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The Role of the Market and Traditional Regulation in Decarbonising China's Energy Supply

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ABSTRACT

The introduction of an Emissions Trading Scheme (ETS) to decarbonise the Chinese economy faces challenges relating to the tradition of heavy regulation that characterises the functioning of the largest carbon-emitting sector—coal-fired electricity production. This article examines what scope there is for the market to drive the decarbonisation of China's electricity supply, when hitherto most emission reductions have been achieved through traditional regulation (eg emissions performance standards and the forced closure of inefficient installations). The importance of traditional regulation does not mean that the ETS will not contribute to the decarbonisation of China's energy supply, but the role of the ETS will be different from that in liberalised energy markets (eg the European Union) where the market is supposed to be the main driver of emission reductions. In China, the role of the ETS will be limited to help achieve the energy investment targets set under the government's central planning policy.

KEYWORDS: Emissions trading, China, energy market reform, direct regulation

1. INTRODUCTION

China is introducing a national Emissions Trading Scheme (ETS) in order to achieve the national greenhouse gas (GHG) emission control targets.[1] The objective is to create a level playing field to reduce, or at least limit, GHG emissions by internalising the carbon externality into the carbon-intensive segment of the economy.[2] The energy sector, and, in particular, electricity production, is a key target of the

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1 'The 13th Five-year Plan for Economic and Social Development of the People's Republic of China' [中华人民共和国国民经济和社会发展第十三个五年规划纲要] (State Council, 17 March 2016); 'Regulations on the Management of National Carbon Emissions Trading Program (Draft)' [《全国碳排放权交易管理条例》（送审稿）] (*Ideacarbon*, 2016) <http://www.ideacarbon.org/archives/31714> accessed 6 October 2017.

2 Notice of the State Council on Issuing the Integrated Workplan for Energy Conservation and Emissions Reduction during the 13th Five-Year Period [国务院关于印发"十三五"节能减排综合工作方案的通知], (State Council Order No (2016) 74, 20 December 2016); 'Enhanced Actions on Climate Change: China's Intended Nationally Determined Contributions' (UNFCCC, 30 June 2015) <http://www4.unfccc.int/ndcregistry/PublishedDocuments/China%20First/China%27s%20First%20NDC%20Submission.pdf> accessed 6 October 2017.

Chinese government GHG emission control strategy.[3] A total of 70.5% of national electricity production is based on coal, amounting to 37.31% of national GHG emissions.[4] China's ETS initiative has been welcomed as a significant step towards the decarbonisation of energy supply in China,[5] and a sign of China's increasingly active role on the international climate scene.[6]

However, introducing a market-based environmental instrument to achieve emission reductions in the Chinese economy, especially in the power generation sector, faces important regulatory challenges. In order to generate emission reductions in an effective way, the ETS presupposes the freedom of economic entities to adjust their economic operations and investment decisions.[7] It also presupposes that the carbon cost can be freely reflected in the price of goods produced in a carbon-intensive way. In China, both the making of electricity investments and the electricity price formation mechanism are characterised by a tradition of heavy government regulation.[8] Similarly, command and control is the main instrument of China's environmental protection policy.[9] In the context of the forthcoming introduction of the national ETS, what scope is there for the market to drive the decarbonisation of China's energy supply?

Because of a tradition of command and control, the decarbonisation of China's energy supply provides a highly relevant case study of the interaction between traditional regulation and market mechanisms, both at the level of environmental and energy regulation. The environmental law literature studies traditional regulation and environmental markets separately to, or in comparison with, each other without engaging in an in-depth analysis of the interaction between these regulatory instruments.[10] Similarly, with few exceptions, the interaction between carbon markets and

3 See eg, 'Similarities and Differences of the Allowances Allocation Method in China's National and Pilot ETS' [国家碳市场和试点省市碳配额分配方法对比分析都有哪些异同？] (*Ideacarbon*, 19 May 2017) <http://www.ideacarbon.org/archives/39677> accessed 6 October 2017.

4 'White Paper of China Huadian Corporation's Greenhouse Gas Emissions During the 12th Five-year Plan Period' [中国华电"十二五"温室气体排放白皮书] (China Huadian Corporation, June 2016) <http://cluster.chd.com.cn/webfront/doFileDownload.do?serviceId=articleAttach_20160613091551.> accessed 6 October 2017.

5 Zhongxiang Zhang, 'Making the Transition to a Low-Carbon Economy: The Key Challenges for China' (2016) 3 Asia and the Pacific Policy Studies 187; 'EU-China Cooperation on Emission Trading in China: Achievements and Lessons' (European Union External Action, 20 October 2016) <https://eeas.europa.eu/headquarters/headquarters-homepage_en/15469/EU-China Cooperation on Emission Trading in China: Achievements and Lessons> accessed 6 October 2017.

6 Warwick McKibbin and Weifeng Liu, *China: Ambitious Targets and Policies* (Brookings Institution, July 2017) <https://www.brookings.edu/wp-content/uploads/2016/07/china-mckibbin.pdf> accessed 6 October 2017.

7 W David Montgomery, 'Markets in Licenses and Efficient Pollution Control Programs' (1972) 5 Journal of Economic Theory 395; European Commission, 'Proposal for a Directive Establishing a Scheme for Greenhouse Gas Emission Allowance Trading' COM (2001) 581 final.

8 See sections 3 and 4 below.

9 Charles McElwee, *Environmental Law in China: Managing Risk and Ensuring Compliance* (OUP 2011) 47–48.

10 See, however, David Driesen, 'Emissions Trading Versus Pollution Taxes: Playing Nice With Other Instruments' (2018) 48 Environmental Law (forthcoming) ; Paul Twomey, 'Rationales for Additional Climate Policy Instruments Under a Carbon Price' (2016) 23 Economics and Labour Relations Review 7, 12; Ann Carlson, 'Designing Cost Effective Climate Policy: Cap-and-Trade and Complementary Policies' (2012) 49 Harvard Journal of Legislation 207, 210.

energy market regulation has not yet been thoroughly studied in the environmental and energy law literature.[11] Scholars have only recently started to examine the necessity of 'companion policies' to the ETS, in reaction to the failure of the ETS to drive low-carbon investments (eg in the European Union (EU)).[12]

The case of China illustrates the investment function of traditional regulation—a key companion policy to the ETS—regardless of the official market-oriented rhetoric. Although in theory carbon prices can influence the proposals that utilities make to build new power plants, in practice, the central government influences investment decisions by setting binding emission performance standards and enforcing the closure of facilities that fail to meet these standards. This approach is not necessarily incompatible with the ETS, provided that the government anticipates the impact ('waterbed effect') that these companion policies have on the demand of allowances in other ETS sectors (eg by cancelling a number of allowances corresponding to the emission reductions achieved through traditional regulation). In the context of the gradual opening of electricity prices to the forces of supply and demand, the Chinese ETS can play a role in internalising the carbon externality in end-user electricity prices. However, with investments subject to the government's approval, the function of the ETS will be limited to help achieve the energy investment targets set under China's central planning policy.

