers have not ruled out the possibility of administering a carbon tax in tandem with a national ETS in the future.

Chinese policymaking follows the principle of “adaptive governance,” in which the government conducts regional experiments with policy instruments and tools before nationwide implementation.<sup>41</sup> China’s approach to ETS has followed this process, building up from city and province-level pilots. Launched between 2013 and 2014, the ETS pilots cover five cities and two provinces, accounting for 18 percent of China’s population and 28 percent of its national GDP.<sup>42</sup> NDRC selected the pilot sites, which cover both strategic economic hubs and traditional industrial bases, to reflect regional diversity in terms of economic activity and development, as

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<sup>39</sup> While China came close to meeting its 11<sup>th</sup> Five Year Plan (2006-2010) energy intensity targets, progress came with great difficulties: Toward the end of 2010, some local governments resorted to deliberate power outages as part of last-ditch efforts to meet their targets. (Guoyi Han, Marie Olsson, Karl Hallding, and David Lunsford, “China’s Carbon Emission Trading: An Overview of Current Development,” *FORES Study*, 2012, 4)

<sup>40</sup> Lawrence MacDonald and Jing Cao, “The Sudden Rise of Carbon Taxes, 2010-2030,” Center for Global Development, October 2014, 23.

<sup>41</sup> Sebastian Heilmann and Elizabeth J. Perry, “Embracing Uncertainty: Guerrilla Policy Style and Adaptive Governance in China,” in *Mao’s Invisible Hand: The Political Foundations of Adaptive Governance* (Harvard University Press, 2011), 8.

<sup>42</sup> World Bank, “China,” Partnership for Market Readiness, 2016, <https://www.thepmr.org/country/china-0>

well as their capacity to pay for the high costs associated with setting up an ETS.<sup>43</sup> Cumulatively, the pilots cover 7 percent of China's total emissions—just over one billion tons of CO<sub>2</sub>.<sup>44</sup>

NDRC regulations issued in 2012 required each pilot to establish an emissions cap, an allowance allocation methodology, an emissions trading registry, and a monitoring, reporting and verification (MRV) system.<sup>45</sup> Beyond these standards, provincial and municipal governments were given significant leeway to design their pilot implementation plans; as a result, ETS design varies across the pilots, reflecting diverse conditions and priorities in the localities where they are implemented.

Consistent with China's domestic climate policy approach, the ETS pilots focus on CO<sub>2</sub>, the major energy-related greenhouse gas, and cover both direct and indirect emissions.<sup>46</sup> Most pilots have an absolute cap on emission, and caps are derived from China's target of reducing national carbon intensity by 40-45 percent by 2020.<sup>47</sup> All pilots cover the power sector and a wide range of industries, including: heat, iron and steel, nonferrous metals, petrochemicals and chemicals, paper, glass and cement. However, pilots vary in their sectoral coverage—Shenzhen covers road transport, for example, while Shanghai has announced that it will become the world's first carbon market to include shipping.<sup>48</sup>

Pilots allocate emission permits for free based on historical emissions (an approach known as grandfathering), except for Guangdong and Hubei, which also use auctioning as a

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<sup>43</sup> Ying Shen, "Moving Steadily or Great Leap Forward? The Emerging Carbon Market in China," *Deakin Law Review*, 18 no. 2 (2013): 241.

<sup>44</sup> Da Zhang et al. "Emissions trading in China: Progress and prospects," *Energy Policy*, 75 (December 2014): 11.

<sup>45</sup> CDC Climat Research & IETA, "China: An Emissions Trading Case Study," March 2015, 4.

<sup>46</sup> Da Zhang et al. "Emissions trading in China: Progress and prospects," *Energy Policy*, 75 (December 2014): 12.

<sup>47</sup> World Bank, *State and Trends of Carbon Pricing 2014* (Washington, DC: World Bank, 2014), 66.

<sup>48</sup> Stian Reklev, "Shanghai expands carbon market, adds local shipping," Carbon Pulse, February 22, 2016, <http://carbon-pulse.com/15981>; Ranping Song, "Emissions Trading in China: First Reports from the Field," World Resources Institute, January 24, 2014.

complementary allocation method.<sup>49</sup> The preference for free allocation stems from the fact that it reduces the burden of compliance for enterprises and thus limits the carbon market's impact on economic development, which remains a priority for local governments.<sup>50</sup> Additionally, Chinese policymakers appear to have studied the EU ETS's experiences closely: To mitigate overallocation and price volatility, all pilots include price stabilization measures, and certain pilots also allow ex-post adjustments to allocated allowances.<sup>51</sup>

Domestic offsets—known as Chinese Certified Emissions Reductions (CCERs)—are included in the seven pilots as another cost containment mechanism. Offsets allow companies to access lower-cost emission reductions opportunities outside sectors and regions not covered by an ETS. Offsets are priced lower than allowances, so companies can use them to lower compliance costs. All of the pilots have restrictions on how CCERs can be used, such as having a maximum cap on offset use, restrictions on offset origin, and restrictions on offset project type.<sup>52</sup>

Each pilot has an electronic registry. In many cases, pilots partnered with existing registries to quickly develop the necessary trading infrastructure. Out of concern for market risks, pilots currently limit trading to spot transactions—financial derivatives, such as futures, are banned.<sup>53</sup> The pilots have developed emissions monitoring, reporting, and verification (MRV) rules as well as accreditation management processes for third-party verification service providers;

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<sup>49</sup> Kathy Chen and Stian Reklef, "China's Hubei plans province's first carbon auction next month," Reuters, February 11, 2014.

<sup>50</sup> Da Zhang et al. "Emissions trading in China," 12.

<sup>51</sup> Carbon Market Watch, "Towards a Global Carbon Market: Prospects for Linking the EU ETS to other Carbon Markets," *Carbon Market Watch Report*, May 2015, 14.