The argument proceeds as follows. Section 2 briefly introduces the theory on traditional regulation and markets in the environmental and energy law literature, and discusses how companion environmental and energy policies can support—or distort—the realisation of low-carbon investments under the ETS. Sections 3 and 4 examine the interaction between Chinese electricity regulation, environmental regulation and the ETS by first looking at the regulation of electricity investments, followed by an analysis of the formation of electricity prices in China and its interaction with carbon prices.

2. TRADITIONAL REGULATION AND MARKETS FOR ENVIRONMENTAL PROTECTION AND ENERGY SECURITY

The use of traditional regulation *versus* markets to achieve public policy objectives is a central topic in the environmental law and energy law literature.[13] A common topic is the effectiveness of these regulatory approaches in stimulating market players to deliver the necessary investments in environmental protection and energy security. Following criticism of the inefficiency and cost ineffectiveness of command and

11 See eg Anatole Boute, 'The Impossible Transplant of the EU Emissions Trading Scheme: The Challenge of Energy Market Regulation' (2017) 6 Transnational Environmental Law 59; Yong-Gun Kim and Jong-Soo Lim, 'An Emissions Trading Scheme Design for Power Industries Facing Price Regulation' (2014) 75 Energy Policy 84.

12 See eg Felix Matthes, 'Structural Reform of the European Union Emissions Trading System and the Interfaces to the Clean Energy Package' (Presentation at Carbon Market Watch, 'A Clean Fit: How the EU ETS and the Clean Energy Package Can Work Together for the Climate, 6 June 2017) <http://carbonmarketwatch.org/wp-content/uploads/2017/05/2017-06-06-ETS-CWNLLU-Brussels.pdf> accessed 6 October 2017.

13 See, eg, Elizabeth Fisher, Bettina Lange and Eloise Scotford, *Environmental Law: Text, Cases and Materials* (OUP 2013) 491–93; Michael Faure and Göran Skogh, *The Economic Analysis of Environmental Policy and Law: An Introduction* (Edward Elgar 2003).

control, there is now an increasing controversy in the literature on the extent to which markets can provide to investors the certainty necessary to make capital-intensive investments in environmental protection and energy security.[14]

Although the debate in both disciplines covers similar topics, the discussions in the energy literature and the environmental law literature have largely remained separate from each other. In the gap between both discussions, an important dimension to environmental change is lost: the interaction between environmental regulation and the regulation of energy. Taking into account that energy is responsible for the bulk of the GHG emissions, the absence of common analysis on energy and environmental regulation negatively affects the effectiveness of environmental rules in promoting the decarbonisation of the energy supply.

2.1. Traditional Regulation and Markets in the Environmental and Energy Law Literature

In environmental law and policy, command and control refers to technology-based regulation, eg the requirement of use of specific equipment or, more radically, the forced shutdown of facilities.[15] More flexible types of traditional regulation include performance standards.[16] States can also combine both mechanisms by requiring the forced shutdown of installations that fail to comply with the performance standards (as is the case for coal-fired power plants in China, as will be seen below).[17] If properly enforced, performance standards provide certainty regarding emission reductions, but this is achieved at a relatively high cost because emission reductions cannot be averaged across different facilities.[18] Market mechanisms, including taxes and ETSs, are expected to reduce pollution in a more cost-effective way than traditional regulation.[19] Because it is based on a maximum volume of emissions, an ETS provides more certainty regarding the quantity of pollution reduction than a tax.[20] However, the tax provides more certainty about cost.

14 It must be noted that regulatory choices on the design of markets and the ability of governments to interfere with their functioning is often seen as one of the main causes of the failure of markets to drive capital-intensive investments. See eg Karsten Neuhoff and Laurens De Vries, 'Insufficient Incentives for Investment in Electricity Generations' (2004) 12 Utilities Policy 253, 264; Fabien Roques, 'Market Design for Generation Adequacy: Healing Causes Rather Than Symptoms' (2008) 16 Utilities Policy 171, 175.

15 David Driesen, 'Alternatives to Regulation? Market Mechanisms and the Environment' in Robert Baldwin, Martin Cave and Martin Lodge (eds), *The Oxford Handbook of Regulation* (OUP 2010) 204–05; David Driesen, 'Traditional Regulation's Role in Greenhouse Gas Abatement', in Michael Faure (ed), *Elgar Encyclopaedia of Environmental Law* (Edward Elgar 2015) 415; Mingyuan Wang, *The Theory of Law on Clean Production* [清洁生产法论] (Tsinghua UP 2004) 14–17.

16 Faure and Skogh (n 13) 190.

17 See section 3.2 below.

18 Driesen, 'Traditional Regulation's Role in Greenhouse Gas Abatement' (n 15) 4.

19 William Nordhaus, *A Question of Balance: Weighing the Options on Global Warming Policies* (Yale UP 2008) 11–13; Guang Xia, Hai Yu and Qingdan Yuan, *China Environmental Policy Review Report (2014)* [中国环境政策述评报告(2014年度)] (China Environmental Science Publishing 2016) 78–95.

20 Driesen, 'Alternatives to Regulation? Market Mechanisms and the Environment' (n 15) 207.

Insufficient certainty about the cost of carbon is one of the main criticisms made against the EU ETS.[21] Low and volatile carbon prices are an impediment to investments in the decarbonisation of the EU's energy infrastructure. A return to more regulation and direct government intervention is increasingly advocated as a necessary measure to improve price certainty for low-carbon investors.[22] The UK introduced a carbon price floor,[23] and the EU established the market stability reserve.[24] Both mechanisms aim to stabilise carbon prices based on direct regulatory intervention in the carbon market. Moreover, in the absence of the internalisation of the carbon externality based on the ETS, EU Member States subsidise investments in renewable energy.[25] More radically, the Netherlands has proposed to phase out coal-fired power generation in the country.[26]

In energy law and policy, command and control refer to the monopolistic approach to energy supply, according to which the government decides the type and location of the infrastructure to be built, and determines end-user energy prices.[27] The advantage of this approach is its simplicity given that the government controls all parts of the energy system, and regulated price guarantees provide certainty to investors. The main drawback concerns the economic inefficiency of monopolies. Utilities can overinvest (resulting in overcapacity, as is the case in China currently)[28] or underinvest, depending on the government's policy on prices and investments.

Since 1990, states have engaged in liberalisation reforms of energy markets because of the efficiency benefits that a competitive approach to energy supply is expected to generate.[29] In liberalised markets, utilities make investment decisions in

21 Michael Grubb, 'Strengthening the EU ETS: Creating a Stable Platform for Energy Sector Investment' (Climate Strategies Report, 2012) <http://climatestrategies.org/wp-content/uploads/2012/03/cs-strengtheningtheeuets-fullreport.pdf> accessed 6 October 2017.

22 Peter John Wood and Frank Jotzo, 'Price Floors for Emissions Trading' (2011) 39 Energy Policy 1746; Ian Bartle and Peter Vass, 'Climate Change Policy and the Regulatory State – A Better Regulation Perspective' (Centre for the Study of Regulated Industries Research Report 19, University of Bath, September 2007) <http://www.bath.ac.uk/management/cri/pubpdf/Research_Reports/19_Ian_Peter.pdf> accessed 6 October 2017.

23 Elena Ares and Jeanne Delebarre, 'The Carbon Price Floor' (House of Commons Briefing Paper Number CBP05927, 23 November 2016) <http://researchbriefings.files.parliament.uk/documents/SN05927/SN05927.pdf> accessed 6 October 2017.

24 Decision (EU) 2015/1814 of 6 October 2015 Concerning the Establishment and Operation of a Market Stability Reserve for the Union GHG Emission Trading Scheme and Amending Directive 2003/87/EC [2015] OJ L264/1.

25 Recital 27, Directive 2009/28 on the promotion of the use of energy from renewable sources and repealing Directive 2001/77 [2009] OJ L140/16.

26 'Energy Agreement for Sustainable Growth' [Energieakkoord voor duurzame groei] (Social and Economic Council of the Netherlands, 6 September 2013) < https://www.ser.nl/en/publications/publications/2013/energy-agreement-sustainable-growth.aspx> accessed 6 October 2017; Ministerie van Economische Zaken, Brief Minister Kamp aan Tweede Kamer betreffende uitvoering motie over uitfaseren van kolencentrales (18 December 2015).

27 See Manuel Baritaud, 'Securing Power during the Transition: Generation Investment and Operation Issues in Electricity Markets with Low-Carbon Policies' (International Energy Agency (IEA), 2012) 15–17 <http://www.iea.org/publications/insights/insightpublications/SecuringPowerTransition_Secondeedition_WEB.pdf> accessed 6 October 2017.

28 See section 3.1. below.

29 See, eg Fereidoon Sioshansi (ed), *Evolution of Global Electricity Markets: New Paradigms, New Challenges, New Approaches* (Elsevier 2013); Paul Joskow, 'Lessons Learned from Electricity-Market Liberalization' (2008) 29 (2) The Energy Journal 9.

energy production based on the predicted return that these investments can be expected to generate. Similarly, prices are deregulated (ie determined on the basis of the forces of supply and demand). The challenge for policy-makers is that the choice of technologies becomes the responsibility of the private utilities.[30] The government can no longer dictate the implementation of certain investments. The ability of liberalised electricity ('energy only') markets to deliver energy security is increasingly questioned.[31] States are reintroducing direct regulation to ensure the necessary investments, eg through capacity tenders or capacity remuneration mechanisms.[32]

2.2. Companion Policies: the Environment–Energy Interaction

Regulatory choices in the energy sector influence the effectiveness of environmental instruments in achieving environmental protection objectives.[33] For instance, the limited literature on the environment–energy interaction highlights how, in regulated power markets, the operators of power plants will more readily comply with a requirement to use expensive environmental control equipment if the government increases the price of electricity to recover the cost of this equipment.[34] As will be seen below,[35] China followed this approach by setting higher electricity tariffs for cleaner power generation installations. Moreover, the regulatory regime that applies to electricity investments and electricity prices influences the functioning of market-based environmental instruments, eg the ETS.

First, the efficient functioning of an ETS depends on a certain level of flexibility for energy companies to determine their investment programme. As will be highlighted by the case of China,[36] if energy investments remain subject to direct regulation, the impact of an ETS on the implementation of decarbonisation measures is limited; this is because it is the government (and not the companies) that decides what investments are made. Supplementing the market with elements of traditional regulation can be necessary to provide clearer and more certain signals to decarbonisation investments than is the case with markets only. In fact, in most energy markets, low-carbon investments are still made on the basis of direct government support (eg renewable energy subsidies or portfolio standard obligations).[37]

30 Catherine Mitchell and Bridget Woodman, 'Regulation and Sustainable Energy Systems' in Robert Baldwin, Martin Cave and Martin Lodge (eds), *The Oxford Handbook of Regulation* (OUP 2010) 573.

31 See, eg Neuhoff and De Vries (n 14) 264; Roques (n 14) 175.

32 See European Commission, 'Final Report of the Sector Inquiry on Capacity Mechanisms', 30 November 2016 COM (2016) 752 final; Jens Perner and Christoph Riechman, 'Energy Market Design with Capacity Mechanisms', in Leigh Hancher, Adrien de Hauteclocque and Malgorzata Sadowska (eds), *Capacity Mechanisms in the EU Energy Market: Law, Policy and Economics* (OUP 2015) 59–78.

33 See, eg Jay Coggins and Vincent Smith, 'Some Welfare Effects of Emission Allowance Trading in a Twice-Regulated Industry' (1993) 25 Journal of Environmental Economics and Management 275; Meredith Fowlie, 'Emissions Trading, Electricity Restructuring, and Investment in Pollution Abatement' (2010) 100 American Economic Review 837; Douglas Bohi and Dallas Burtraw, 'Utility Investment Behavior and the Emission Trading Scheme' (1992) 14 Resources and Energy 129.

34 Janice Hauge and David Sappington, 'Pricing in Network Industries' in Robert Baldwin, Martin Cave and Martin Lodge (eds) *The Oxford Handbook of Regulation* (OUP 2010) 486; Fowlie, ibid 837.