<sup>52</sup> Jeff Swartz, "China's National Emissions Trading Scheme: Implications for Carbon Markets and Trade," ICTSD Issue Paper No. 6, March 2016, 15-16, [http://www.ictsd.org/sites/default/files/research/Chinas\\_National\\_ETS\\_Implications\\_for\\_Carbon\\_Markets\\_and\\_Trade\\_ICTSD\\_March2016\\_Jeff\\_Swartz.pdf](http://www.ictsd.org/sites/default/files/research/Chinas_National_ETS_Implications_for_Carbon_Markets_and_Trade_ICTSD_March2016_Jeff_Swartz.pdf)

<sup>53</sup> In February, Guangdong's ETS pilot became the first in China to release rules for forward trading. However, "the rules probably come too late to impact trade in the Guangdong market, as most traders interested in dealing in forward contracts are shifting their focus towards the national ETS, which is due to begin in 2017." (Stian Reklef, Guangdong becomes China's first carbon market to green-light OTC forward trading," *Carbon Pulse*, February 3, 2016, <http://carbon-pulse.com/15075/>; Da Zhang et al. "Emissions trading in China," 13)



however, since each pilot developed its rules independently, this raises concerns about the comparability of reported results across pilots.<sup>54</sup>

The pilots have also developed penalties for non-compliance of varying strength. Shenzhen and Hubei have the stiffest penalties—non-compliant companies face a maximum fine of \$32,800 and \$24,600 respectively and a reduced allowance for the following year. Tianjin and Chongqing have the weakest penalties; noncompliant enterprises are not fined but subject to softer measures, such as public shaming and being disqualified from receiving preferential financial support and subsidies for emissions reduction and energy saving projects.<sup>55</sup>

Beyond the seven pilots, several cities (such as Hangzhou and Qingdao) and provinces (such as Gansu and Anhui) have also begun to plan for their own emissions trading systems. However, it remains unclear what role these additional pilots will play in the lead up to the national ETS.<sup>56</sup>

#### *Preliminary Analysis of Performance and Effectiveness*

While it is premature to make a full assessment of China's seven pilot schemes—the final two, Hubei and Chongqing, only began trading in April 2014 and June 2014 respectively—their experiences demonstrate the possibility of carbon trading in the Chinese context. In a very short amount of time, the pilots have gone through all the necessary steps to become operational.<sup>57</sup>

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<sup>54</sup> Ranping Song et al, "Assessing Implementation of China's Climate Policies in the 12<sup>th</sup> 5-Year Period," World Resources Institute Working Paper, September 2015, 32,

[http://www.wri.org/sites/default/files/15\\_WP\\_China\\_Climate\\_Policies\\_final-v2\\_0.pdf](http://www.wri.org/sites/default/files/15_WP_China_Climate_Policies_final-v2_0.pdf)

<sup>55</sup> Song et al, "Assessing Implementation of China's Climate Policies in the 12<sup>th</sup> 5-Year Period," 2015, 31.

<sup>56</sup> CDC Climat Research & IETA, "China: An Emissions Trading Case Study," March 2015, 3, [https://ieta.memberclicks.net/assets/CaseStudy2015/china-emissions-trading-case-study\\_cdc\\_climat\\_ieta\\_march\\_2015.pdf](https://ieta.memberclicks.net/assets/CaseStudy2015/china-emissions-trading-case-study_cdc_climat_ieta_march_2015.pdf)

<sup>57</sup> China set up its pilots in less than two years, in contrast to the more than six years developed economies have spent to set up their carbon markets. (South Pole Group/IFC, *Environomist China Carbon Market Research Report 2016*, 2016, 23, [http://carbon-pulse.com/wp-content/uploads/2016/02/2016-Environomist-China-Carbon-Market-Research-Report\\_En\\_20160217\\_CW.pdf](http://carbon-pulse.com/wp-content/uploads/2016/02/2016-Environomist-China-Carbon-Market-Research-Report_En_20160217_CW.pdf))

Still, market liquidity in the pilots has been low, limiting their mitigation impact.<sup>58</sup> Trading volumes have been extremely modest relative to the size of the markets. As of December 31, 2015, the secondary carbon market for the seven pilots has accumulated a trading volume of 49.8 million tons, valued at \$232.3 million, with an average price of \$4.66/ton.<sup>59</sup> The seven pilots put a combined cap on 1.3 gigatons of CO<sub>2</sub> equivalent, so the total trading volume is about 4 percent of the total cap.<sup>60</sup> Low transaction volumes and market liquidity can be explained by several factors, including: the pilots' small geographic scope, which limits market size (and thus, liquidity); a reliance on free allocation, which results in over-allocation of allowances; and the prohibition on futures, which hinders the formation of liquidity in the secondary market.<sup>61</sup>

Trading across the pilots has been most active right before the close of the compliance period, suggesting that trading is driven by compliance.<sup>62</sup> 2015 was the first year all seven pilots completed their annual compliance cycle. Companies are complying with the schemes; compliance rates have been very high across the board and have even increased in 2015, ranging from 99.1 percent to 100 percent for the five pilots that recorded compliance rates for 2014 and 2015.<sup>63</sup>

Allowance prices in 2015 were generally lower than 2014.<sup>64</sup> There are also gaps in allowance prices between the pilot schemes.<sup>65</sup> Many observers have ascribed low carbon prices

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<sup>58</sup> Song et al, "Assessing Implementation of China's Climate Policies in the 12<sup>th</sup> 5-Year Period," WRI Working Paper, September 2015, 29.

<sup>59</sup> Partnership for Market Readiness, "China Carbon Market Monitor," World Bank, February 2016, 2. In comparison, the EU ETS carbon price is currently around \$9/ton. Both fall short of what some experts consider the optimal carbon price, \$35/ton. (World Bank, *State and Trends of Carbon Pricing 2015*, 44; World Bank, *State and Trends of Carbon Pricing 2014*, 30.)

<sup>60</sup> World Bank, *State and Trends of Carbon Pricing 2015*, 43.

<sup>61</sup> World Bank, *State and Trends of Carbon Pricing 2014* (Washington, DC: World Bank, 2014), 125.

<sup>62</sup> Partnership for Market Readiness, "China Carbon Market Monitor," World Bank, February 2016, 2.

<sup>63</sup> ICAP, "Emissions Trading Worldwide: ICAP Status Report 2016," 2016, 17,

[https://icapcarbonaction.com/images/StatusReport2016/ICAP\\_Status\\_Report\\_2016\\_Online.pdf](https://icapcarbonaction.com/images/StatusReport2016/ICAP_Status_Report_2016_Online.pdf)

<sup>64</sup> South Pole Group & IFC, *China Carbon Market Research Report 2016*, 65.

across the pilots to the oversupply of allowances in the market, which has exerted downward pressure on allowance prices. Towards the end of 2015, allowance prices in almost all of the pilot schemes dropped to near all-time lows, and have not recovered (as of May 2016).<sup>66</sup> Analysts attribute this drop to the uncertainty over the shift to the national ETS and whether and how the pilots might be incorporated.<sup>67</sup>

These challenges notwithstanding, some analysts argue “it would be a mistake to judge the success of the pilots based on how they compare with already established ETS programs.”<sup>68</sup> Indeed, the intent of China’s pilots vis-à-vis ETS programs elsewhere merits consideration. The primary goal of an emissions trading system is to reduce emissions reductions at the lowest possible cost. In contrast, the primary objective of China’s ETS pilots is *not* to serve as a key tool for achieving carbon emissions reductions, but rather to help China gain practical experience with ETS to help inform the design and implementation of the national ETS.<sup>69</sup> Any appraisal of the pilots’ impact should acknowledge this key difference.