35 See section 4.2 below.

36 See section 3.1 below.

37 See eg, 'UNECE Renewable Energy Status Report 2017' (REN21, 2017), available at < http://www.ren21.net/status-of-renewables/regional-status-reports/ > accessed 6 October 2017.

However, following the 'waterbed effect' theory,[38] these 'companion policies'[39] to the ETS can distort the functioning of the ETS, and thereby further undermine the effectiveness of this market mechanism in ensuring low-carbon investments. Indeed, by reducing the emissions of power plants, companion policies reduce the need for allowances in the energy sector, which increases the availability of allowances—and thus stimulates increases of emissions—in other ETS sectors.[40] The effectiveness of the Dutch proposal to shut down coal-fired power stations was questioned on this basis.[41] In the absence of an adjustment to the cap of the EU's ETS, the closure of coal-fired installations in the Netherlands would result in an increase of GHG emissions somewhere else in the EU. In China, as will be discussed below,[42] this risk is limited because of the output-based approach to the allocation of carbon allowances.

Secondly, the impact of an ETS on energy decarbonisation depends on the extent to which energy prices reflect the carbon cost. In the liberalised markets, the cost of carbon is 'passed through' to electricity consumers through the electricity market price.[43] Following the 'merit order' effect, the ETS reduces the profit margin of the more polluting power plants and increases the profits of cleaner energy sources.[44] In regulated markets, the financial impact of an ETS on energy producers depends primarily on the regulatory treatment of allowances by the tariff authorities.[45] The tariff regulator determines whether and how energy companies can recover the cost of carbon allowances by increasing the price of electricity. The regulator also determines whether and how energy companies can recover the capital expenses, they incur in emission-reduction measures. As will be examined in the Chinese case study below,[46] the transition from regulated to liberalised energy markets provides an opportunity to align ETS and energy price signals.

3. INVESTMENTS IN DECARBONISATION IN CHINA: CENTRALLY PLANNED OR MARKET-DRIVEN?

China's electricity sector has gone through several stages of reform aiming at gradually introducing market-based principles in the organisation of the electricity supply. Each reform stage had a significant impact on the way investments are made in the country, with important consequences for the environmental problems that the

38 See, eg, Driesen 'Emissions Trading versus Pollution Taxes' (n 10).

39 Matthes (n 12).

40 'The Waterbed Effect and the EU ETS: An Explanation of a Possible Phasing Out of Dutch Coal Fired Power Plants As an Example' (*Ecofys*, 22 June 2016) <http://www.ecofys.com/files/files/ecofys-2016-the-waterbed-effect-and-the-euets.pdf> accessed 6 October 2017.

41 ibid.

42 See section 3.3 below.

43 Jos Sijm, Yihsu Chen and Benjamin Hobbs, 'The Impact of Power Market Structure on CO2 Cost Pass-Through to Electricity Prices under Quantity Competition – A Theoretical Approach' (2012) 34 Energy Economics 1143.

44 See eg J Horst Keppler, 'Annex: The Interaction between the EU ETS and European Electricity Markets' in A Denny Ellerman, Christian de Perthuis and Frank Convery (eds), *Pricing Carbon: The European Union Emissions Trading Scheme* (CUP 2010) 293.

45 Fowlie (n 33) 840; Bohi and Burtraw (n 33) 130–31; Gary Hart, 'Southern Company's BUBA Strategy in the SO_2 Allowance Market' in Richard Kosobud (ed), *Emissions Trading: Environmental Policy's New Approach* (Wiley 2000) 204–08.

46 See section 4.3 below.

Chinese electricity sector is facing.[47] To understand the scope for the ETS to drive investments in the decarbonisation of the energy supply, it is necessary to briefly examine the reform of the Chinese electricity market, with a focus on the planning and approval of investments. Are investments in China's electricity production infrastructure dictated by the state or do companies determine their investments, thus leaving scope for the ETS to influence companies' investment decisions?

3.1. Approval of Investments

Before 1985, the electricity industry in China was organised as part of the Ministry of Electric Power and Hydro Resources; this official body took all decisions on the organisation of the sector and the development of the infrastructure.[48] China initiated the first stage of reform of the electricity industry in 1985 with the objective of promoting domestic and foreign investments.[49] In 1997, the sector was corporatised under the State Power Corporation.[50] In 2002, the State Power Corporation was dismantled and on its foundations 11 smaller companies were created, including China's 'big five' power generation companies.[51] These reform measures placed energy companies at the centre of the investment-making process. From that moment, companies made investment proposals to be approved by the state.

During the reform process, state approval of power generation projects was transferred back and forth from the central government to the provincial administration. The decentralisation of licensing powers plays a significant role in explaining the carbon intensity of the Chinese electricity sector and the type of regulatory responses needed to reduce the GHG emissions of electricity generation in China (ie ETS or traditional regulation; planning of investments).

The 1985 reform delegated to the provincial authorities the responsibility of approving power plants below a certain production capacity.[52] Desperate to maintain the power supply to the regional industry and population, the provinces accelerated the construction of additional production capacity, regardless of the energy efficiency

47 See eg Philip Andrews-Speed, *The Governance of Energy in China: Transition to a Low-Carbon Economy* (Palgrave Macmillan 2012); Fredrich Kahrl and others, 'Challenges to China's Transition to a Low Carbon Electricity System' (2011) 39 Energy Policy 4032; HW Ngan, 'Electricity Regulation and Electricity Market Reforms in China' (2010) 38 Energy Policy 2142, 2143.

48 Qiang Wang and Xi Chen, 'China's Electricity Market-oriented Reform: From an Absolute to a Relative Monopoly' (2012) 51 Energy Policy 143, 146.

49 Notice of the State Council's Approval and Written Reply to the 'Interim Provisions on Encouraging Fund-raising for Power Construction and Implementing Differentiated On-grid Tariffs' Initiated by the State Economic and Trade Commission and other Departments [国务院批转国家经委等部门《关于鼓励集资办电和实行多种电价的暂行规定》的通知] (State Council Order No (1985) 72, 23 May 1985).

50 Notice of the State Council on the Establishment of the State Power Corporation [国务院关于组建国家电力公司的通知] (State Council Order No (1996) 48, 7 December 1996).