***b. A National ETS: Stated Plans and Key Challenges***

Chinese political leaders have confirmed the launch of a national ETS by 2017, both in the US-China Joint Presidential Statement on Climate Change adopted September 2015 and in the Resolution adopted at the Fifth Plenary Session of the 18<sup>th</sup> CPC Central Committee last October.

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<sup>65</sup> For instance, “between September and December 2015, Beijing and Shenzhen reported the highest average prices [of the seven pilots] at US\$6.44/ton and US\$6.07/ton, respectively, but also the most price volatility. At US\$1.07/ton, the Chongqing market had the lowest average price during the same period.”

(Partnership for Market Readiness, “China Carbon Market Monitor,” World Bank, February 2016, 2.)

<sup>66</sup> Stian Reklef, “Trade in China’s pilot carbon markets grew by 87% in 2015,” February 23, 2016, <http://carbon-pulse.com/16032/>

<sup>67</sup> South Pole Group & IFC, *China Carbon Market Research Report 2016*, 74.

<sup>68</sup> Daniel Dudek, “Emissions Trading and Institutional Innovation: Lessons Learned from China’s Carbon Trading Pilots,” China Council for International Cooperation on Environment and Development, December 2014, 41, [http://www.cciced.net/encciced/event/AGM\\_1/AGM2014/wybg/201412/P020141201319105351241.pdf](http://www.cciced.net/encciced/event/AGM_1/AGM2014/wybg/201412/P020141201319105351241.pdf)

<sup>69</sup> CBEEEX official, interview, March 14, 2016; NDRC official, interview, March 15, 2016

Several high-level government documents also sketch out the programmatic contours of a national ETS.<sup>70</sup>

First, China's national ETS will be a "unified national market."<sup>71</sup> A high level regulation issued by NDRC in December 2014 outlined the division of responsibilities between national and provincial authorities: NDRC will be the central-level authority for managing the national ETS, responsible for developing national standards for scope and coverage, allocation methods and MRV requirements, while local DRCs will be responsible for ETS implementation in their region.<sup>72</sup>

According to a NDRC notice released in January 2016, China's national ETS will include enterprises from eight sectors (power, petrochemicals, chemicals, iron and steel, non-ferrous metals, building materials, pulp and paper, and aviation) that consumed over 10,000 tons of coal equivalent per year between 2013 and 2015.<sup>73</sup> A senior NDRC official has stated that using that threshold, approximately 10,000 companies—emitting around 4 billion tons of CO<sub>2</sub>—will be covered in the national ETS when it starts.<sup>74</sup> The pilots can include sectors in addition to the

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<sup>70</sup> These documents include: NDRC, *Provisional Measures for the Administration of Carbon Emission Rights Trading*, December 2014; NDRC, *Notice Regarding the Fundamental Conditions and Operational Thinking Behind the Promotion and Establishment of the National Carbon Emissions Rights Trading Market*, February 2015; NDRC, *Notice on Key Works in Preparation for the Launch of the National ETS*, January 2016.

<sup>71</sup> NDRC official, interview, March 15, 2016

<sup>72</sup> NDRC, "Provisional Measures for the Administration of Carbon Emission Rights Trading," [碳排放权交易管理暂行办法], December 2014, [http://qhs.ndrc.gov.cn/gzdt/201412/t20141212\\_652035.html](http://qhs.ndrc.gov.cn/gzdt/201412/t20141212_652035.html); CDC Climat Research & IETA, "China: An Emissions Trading Case Study," March 2015, p. 3, [https://ieta.memberclicks.net/assets/CaseStudy2015/china-emissions-trading-case-study\\_cdc\\_climat\\_ieta\\_march\\_2015.pdf](https://ieta.memberclicks.net/assets/CaseStudy2015/china-emissions-trading-case-study_cdc_climat_ieta_march_2015.pdf)

<sup>73</sup> ICAP, "NDRC outlines national ETS sector coverage," <https://icapcarbonaction.com/en/news-archive/338-ndrc-outlines-national-ets-sector-coverage>; Partnership for Market Readiness, "China Carbon Market Monitor," World Bank, February 2016, 8.

<sup>74</sup> Stian Reklef, "China's national ETS to go big from the start - official," *Carbon Pulse*, December 8, 2015, <http://carbon-pulse.com/13025/>

eight sectors currently delineated as long as they provide MRV guidelines for the sector and receive NDRC approval.<sup>75</sup>

The national allowance allocation plan will come out at the end of 2016. It is expected that the national ETS will begin with free allocation with some limited auctioning, and move towards greater auctioning over time.<sup>76</sup> A significant quandary for ETS policymakers has been whether companies will be able to carry over their unused allowances from the pilots to the national ETS. Completely restricting their use in the national ETS could cause allowance prices in the pilots to fall to near zero, whereas allowing companies to carry their unused allowances over would greatly increase the chances of overallocation in the national ETS.<sup>77</sup>

In April 2016, the director of NDRC's Department of Climate Change announced that the national ETS would use a tiered discounting system for carrying over allowances from the pilots to the national scheme. Surplus allowances from the pilots brought into the national ETS will be given a value based on the degree of overallocation and price levels in the market from where they originated; for example, a higher discount rate will be accorded to surplus allowances from pilots with high levels of overallocation and low price levels.<sup>78</sup>

The State Council is currently reviewing the national ETS law, which will provide the legal basis for the national ETS. The State Council must approve the law in order for the national ETS to go into effect. The legislation is expected to pass in the second half of 2016.<sup>79</sup>

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<sup>75</sup> If approved by NDRC, the pilot's MRV guideline for the additional sector will become the national standard. (NDRC official, interview, March 15, 2016; Chinese carbon trading expert, interview, March 17, 2016)

<sup>76</sup> Jeff Swartz, "China's National Emissions Trading Scheme: Implications for Carbon Markets and Trade," ICTSD Issue Paper No. 6, March 2016, 17.

<sup>77</sup> Stian Reklef, "China plans tiered discounting system for carrying over pilot CO2 units into national ETS," *Carbon Pulse*, April 22, 2016, <http://carbon-pulse.com/18710>

<sup>78</sup> Ibid.

<sup>79</sup> Stian Reklef, "China's NDRC passes emissions trading bill to State Council," *Carbon Pulse*, March 29, 2016, <http://carbon-pulse.com/17641/>

## *Key Challenges for the National ETS*

As China moves closer to launching its national carbon market, it will have to confront many of the same challenges other emission trading schemes have faced as well as some of its own special challenges.<sup>80</sup>

***Allocations*** - Most of the pilots overallocated emission permits, doing so to compensate companies for their initial participation. While most analysts expect some overallocation in the first few years of the national ETS, NDRC should carefully weigh the benefits and risks of overallocation to avert serious overallocation like that in the EU's ETS. Researchers involved in drafting the national allocation plan have indicated that NDRC is considering a mix of benchmarking and grandfathering, depending on the quality of emissions data, on a sector-by-sector basis.<sup>81</sup> As the country's economic growth slows, the drop in fossil-fuel power generation and manufacturing activity has raised concerns that allocations based predominantly on historical emissions may lead to serious overallocation.<sup>82</sup> Over time, NDRC should move away from free allocation towards greater use of auctioning.

***Data accuracy and transparency*** - Accurate and transparent emission reporting and monitoring is the bedrock of an effective ETS. There have been perennial concerns over emissions data quality in China.<sup>83</sup> An already tangible benefit of China's decision to pursue emissions trading is the push it has given emissions data collection efforts at the local level.

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<sup>80</sup> For more comprehensive coverage of the challenges facing China's national ETS, see: Clayton Munnings et al., "Assessing the Design of Three Pilot Programs for Carbon Trading in China," *Resources for the Future Discussion Paper*, October 2014, 8-14; Da Zhang et al., "Emissions trading in China: Progress and prospects," *Energy Policy*, 75 (December 2014): 14-15; Jeff Swartz, "China's National Emissions Trading Scheme: Implications for Carbon Markets and Trade," ICTSD Issue Paper No. 6, March 2016, 18-19.

<sup>81</sup> Stian Reklef, "Draft plan to propose mix of grandfathering and benchmarks, ex-post adjustments for China's national ETS," *Carbon Pulse*, November 18, 2015, <http://carbon-pulse.com/12114/>

<sup>82</sup> Stian Reklef, "China national ETS launch likely in the second half of 2017," *Carbon Pulse*, March 15, 2016, <http://carbon-pulse.com/17057/>

<sup>83</sup> Dabo Guan et al., "The gigatonne gap in China's carbon dioxide inventories," *Nature Climate Change* 2 (2012): 672-675; Ranping Song, "Inside China's Emissions Trading Scheme: First Steps and the Road Ahead," World Resources Institute, August 28, 2013, <http://www.wri.org/blog/2013/08/inside-china%E2%80%99s-emissions-trading-scheme-first-steps-and-road-ahead>

According to the Paulson Institute, “The quality of the [pilots’] inventories has improved over the course of the first year, and will continue to improve during the remaining two years of the pilots.”<sup>84</sup> However, the pilots “[have been] generally hesitant to put in place stringent data-quality requirements out of the fear that companies don’t have enough capacity. The fact that caps are derived from intensity targets adds another layer of uncertainty, as economic data...may also be subject to manipulation.”<sup>85</sup> In preparation for the national ETS, in January 2016 NDRC released a work notice instructing all provinces to collect and verify historical emissions data from companies in their region.<sup>86</sup> Given the dearth of qualified verification entities in China, there are also concerns over China’s ability to credibly verify emissions data from the thousands of companies that will be covered under the national market.<sup>87</sup> Independent verification of emissions reporting is essential for the credibility of an ETS as well as for enabling linkages with other carbon markets around the world.<sup>88</sup>

*Ensuring policy coherence* - Emissions trading is just one of many policies aimed at reducing emissions in China. China has a number of complementary climate and energy policies that will interact with the national ETS. These include national and provincial goals to reduce air pollutants, carbon and energy intensity, and coal consumption, as well as measures to promote low carbon technologies and energy efficiency.<sup>89</sup> International experience has shown that

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<sup>84</sup> Josh Margolis, Daniel Dudek, and Anders Hove, “Carbon Emissions Trading: Rolling out a Successful Carbon Trading System,” *Paulson Institute*, September 2015, 18, <http://www.paulsoninstitute.org/wp-content/uploads/2015/09/5-Emissions-Trading-EN-final1.pdf>

<sup>85</sup> Ranping Song, “Inside China’s Emissions Trading Scheme: First Steps and the Road Ahead,” World Resources Institute, August 28, 2013.

<sup>86</sup> NDRC, “Notice on Key Works in Preparation for the Launch of the National ETS,” [国家发展改革委办公厅关于切实做好全国碳排放权交易市场启动重点工作的通知], January 2016, [http://www.ndrc.gov.cn/zcfb/zcfbtz/201601/t20160122\\_772123.html](http://www.ndrc.gov.cn/zcfb/zcfbtz/201601/t20160122_772123.html)

<sup>87</sup> Stian Reklef, “China’s national ETS to go big from the start - official,” *Carbon Pulse*, December 8, 2015, <http://carbon-pulse.com/13025/>

<sup>88</sup> Da Zhang et al, “Emissions trading in China: Progress and prospects,” *Energy Policy*, 75 (December 2014): 15.

<sup>89</sup> Clayton Munnings et al., “Assessing the Design of Three Pilot Programs for Carbon Trading in China,” *Resources for the Future Discussion Paper*, October 2014, 11.

complementary policies can undercut the effectiveness of an ETS if they are not carefully coordinated. Emissions trading tries to produce the cheapest emissions reductions by allowing emitters to trade allowances in search of the most efficient reductions. In contrast, complementary policies specify in advance how to reduce emissions and the sources from which these reductions must come. While complementary policies can be effective at reducing emissions, they also limit choices companies have for reducing their emissions under an ETS, leading to unnecessarily high compliance costs.<sup>90</sup> Thus, China will need to consider the potential effects of interactions between the national ETS and complementary policies as well as ensure policy coherence so that these policies work in a truly complementary fashion.