51 Scheme of Reforming the Electric Power System [电力体制改革方案] (State Council Order No. (2002) 5, 10 February 2002).

52 See State Council Order No (1985) 72 (n 49). Notice of the State Council's Approval and Written Reply to the Opinion of the National Development and Reform Commission on Resolutely Stopping the Disordered Construction of Power Generation Station [国务院批转发展改革委关于坚决制止电站项目无序建设意见的通知] (State Council Order No (2004) 32, 24 November 2004).

and environmental characteristics of the proposed investments. This resulted in a chaotic increase of small-scale and inefficient coal-fired power plants.[53] This energy security policy boosted the country's economic growth, but locked the Chinese electricity industry in a carbon-intensive direction.[54]

In 2004, to strengthen state control over electricity investments, the licensing authority for most types of power generation projects (including coal-fired plants) was transferred to the central government's investment watchdog—the National Development and Reform Commission (NDRC).[55] However, this recentralisation of approval powers did not result in the expected disciplining of the investment-making process. Between 2005 and 2015, the Chinese government did not adopt a national development plan (Five-Year Plan) for the electricity sector, and as a consequence the NDRC's review of investment projects took place without sufficiently rigorous evaluation criteria.[56]

In 2013, the approval of coal-fired power plants (including their Environmental Impact Assessment (EIA)) was again decentralised.[57] The transfer of permitting authority from the NDRC to the provincial authorities was followed by a significant surge in new coal generation projects.[58] However, the growth of electricity demand in China has experienced a dramatic slowdown,[59] thus reducing the operating hours of existing power plants.[60] Electricity production in most Chinese provinces now faces a situation of overcapacity, in particular, the overcapacity of coal-fired power plants.[61]

53 Ngan (n 47) 2143.

54 State Council Order No (2004) 32 (n 52).

55 Decision of the State Council on Reforming the Investment System [关于投资体制改革的决定] (State Council Order No (2004) 20, 16 July 2004).

56 Approval of coal-fired power plants mainly depended on a water consumption permit, a permit for the discharge of emissions, and an EIA. Environmental Compliance Guidelines for Thermal Coal-fired Installations [燃煤火电企业环境守法导则], (Ministry of Environmental Protection Order No (2013) 288, 20 March 2013).

57 Decision of the State Council on Issues Concerning Administrative Approval to be Removed or Delegated to Lower Levels [国务院关于取消和下放一批行政审批项目等事项的决定] (State Council Order No (2013) 19, 15 May 2015); Announcement of the Ministry of Environmental Protection on Issuing the List of Investment Projects that Require Environmental Impact Assessment from the Ministry of Environmental Protection [关于发布《环境保护部审批环境影响评价文件的建设项目目录（2015年本）》的公告] (Ministry of Environmental Protection Order No. (2015) 17, 13 March 2015).

58 In 2015, a total of 210 coal-fired generation projects applied for an EIA, of which 195 (amounting to 159 GW) were ready for clearance. In comparison, the total approved capacity in 2014 amounted to 49 GW. Lauri Myllyvirta, Xinyi Shen and Harri Lammi, 'Consequences of China's Investment Surge in Coal Power Generation in 2015' [2015年中国煤电逆势投资的后果] (*Greenpeace*, 2 March 2016) <http://www.greenpeace.org.cn/wp-content/uploads/2015/11/The-consequences-of-coal-investment-in-china.pdf> accessed 6 October 2017.

59 'Statistic Bulletin of the People's Republic of China on National Economic and Social Development in 2015' [中华人民共和国2015年国民经济和社会发展统计公报] (National Bureau of Statistics, 29 February 2016) <http://www.stats.gov.cn/tjsj/zxfb/201602/t20160229_1323991.html> accessed 6 October 2017.

60 'Briefing on the Operation of Electric Power Industry in China from January to November 2016' [2016年1-11月份电力工业运行简况] (China Electricity Council, 15 December 2016) <http://www.cec.org.cn/guihuayutongji/gongxufenxi/dianliyunxingjiankuang/2016-12-15/162511.html> accessed 6 October 2017.

61 Notice of the NDRC and the National Energy Administration (NEA) on Promoting the Proper Development of China's Coal Power Generation [国家发展改革委 国家能源局关于促进我国煤电有序发展的通知] (NDRC and NEA Order No (2016) 565, 17 March 2016).

3.2. Controlling Overcapacity and Emissions with Investment Planning

To address the overcapacity and environmental problems of electricity production, the central government faces the challenge of ensuring control over new electricity projects in a context of decentralisation of permitting authority.[62] The central government uses a mixture of traditional regulation (in particular, central planning and environmental standards) and market instruments (in particular, taxation and the ETS) to steer investments towards a more sustainable energy supply.[63] The following analysis examines the use of central planning and environmental standards to highlight the continued importance of traditional regulation to address the environmental problems in China's electricity sector.

The Five-Year Plan—China's periodical planning instrument—plays a key role in the latest attempt of the central government to regain control over the development of the electricity sector, while leaving the provincial authorities in charge of the approval of investments. The Five-Year Plan for Economic and Social Development is intended to coordinate public policy priorities and to set out major development objectives for the coming five years. Since 2006, the Five-Year Plan has integrated climate change mitigation into the country's economic planning.[64] Moreover, the NDRC in 2016 approved a Five-Year Plan for Energy Development[65] and a Five-Year Plan for Electricity Development.[66] Recognising the problem of overcapacity and heavy dependence on coal, the 2016 Energy and Electricity Five-Year Plans aim to limit the capacity of coal-fired power generation by 2020.[67]

To achieve this objective, the central government firstly seeks to enforce compliance with the existing planning rules. The chaotic development of coal-fired power plants was, to a certain extent, the consequence of the construction of these installations without waiting for the license, or in violation of the terms of the license.[68] This was tolerated in a context of pressure on the supply—demand adequacy of the Chinese electricity system. However, in a situation of overcapacity, the NDRC

62 Li Keqiang, 'Speech at a Meeting on Functional Transformation and Institutional Reform of Local Government' [李克强总理在地方政府职能转变和机构改革会议上的讲话] (State Council Official Website, 8 November 2013) <http://www.gov.cn/guowuyuan/2013-11/08/content_2591026.htm> accessed 6 October 2017.