Given the challenges encountered by China's ETS pilots, and the time it will take for non-pilot regions to become trading-ready, a period of experimentation will likely continue even after the national ETS is formally established in 2017. In fact, many analysts believe it is unlikely that China will have a fully developed ETS until 2025-2030.<sup>91</sup>

#### **IV. Power Sector Challenges for a National ETS: Regulated Electricity Pricing and Equal Share Dispatch**

The design and implementation of a national ETS is a large-scale effort that will require coordination between the central government, local governments, regulated enterprises, and financial institutions. While a national ETS could potentially play an important role in reducing China's carbon emissions, current power sector policies will undermine the proposed emissions trading scheme and render it largely ineffective. To ensure that a national ETS reduces carbon emissions and changes the behavior of both electricity producers and consumers, policymakers

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<sup>90</sup> Ann Carlson, "Designing Effective Climate Policies: Cap-and-Trade and Complementary Policies," *Harvard Journal on Legislation* 49 (2012): 207.

<sup>91</sup> ERI researcher, interview, March 15, 2016



must reform the current electricity pricing system as well as the way in which they dispatch electricity.

**a. *Electricity Pricing and Reform***

China's "opening up" in the 1980s brought about dramatic changes in the Chinese power sector as demand for electricity steadily climbed. In the late 1980s, Chinese policymakers made their first forays into price reform by allowing local and provincial governments to invest in power plants.<sup>92</sup> The system remained largely intact until February 2002, when China's State Council released State Council Decree No. 5 – a document significantly overhauling the way that China's centralized electricity system would operate.<sup>93</sup>

State Council Decree no. 5 laid out basic guiding principles that separated generation and transmission, divided the State Power Corporation into five new state-owned generation companies, and formally established the State Electricity Regulatory Commission.<sup>94</sup> SERC would be entrusted with approving new generating capacity and addressing power shortages affecting industries and households throughout the country. In addition, it had to find a way to collaborate with the NDRC, the traditional power sector planner and regulator. This decree represented China's first step towards developing a market-based power sector that would ensure a reliable power supply and balance rising energy demand with environmental concerns.<sup>95</sup>

State Council Decree No. 5 implemented a pricing structure that the Regulatory Assistance Project has characterized as a single-buyer purchasing agency model.<sup>96</sup> Under this

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<sup>92</sup> Regulatory Assistance Project, "China Power Sector: A Backgrounder for International Regulators and Policy Advisors," February 2008, 3.

<sup>93</sup> Regulatory Assistance Project, "Power Sector Policy in China: Next Steps," September 2011, 2.

<sup>94</sup> Regulatory Assistance Project, "China Power Sector: A Backgrounder for International Regulators and Policy Advisors," February 2008, 3.

<sup>95</sup> International Energy Agency/Organization for Economic Cooperation and Development, "China's Power Sector Reforms: Where to Next?" 2006, 15.

<sup>96</sup> Regulatory Assistance Project, "China Power Sector: A Backgrounder for International Regulators and Policy Advisors," February 2008, 3.

pricing model, provincial and municipal grid utilities were the sole customers of generating companies. These grid utilities would purchase power and then re-sell the electricity to consumers and distribution companies within their respective regions.<sup>97</sup> The NDRC closely monitored these transactions and oversaw long-term contracts that would ensure that adequate electricity was being supplied at an appropriate price. While this system ensured price stability, it also stifled competition in the wholesale market and prevented new generators or grid companies from entering the market.

### *Wholesale Pricing Reforms*

As the only buyers in the wholesale electricity market, grid companies had enormous influence over both wholesale and retail prices. Grid companies benefitted from this arrangement by earning a profit from the difference between the generation and retail prices.<sup>98</sup> While Beijing was able to implement a policy linking the wholesale price to the price of coal, regulators were reluctant to further alter wholesale prices for fear that price rises would lead to inflation.<sup>99</sup> Despite Beijing's general reluctance to implement policies affecting economic output, regulators have been able to institute a number of policies affecting wholesale pricing and changing the way grid companies operate.

In 2004, China enacted a new pricing policy whereby the wholesale prices paid to new generators are standardized based on fuel and power plant technology.<sup>100</sup> Prices can be modified over time to reflect fluctuating variable costs. In March 2005, the NDRC issued the Circular of the National Development and Reform Commission Concerning the Printing and Distribution of

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<sup>97</sup> Ibid.

<sup>98</sup> "China's New Electric System Reforms," China Energy Storage Alliance, accessed April 28, 2016, <http://en.cnesa.org/featured-stories/2015/8/4/chinas-new-electric-system-reforms>.

<sup>99</sup> Fei, Teng, Xin Wang, and Lu Zhiqiang, "Introducing the emissions trading system to China's electricity sector: Challenges and opportunities," *Energy Policy* 75 (2014): 41.

<sup>100</sup> Ibid, 8.

Implementation Measures for Electricity Price Reforms.<sup>101</sup> This document announced the NDRC's intention to establish a two-tiered pricing system that would consist of a capacity price and a system marginal price.<sup>102</sup> The capacity price would be determined by the government while the marginal price would be determined through market competition. Through this new pricing system, the wholesale price of electricity would be linked to fuel costs and retail pricing would gradually be liberalized as competition was introduced into the retail market.<sup>103</sup>

While the March 2005 document signaled the NDRC's market reform intentions, the pricing system "[was] not systematic, transparent, nor cost-reflective."<sup>104</sup> One of the principal problems with the NDRC's new pricing mechanism was that it used existing prices as a baseline rather than reviewing the existing costs of electricity generation and proposing new prices.<sup>105</sup> Market-based wholesale pricing reforms would have to wait until successes in pilot programs would encourage authorities to experiment with greater reforms.

With the introduction of Policy No. 9 in March 2015, regulators proposed a series of ambitious reforms that would overhaul various aspects of China's power sector including electricity pricing.<sup>106</sup> Building on successful pilot programs in Shenzhen and Inner Mongolia, Policy No. 9 seeks to break up "China's long-standing model that integrates transmission, distribution, and retail in a single entity."<sup>107</sup> While Policy No. 9 has only been implemented in a few pilots, the scale of the proposed reforms indicates that Chinese policymakers are moving to further reform wholesale pricing.

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<sup>101</sup> Regulatory Assistance Project, "China Power Sector: A Backgrounder for International Regulators and Policy Advisors," February 2008, 7.

<sup>102</sup> Russell Pittman and Vanessa Yanhua Zhang, "Electricity Restructuring in China: The Elusive Quest for Competition," Economic Analysis Group Discussion Paper, April 2008, 8.

<sup>103</sup> Regulatory Assistance Project, "China Power Sector: A Backgrounder for International Regulators and Policy Advisors," February 2008, 8.

<sup>104</sup> *Ibid.*, 7.

<sup>105</sup> *Ibid.*

<sup>106</sup> "China's New Electric System Reforms," China Energy Storage Alliance, May 11, 2015.

<sup>107</sup> *Ibid.*

## *Retail Pricing Reforms*

Perpetually concerned with the potential inflationary risks of raising residential electricity prices, regulators have shown greater willingness to modify retail rates for industrial consumers. One successful program, aimed at closing down the country's high polluting and inefficient factories, was introduced in the March 2005 NDRC Circular.

The same 2005 NDRC circular that recommended market price reforms contained a provision linking electricity pricing for large industrial consumers to their overall energy efficiency.<sup>108</sup> The provisions applied to high-intensity energy industries such as cement, steel, and aluminum and divided enterprises into four distinct categories: encouraged, permitted, restricted, and eliminated.<sup>109</sup> Enterprises in the "encouraged" category paid the lowest prices while industries in the "eliminated" category were forced to pay gradually higher electricity costs over time. This initiative, coupled with "Top-1000 Energy-Consuming Enterprises Program," would close down inefficient factories and eventually exceed China's goal of saving more than 100 million tons of coal equivalent during the 11<sup>th</sup> FYP period.<sup>110</sup> The success of this program led to the creation of the "Top-10,000 Energy Consuming Enterprises Program" that was instituted during the 12<sup>th</sup> FYP.<sup>111</sup>

Historically, these energy-consuming industries have paid much higher prices than the agricultural and residential sectors.<sup>112</sup> The high prices paid by the industrial and commercial sectors have, in turn, subsidized residential customers. These artificially low prices have reduced

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<sup>108</sup> Regulatory Assistance Project, "China Power Sector Backgrounder," 14.

<sup>109</sup> "CN-16: Differential Electricity Pricing for Industry," Industrial Efficiency Policy Database, accessed April 28, 2016, <http://iepd.iipnetwork.org/policy/differential-electricity-pricing-industry>

<sup>110</sup> "CN-3a: Top-1000 Energy-Consuming Enterprises Program," Industrial Efficiency Policy Database, accessed April 28, 2016, <http://iepd.iipnetwork.org/policy/top-1000-energy-consuming-enterprises-program>

<sup>111</sup> Ibid.

<sup>112</sup> Shawn Zhang and Xuqing Qin, "Lessons Learned from China's Residential Tiered Electricity Pricing Reform," International Institute for Sustainable Development, May 2015, 3.

the incentives for residential customers to save energy and have prevented grid companies from recovering costs associated with electricity distribution to these consumers.<sup>113</sup>

To counteract these losses, Beijing implemented a nationwide residential tiered electricity pricing scheme that placed residential consumers in specific price blocks depending on their overall electricity consumption.<sup>114</sup> Under this system, residential users that consume large amounts of electricity will pay higher rates than low-consuming users. These policies include inclining block rates, time of use pricing, differential pricing, and demand response policies.<sup>115</sup> While price increases are minor and are unlikely to change behavior, it nonetheless demonstrates a new approach to encouraging energy savings in households.

### *Policy Recommendations*

If a national ETS were implemented under the current electricity pricing regime, the cost of electricity would only increase for producers while consumers would be insulated from the higher prices due to fixed rates.<sup>116</sup> To rectify this problem, Beijing must reform both wholesale and retail electricity prices. Nevertheless, China's electricity sector has historically been resistant to change and implementing these reforms will require coordination and compromise among policymakers, energy producers, and grid companies.

In countries with developed electricity markets, policymakers set electricity plans to “facilitate least-cost investment in demand-side generation and transmission resources while meeting reliability and environmental goals.”<sup>117</sup> In order to accomplish this goal, policymakers must identify resource needs and harmonize them with policy goals, coordinate the usage of

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<sup>113</sup> Ibid, 4.

<sup>114</sup> Regulatory Assistance Project (RAP), “Low Carbon Power Sector Regulation: Options for China,” February 2015, 39.

<sup>115</sup> Regulatory Assistance Project, “Power Sector Policy in China: Next Steps,” September 2011, 32.

<sup>116</sup> Fei Teng, Xin Wang, and Lu Zhiqiang, “Introducing the emissions trading system to China’s electricity sector: Challenges and opportunities,” *Energy Policy* 75 (2014): 39.

<sup>117</sup> Regulatory Assistance Project, “Low Carbon Power Sector Regulation: Options for China,” February 2015, .2.

various resources, and link the planning process to resource investment.<sup>118</sup> In China, while Beijing has enacted various laws and regulations to make the price of electricity more responsive to fluctuating inputs, policymakers, wary of inflation and social unrest due to rising power prices, have resisted changes.

Given the numerous institutional challenges preventing the implementation of a competitive electricity market, Chinese policymakers should focus on implementing a series of short-term options that will lay the groundwork for future changes. First, the national ETS should cover indirect emissions that are associated with electricity consumption. Under this system, carbon allowances are allotted to downstream consumers based on their electricity usage. This allows carbon pricing to affect electricity end users without having to fully liberalize electricity pricing throughout the country. While this system can effectively change consumers' behavior, a clear database of electricity sources must be established to prevent potential double counting of emissions.

In addition, China should develop a stronger linkage between the retail and wholesale markets. An improved linkage will allow price signals in the wholesale market to affect pricing in the retail market, while allowing authorities to retain some level of control over politically sensitive retail prices. In the long-term, China should move toward a fully competitive electricity market. A fully competitive electricity market would enable carbon cost pass through, allowing an ETS to change behavior and achieve emission reductions. When electricity prices reflect the marginal costs of production, firms will alter their behavior, adopt cost-cutting measures, or reduce electricity consumption in response to price changes. Achieving this, however, requires the cooperation of provincial and local governments, grid companies, and power producers.

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<sup>118</sup> Ibid.