63 Notice of the NEA on Issuing the 'Interim Measures of Strengthening the Supervision of the Planning and Construction Work after Decentralizing the Authority of Energy Project Approval' [国家能源局关于印发《关于加强电力项目核准权限下放后规划建设监管工作的暂行办法》的通知] (NEA Order No (2015) 545, 12 December 2014); Notice of the NDRC and the NEA on Accomplishing the Relevant Planning and Construction Work after Decentralizing the Authority of Energy Project Approval [国家发展改革委 国家能源局关于做好电力项目核准权限下放后规划建设有关工作的通知] (NDRC and NEA Order No (2015) 2236, 8 October 2015).

64 Hao Zhang, 'China's Energy Conservation and Carbon Emissions Reduction System: Development and Status Quo of the Regulatory and Institutional Framework' (2012) 42 (3) Environmental Law Reporter: News & Analysis 10260.

65 Notice of the State Council on Issuing the 13th Five-Year Plan for Energy Development [国务院关于印发能源发展"十三五"规划的通知] (NDRC and NEA Order No (2016) 2744, 20 December 2016) ch 3, pt 3.

66 The 13th Five-Year Plan for Electricity Development (2016– 2020) [电力发展"十三五"规划(2016-2020)] (NDRC and NEA, 7 November 2016).

67 ibid. The goal is to limit the total capacity of coal-fired plants in China to less than 1,100 GW by 2020; see also NDRC and NEA Order No (2016) 2744 (n 65).

68 NDRC and NEA Order No (2016) 565 (n 61).

ordered the provincial authorities not to grant business operation licences for power generation to any new project that was not permitted in compliance with the national and provincial planning procedures.[69]

Secondly, the NEA established a 'capacity warning mechanism' to limit the construction of new coal-fired power plants and avoid the construction rush that characterised previous experiences with the decentralisation of licensing authority.[70] To assess the risk of overcapacity in a province's electricity system, the administration uses a mixture of energy security (reserve margin), financial (rate of return), and environmental indicators. The projected cost of carbon is not part of the administration's financial and environmental analysis, but the administration pays attention to the impact of coal-fired power plants on the quality of the environment (air) and the use of natural resources (water and coal).[71] Provinces with high risk of overcapacity are strongly recommended to postpone the approval of coal-fired plants and plants that are already under construction should be 'reasonably sequenced to commence production'.[72]

Thirdly, the NDRC opted for one of the most radical forms of direct regulatory interference with investment projects—the retroactive cancellation of construction permits[73] and of planning decisions.[74] This was justified based on the fact that many

69 Notice of the NDRC and the NEA on Further Controlling the Pace of Constructing Electric Power Projects [国家发展改革委 国家能源局关于进一步规范电力项目开工建设秩序的通知] (NDRC Order No (2016) 1698, 5 August 2016), arts 6 and 7. The provincial authorities must review compliance with all permitting procedures and suspend construction in cases of non-compliance with the law. If the investor refuses to suspend construction, the provincial authority must restrict the approval of other new investments from the same investor. The NEA will publicise the names of these investors, and banks and other financial institutions are requested to stop lending to them. Network companies are forbidden from connecting to the network power plants that were constructed without the required licenses.

70 Notice of the NEA on Establishing the Risk Warning Mechanism for the Construction and Planning of the Coal-fired Plants & Issuing the Risk Warning for the Construction and Planning of the Coal-fired Plants till 2019 [国家能源局关于建立煤电规划建设风险预警机制暨发布2019年煤电规划建设风险预警的通知] (NEA Order No (2016) 42, 17 March 2016).

71 The latest assessment in 2016 shows the extent of China's overcapacity and environmental problem. Only three provinces (Jiangxi, Anhui and Hainan) received a green light to construct more coal-fired plants, and one (Hubei province) was granted a moderate warning. All other provinces were given red alerts.

72 NEA Order No (2016) 42 (n 70), para 6.

73 Nine provinces were required to reverse 15 construction licenses, amounting to 12.4 GW installed production capacity. The NEA also engaged in consultations with 11 more provinces to further suspend or halt construction of 83 coal-fired investment projects, with an estimated total capacity of 100 GW. See Notice of the NEA on Abolishing the Construction of a Number of Coal-fired Plants that Fail to Meet the Requirement for Approval [国家能源局关于取消一批不具备核准建设条件煤电项目的通知] (State Council Order No. (2016) 244, 13 September 2016). See also 'Several Provinces being Notified to Control the Scale of Coal-fired Power Generation and a Number of Projects being Postponed for Construction after the 13th Five-year Period' [多地接通知控制煤电规模 一批项目推迟至"十三五"后] (Power Construction Corporation of China website, 19 January 2017) <http://www.powerchina.cn/art/2017/1/19/art_26_218392.html> accessed 6 October 2017.

74 The administration reversed the planning decision to develop more coal-fired power stations in the traditional coal-basins of Xinjiang, Ningxia, Shaanxi and Inner Mongolia. The coal provinces are required to cut the capacity of their previously approved coal-fired plants by 50% before 2020. Notice of the NEA on Further Controlling the Planning and Construction of Coal-fired Power Generation [国家能源局关于进一步调控没电规划建设的通知] (NEA Order No (2016) 275, 10 October 2016); Action Plan for Upgrading and Retrofitting the Coal Thermal Power to Conserve Energy and Reduce Emissions [国家发展改革委员会 环境保护部 国家能源局 关于印发《煤电节能减排升级与改造行动计划(2014-2020)》的通知] (NDRC Order No (2014) 2093, 12 September 2014) ch 2, para 5.

new coal-fired production projects were already approved before the entry into force of the capacity warning mechanism.[75] Based on the evidence accumulated so far, direct interference by the central government with planning and licensing decisions appears to be effective in addressing the overcapacity problem. According to the China Electricity Council, total investments in coal-fired power plants dropped by 9.1% by October 2016 in comparison with 2015.[76] By limiting the addition of new coal-fired power plants, the central government's interference with electricity licences clearly contributes to limiting the GHG emissions in the Chinese electricity sector.

This regulatory intervention is not necessarily incompatible with the introduction of an ETS. In the EU, for instance, national energy regulators are also charged with the licensing of new power plants, and during this approval process they must take into account the impact of new facilities on energy security and environmental protection.[77] The purpose of the ETS is to drive companies to propose cleaner investments, but it does not prevent the government from intervening if investment proposals do not correspond to the government's sustainability plans for the electricity sector.

3.3. Targets, Performance Standards and the Forced Decommissioning of Power Plants

Besides reinforced central planning, the Chinese government is making increasing use of targets and performance standards to steer investments in the context of the decentralisation of permitting authority. Targets and performance standards are economy-wide, sector-specific (eg electricity) and installation-specific (eg coal-fired power plants). They can be binding (with specific enforcement procedures) or non-binding (guidelines to be taken into account in the development of projects). Because they relate to the energy intensity of coal-fired power plants and the carbon intensity of the Chinese economy, targets and performance standards have an impact on GHG emissions in the electricity sector and thus closely interact with the ETS.

Building on the achievements of the 11th and 12th Five-Year Plans in the field of energy efficiency improvement,[78] the 13th Five-Year Plan (2016–20) adopted energy and carbon efficiency improvement targets of 15% and 18%, respectively, to be achieved by the provincial authorities by 2020 (Table 1).[79] Because of its heavy

75 A total of 160 GW production capacity received environmental clearance between 2012 and 2014 and can start construction. Jiahai Yuan, 'Overcapacity and Investment Bubbles in China's Coal-fired Power Generation' [中国煤电产能过剩及投资泡沫研究] (Greenpeace Climate and Energy Project, November 2015) <http://www.greenpeace.org.cn/wp-content/uploads/2015/11/Media-Briefing_CN_20151118.pdf> accessed 6 October 2017.

76 'Briefing on the Operation of Electric Power Industry in China from January to October 2016' [2016年1-10月份电力工业运行简况] (China Electricity Council, 17 November 2016) <http://www.cec.org.cn/guihuayutongji/gongxufenxi/dianliyunxingjiankuang/2016-11-17/161073.html> accessed 6 October 2017.

77 Directive 2009/72/EC concerning Common Rules for the Internal Market in Electricity and Repealing Directive 2003/54/EC [2009] OJ L211/55, art 7.

78 Xiaowei Xuan, 'Analysis on the Implementation of the 12th Five-year Plan and its Enlightenment to Formulating the 13th Five-year Plan' ["十二五"规划执行情况的分析及对"十三五"规划制定的启示] (2015) 1 Regional Economic Review [区域经济评论] 5.

79 The 13th Five-Year Plan for Economic and Social Development (n 1); State Council Order No (2016) 74 (n 2); *Notice of the State Council on Issuing the Workplan to Control Greenhouse Gas Emissions during the*

Table 1 Economy-wide and electricity-specific targets in the 13th Five-Year Plan period

Target	By 2020	Bound entities	Enforcing agencies	Implications of non-compliance
Energy intensity	15% reduction per unit GDP	Provincial governments and central SOEs	NDRC and provincial governments	Affecting overall performance assessment of officials, reducing relevant financial support, facing higher end-use tariff and restrictions on new investment approval for energy-intensive projects
Carbon emissions intensity	18% reduction per unit GDP	Provincial governments and central SOEs	NDRC and provincial governments	Affecting overall performance assessment of officials and reducing relevant financial support
Electricity consumption from non-fossil fuel sources	Increasing to 15% and above in the total electricity consumption (12% in 2015)	Provincial governments, and central SOEs	NDRC, NEA and provincial governments	Revoking the business licence of power generators

Source: Compiled by authors based on official documents.

reliance on coal, the electricity sector has a key role to play in achieving the national energy efficiency and carbon intensity targets.

At the installation-specific level, binding energy efficiency, coal consumption and emission-reduction standards aim to reduce the use of coal by existing and new thermal power plants, and to control the major pollutants associated with the coal combustion process (see Table 2).[80] Small installations (ie those below 300 MW) that are in operation for more than 20 years must be retrofitted to 'ultra-low emission' facilities,[81] ie facilities that emit less than 35 mg/m^3 SO_2, 50 mg/m^3 NO_X and 10 mg/m^3 ashes.[82]

13th Five-Year Period [国务院关于印发"十三五"控制温室气体排放工作方案的通知] (State Council Order No (2016) 61, 27 October 2016).

80 ibid pt 1, para 2.

81 NDRC and NEA Order No (2016) 2744 (n 65) 25.

82 *Notice of the NDRC, Ministry of Environmental Protection and NEA on the Implementation of the Pricing Policy so as to Support the Ultra-low Emissions of Coal-fired Power Plants* [国家发展改革委 环境保护部 国家能

Table 2 Installation-specific binding targets

Target	By 2020	Bound entities	Enforcing agencies	Implications of non-compliance
Energy efficiency of existing coal-fired power plant	310 g standard coal-eq and below per kwh electricity generated (reduced from 318 g in 2015)	Coal-fired power plants	NDRC and NEA	Restrictions to access to resources (ie water) and facing elimination
Energy efficiency of new coal-fired power plant	300 g standard coal-eq and below per kwh electricity generated	Coal-fired power plants	NDRC and NEA	Disapproval for construction
Pollutants discharged by coal-fired power generation	Less than 35 mg SO_2, 50 mg NO_x and 10 mg ashes per cubic meter of emissions discharged	Coal-fired power plants	NDRC and Ministry of Environmental Protection	Restrictions to access to resources (ie water) and facing elimination

Source: Compiled by authors based on official documents.

The consequences of not complying with targets and emission performance standards are severe. To ensure the achievement of the provincial energy efficiency and the environmental targets determined in the 11th and 12th Five-Year Plans, the State Council required the provincial authorities and state-owned enterprises (SOEs) to eliminate inefficient installations.[83] This policy was successful. The 11th Five-Year Plan aimed to close up to 50 GW of inefficient power stations by 2010[84]—a target that was largely overachieved with the closure of 72.1 GW capacity.[85] Moreover, between 2011 and 2015, 28 GW was effectively closed down, surpassing the target of 20 GW in the 12th Five-Year Plan period (Table 3).[86]

源局关于实行燃煤电厂超低排放电价支持政策有关问题的通知] (NDRC Order No (2015) 2835, 2 December 2015) pt 1.

83 Notice of the State Council on Issuing the Comprehensive Workplan for Energy Conservation and Emissions Reduction [国务院关于印发节能减排综合性工作方案的通知] (State Council Order No (2007) 15, 23 May 2007).

84 ibid. Annex table of major targets.

85 'China's Energy Development in the 11th Five-year Plan Period' ["十一五"时期我国能源发展概况] (The Central People's Government of the People's Republic of China website, 26 February 2012) <http://www.gov.cn/test/2012-06/26/content_2169887_2.htm> accessed 6 October 2017.