### ***b. Electricity Dispatch***

In the face of power shortages in the 1980s, Beijing allowed local and provincial governments into the electricity generation market.<sup>119</sup> Throughout these initial reforms Beijing retained complete control over transmission; to incentivize investment it guaranteed long-term prices and operating hour quotas to new power generators.<sup>120</sup> By decentralizing generation planning and eliminating risk in power sector investment, China was able to solve its supply-side electricity shortages quickly. By the time the State Power Corporation of China was broken up into the big five and other SOEs in 2002, the growth of these smaller players had reduced the central government's share of generation to 46%.<sup>121</sup>

Wholesale prices in China's electricity market are still set by the central government. They vary based on three variables: the age of the plant, plant type, (nuclear, subcritical coal, supercritical coal, etc.), and generation capacity.<sup>122</sup> However, the central government's practice of allocating operating hours to generators, referred to as *equal shares dispatch*, set a precedent that local authorities followed in order to boost their respective economies. Equal shares dispatch differs from *economic dispatch* used in the U.S., which seeks to minimize power production costs by dispatching generation with the lowest variable costs first.<sup>123</sup> The resulting structure has made it difficult for renewables as well as newer, more efficient power plants to maximize their

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<sup>119</sup> Daniel H. Rosen and Trevor Houser, "China Energy: A Guide for the Perplexed," May 2007, 24, <http://www.iie.com/publications/papers/rosen0507.pdf>

<sup>120</sup> Teng Fei, Gu Alun, and Lu Zhiqiang, "Institutional analysis of introducing an emissions trading system to China's power industry," in *Market mechanisms for China's carbon emission reductions: Economics, modelling and international experience*, (Beijing: China NDRC State Information Center, April 2013), 247-268.

<sup>121</sup> Ibid.

<sup>122</sup> Rick Weston (RAP China Program Director), interview, March 16, 2016

<sup>123</sup> United States Department of Energy, "the Value of Economic Dispatch: a Report to Congress Pursuant to Section 1234 of the Energy Policy Act of 2005," November 2005, 4, <http://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/value.pdf>

capacity factors despite their low variable costs and the central government's desire to reduce China's carbon intensity.<sup>124</sup>

In 2005, Beijing passed the Renewable Energy Law mandating grid companies to purchase all of the electricity produced by “approved renewable energy facilities.”<sup>125</sup> Similar language has continued to appear in official documents, such as a 2007 SERC regulation and the September 2015 U.S.-China Joint Statement on Climate Change.<sup>126</sup> Nevertheless, despite a decade of additional efforts by the central government to prioritize renewables, 15 percent of China's wind energy and 12 percent of its solar was still curtailed in 2015.<sup>127</sup> Grid operators cite “grid security constraints” as the reason for this curtailment, but legal ambiguity gives them considerable latitude in its application.<sup>128</sup>

### *Design*

Equal shares dispatch does not have a transparent, formal structure. Instead, its foundation is the product of decentralized ad-hoc power sector development and sustained provincial commitment to economic growth.

There are six regional grids in China, five of which are interconnected, though this transmission capacity is “relatively constrained.”<sup>129</sup> Dispatch between regions and provinces is managed by the two T&D SOEs, SGCC and China Southern Grid, but provincial grid companies

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<sup>124</sup> Regulatory Assistance Project, “Low-Carbon Power Sector Regulation: Options for China,” 24.

<sup>125</sup> “China Passes Renewable Energy Law,” March 9, 2005, <http://www.renewableenergyworld.com/articles/2005/03/china-passes-renewable-energy-law-23531.html>

<sup>126</sup> “U.S.-China Joint Presidential Statement on Climate Change,” (The White House, September 2015), <https://www.whitehouse.gov/the-press-office/2015/09/25/us-china-joint-presidential-statement-climate-change>; Friederich Kahrl and Wang Xuan, “Integrating Renewables Into Power Systems in China: A Technical Primer – Power Systems Operations,” (Beijing: Regulatory Assistance Project, December 2014), 23, <http://www.raonline.org/document/download/id/7459>

<sup>127</sup> Kathy Chen and Dominique Patton, “China Steps up Efforts to Tackle Curtailment of Renewable Energy,” Reuters, October 2015, <http://www.reuters.com/article/us-china-renewables-idUSKCN0SE0NG20151020>

<sup>128</sup> Kahrl and Wang, “Integrating Renewables,” 23-24

<sup>129</sup> James H. Williams and Fredrich Kahrl, “Electricity Reform and Sustainable Development in China,” *Environmental Research Letters* 3, no. 4 (December 2008). <http://iopscience.iop.org/article/10.1088/1748-9326/3/4/044009/fulltext/>



have the power to control dispatch within their respective provinces.<sup>130</sup> Despite the grid's ability to tolerate larger balancing areas, electricity supply and demand are balanced primarily at the provincial level.<sup>131</sup> This gives local system operators the ability to allocate operating hours and, by doing so, reduce risk for potential generation investors.<sup>132</sup> Larger balancing areas across multiple provinces would make it difficult for governments to make these assurances. Provincially-owned generation units are generally favored over those owned by the big five, independent producers, or national grid companies regardless of their tendency to be more efficient.<sup>133</sup> If preferred generation units cannot serve electricity demand, generators outside of the equal shares cohort are called upon, and if supply exceeds demand then grid operators distribute the burden of curtailment equally.

Local power generation investment has important benefits for local governments that serve as a disincentive for reforming equal shares dispatch. It creates jobs, grows the local economy, and generates tax revenue (imported electricity cannot be taxed).<sup>134</sup> Once built, however, local power plants also represent potential stranded assets due to the financial and economic fallout that would accompany their closure. Indeed, many of China's most inefficient power plants have generation capacities below 300 MW and were never approved by the central government; finance often came from local authorities at even the county level, sometimes through direct fiscal allocations.<sup>135</sup> These smaller plants employ hundreds of thousands of

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<sup>130</sup> Williams and Kahrl, "Electricity Reform"

<sup>131</sup> Kahrl and Wang, "Integrating Renewables," 21

<sup>132</sup> Rick Weston (RAP China Program Director), interview, March 16, 2016

<sup>133</sup> Chi Zhang and Thomas C. Heller, "Reform of the Chinese electric power market: economics and institutions," Stanford Program on Energy and Sustainable Development, January 2004, [http://pesd.fsi.stanford.edu/sites/default/files/wp3%2C\\_10\\_May\\_04.pdf](http://pesd.fsi.stanford.edu/sites/default/files/wp3%2C_10_May_04.pdf)

<sup>134</sup> Ibid.

<sup>135</sup> Williams and Kahrl, "Electricity Reform"

workers and their premature closure would not only create unemployment, but also place legacy costs on local banks and governments.<sup>136</sup>

### *Attempted Reform*

China has attempted different approaches to reforming equal shares dispatch, but none have succeeded in fully transforming the system. The most straightforward and effective has been the forced closure of the small inefficient plants; indeed, the 11<sup>th</sup> FYP mandated 50 GW of plants with generation capacities of less than 200 MW to shut down, and in 2007 alone China closed 553 units with a combined capacity of 15 GW.<sup>137</sup> However, most of these plants were operated by the big five SOEs, which are controlled by Beijing and have clear incentives for complying with such mandates. An additional incentive allowed some plants to be allocated generation quotas for years after their closure which they could then sell to larger, more efficient units to cover their legacy costs- a practice known as *generation rights trading*.<sup>138</sup> Unfortunately, these successes represent the “low-hanging fruit;” China’s long-term solution cannot take the form of forced closures due to legacy costs, political ramifications, and provincial independence.

China has also attempted several different dispatch methodologies, none of which have effectively replaced equal shares. *Priority dispatch*, established by the Renewable Energy Law of 2005 and detailed in subsequent years, grants qualifying renewable energy sources priority access to the grid. It differs from the *green dispatch* of the U.S.-China September 2015 statement in that green dispatch prioritizes energy sources on the basis of efficiency (kilojoules/kWh) and emissions (CO<sub>2</sub>/kWh).<sup>139</sup> Green dispatch presumably augments *energy efficient dispatch*, in which merit order is determined by heat rate alone (kilojoules/kWh). In practice, both green

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<sup>136</sup> Ibid.

<sup>137</sup> Ibid.

<sup>138</sup> Ibid.

<sup>139</sup> “U.S.-China Joint Presidential Statement”

dispatch and energy efficient dispatch should result in nearly the same merit order as economic dispatch. The central government piloted energy efficient dispatch in 2007 and later expanded it to five provinces within China Southern Grid's territory, but was never able to implement it nationally.<sup>140</sup>

The latest policy announcement on the subject of dispatch, "Document 625," was released by Beijing in March 2016.<sup>141</sup> It is potentially significant because it mandates that renewables be compensated for curtailment by either thermal plants or grid companies themselves, depending on the cause of curtailment.<sup>142</sup> If the central government is able to enforce this penalty, the benefits to local governments of curtailing renewables could disappear. Moreover, Document 625 states that NDRC and NEA will now allocate operating hours to renewables in provinces where they are being curtailed, a task that was previously the responsibility of the provincial grid companies.<sup>143</sup> Finally, it calls on renewable generators to negotiate electricity sales directly with end-users to guarantee grid access and asks grid companies to "gradually" expand balancing areas to enable increased renewable energy penetration.<sup>144</sup>

### *Policy Recommendations*

Document 625 will likely improve dispatch if its mandates can be implemented. Its push to expand balancing areas is essential to fully reforming dispatch. Nevertheless, implementation of Document 625 itself is uncertain given Beijing's lack of success with previous initiatives, and its expensive consequences for thermal units is likely to create political resistance. Instead, we

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<sup>140</sup> Kahrl and Wang, "Integrating Renewables," 11

<sup>141</sup> Max Dupuy and Xuan Wang, "China's String of New Policies Addressing Renewable Energy Curtailment: An Update," (Regulatory Assistance Project: April 2016), <http://www.raponline.org/featured-work/chinas-string-of-new-policies-addressing-renewable-energy-curtailment-an>

<sup>142</sup> Ibid.

<sup>143</sup> Ibid.

<sup>144</sup> Ibid.

recommend *two-part pricing*, in which a generator's existing bundled (per-kWh) compensation rate is split into two streams: one for providing generation capacity that recovers fixed costs and the other for actually generating electricity that recovers variable costs.<sup>145</sup> This approach would enable grid operators to use economic dispatch, which would lower emissions, without making stranded assets out of less efficient thermal plants. This solution is unique in that it covers legacy costs at the lowest expense while quickly getting renewable electricity onto the grid. It would also function more effectively with China's national ETS than alternatives because it would shift the country's electricity system closer to a true market.

## **V. Conclusion**

Developing a meaningful national emissions trading scheme poses an enormous challenge for Chinese policymakers. Policymakers can build on the experiences of China's seven ETS pilots, which have successfully developed institutional capacity; still, they will have to overcome significant challenges, including allocations, data reliability and transparency, and complementary policies.

As one of the largest sources of CO<sub>2</sub> emissions, the power sector presents its own set of challenges and opportunities for Chinese policymakers. The power sector was covered in each of the seven pilots and planned power sector reforms have the potential to impact many other regulated sectors. While China's current electricity pricing and dispatch systems catalyzed the rapid proliferation of generating capacity throughout the country, it is clear that these two systems must be reformed for the national ETS to function.

Electricity pricing has been a delicate issue for policymakers wary of volatile prices that could affect economic output and social stability. Given the political infeasibility of fully

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<sup>145</sup> Xuan Wang and Friederich Kahrl, "Lower Emissions, Costs Possible With Two-Part Pricing and Dispatch Reform in China," (Regulatory Assistance Project: April 2016), <http://raponline.org/featured-work/lower-emissions-costs-possible-with-two-part-pricing-and-dispatch-reform-in>

deregulating the electricity market in the short term, policymakers should ensure that the national ETS covers both direct and indirect emissions. Covering indirect emissions would allow carbon prices to send price signals to consumers ahead of further electricity pricing reforms. Policymakers should continue experimenting with deregulated electricity markets in pilot programs to move toward a fully liberalized electricity market.

China's equal shares dispatch system played an integral role in meeting the country's development needs throughout the late 20th century, but policymakers must now move to a new dispatch model that prioritizes the dispatch of cleaner energy sources. Two-part pricing would address misaligned incentives of the central and provincial governments and would enable economic dispatch, thus permitting a national ETS to function effectively.

Despite significant challenges, launching a national ETS is a top priority for the Chinese government. Putting a price on carbon through a national ETS is critical for helping China transition to a low-carbon economy. Strong political support from the central government has generated momentum for establishing a national ETS, but an effective national ETS for the power sector that is truly capable of driving mitigation efforts requires policymakers to overcome institutional inertia that has stymied real progress on power sector reform.

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