86 Notice of the NDRC and the NEA on Furthering the Elimination of Inefficient Capacity in Coal-fired Power Generation [国家发展改革委 国家能源局关于进一步做好煤电行业淘汰落后产能工作的通知] (NDRC Order No (2016) 855, 18 April 2016).

Table 3 Forced closure of coal-fired power plants in China

Period	Planned closure (GW)	Actual closure (GW)
11th Five-Year Plan	50	72.1
12th Five-Year Plan	20	28
13th Five-Year Plan	20	70 (estimated in total, and 4.918 in 2016)

Source: Compiled by authors based on official documents, and Greenpeace (n 91).

Under the latest (13th) Five-Year Plan, forced decommissioning is used to enforce compliance with the installation-specific standards.[87] Inefficient plants that are not retrofitted to meet the binding energy efficiency standard of 310 g standard coal-eq per kWh electricity generated, will be restricted to access certain resources and eventually face elimination.[88] New investments that do not satisfy the required efficiency standard of 300 g standard coal-eq per kWh cannot be approved for construction.[89] Existing coal-fired power plants that fail to meet the binding energy efficiency and emission (SO_2 and NO_X) performance standards must be closed down.[90] Provincial authorities are required to comply with these stringent and specific closure rules. By 2017, 105 GW of coal-fired production capacity had already been shut down, mainly affecting the small-scale and inefficient thermal installations that provincial authorities promoted bypassing national approval (see Table 3). Greenpeace estimates that an additional capacity of 70 GW can be eliminated, if the objectives and measures of the 13th Five-Year Plan are strictly enforced.[91]

These measures have helped to ensure compliance with the energy intensity and emission performance standards and resulted in significant energy efficiency improvements in the Chinese power sector.[92] Between 2011 and 2015, the average efficiency of coal-fired power plants in China increased to 315 g/kWh,[93] compared to a nation-wide average of 355 g/kWh in 2011.[94] The carbon intensity of China's

87 The 13th Five-Year Plan for Electricity Development (n 66) 13.

88 ibid.

89 ibid.

90 ibid.

91 In 2016, the NEA eliminated a total of 4.918 MW installed capacity of coal-fired power plants by assigning the respective elimination task to provinces. See, in particular, Notice on Eliminating Backward Capacity in Coal-fired Power Industry in 2016 [关于2016年煤电行业淘汰落后产能目标任务的通知] (NEA Order No (2016) 282, 16 October 2016); Lauri Myllyvirta and Xinyi Shen, 'China's Coal-fired Power Boom is Hard to Ease' [中国煤电热潮高烧难退] (*Greenpeace*, July 2016) <http://www.greenpeace.org.cn/wp-content/uploads/2016/07/报告_中国煤电热潮高烧难退.pdf> accessed 6 October 2017.

92 See Chunbo Ma and Xiaoli Zhao, 'China's Electricity Market Restructuring and Technology Mandates: Plant-level Evidence for Changing Operational Efficiency' (2015) 47 Energy Economics 227. See, however, Yinfang Zhang and Ping Gao, 'Integrating Environmental Considerations into Economic Regulation of China's Electricity Sector' (2016) 38 Utilities Policy 62, arguing that China failed to 'adequately and systematically incorporate environmental considerations into the formulation and enforcement of electricity regulation'.

93 China Electricity Council, *Annual Report of the Development of China's Electrical Power Industry* [中国电力行业年度发展报告] (China Market Press [中国市场出版社], 2016) 108–09.

94 ibid. See also Yuan Xu, Chi-Jen Yang and Xiaowei Xuan, 'Engineering and Optimization Approaches to Enhance the Thermal Efficiency of Coal Electricity Generation in China' (2013) 60 Energy Policy 356.

Table 4 Average energy efficiency and number of units based on level of installed capacity

Level of capacity (10,000 kW)		Total number of units and capacity	Total capacity (10,000 kW)	Average level of energy efficiency (g/kWh)	Accounting for the proportion of total capacity surveyed (%)
0.6 and above		7,526	97,033	315	100.00
Among which	60 and above	609	41,638	287* 309**	42.91
	Between 30 and 60 (excluding 60)	1,051	34,600	305	35.66
	Between 20 and 30 (excluding 30)	254	5,488	324	5.66
	Between 10 and 20 (excluding 20)	467	6,403	327	6.60
	Less than 10	5,145	8,904	355	9.18

**Note*: Average energy efficiency for installations above 1,000 MW;
**Average energy efficiency for installations between 600 and 1,000 MW.
Source: Compiled based on China Electricity Council (n 93).

power industry has been decreasing since 2005.[95] Most large thermal installations operate at levels of energy efficiency that meet the existing performance standards and are thus not exposed to closure in the future, at least in the short-to-medium term (see Table 4).

These achievements were made in the face of significant pressure by provinces and SOEs against the closure of power plants. The forced decommissioning of electricity facilities is seen as a threat to the local and provincial economy.[96] Provincial and local governments not only face resistance from enterprises, but also from employees,[97] thus presenting a risk to social stability. To address these obstacles and facilitate the forced closure of inefficient power plants, the central government both rewards provinces and SOEs that outperform their obligations and penalises those that fail to comply. On the one hand, the performance of provinces in the field of energy intensity and emission reductions impacts on the promotion of officials.[98] The failure of provinces to meet binding targets triggers the accountability of the

95 According to Zhixuan Wang and others, 'Estimate of China's Energy Carbon Emissions Peak and Analysis on Electric Power Carbon Emissions' (2014) 5 Advances in Climate Change Research 181; CO_2 emissions from China's power industry were reduced by approximately 4.73 Gt from 2006 to 2013, as compared to the 2005 level.

96 Zhang (n 64).

97 Announcement of the Ministry of Industry and Information Technology and the NEA on Progress of Completion regarding Eliminating Inefficient Production Capacity Nationwide [2012年全国淘汰落后产能目标任务完成情况], Ministry of Industry and Information Technology and NEA Order No. (2013) 57, 21 November 2013.

98 State Council Order No (2016) 74 (n 2), annex 1.

provincial administration towards the central government.[99] On the other hand, special funds for structural adjustment of industrial enterprises have been established in order to compensate SOEs and their employees for the impact of closure.[100]

In the context of the decentralisation of licensing authority, the use of emission performance standards and the forced decommissioning of inefficient power plants is a key instrument whereby the central government enforces compliance with national planning. These instruments are of strategic use for the national government to achieve electricity investment and environmental protection objectives. The statistics on the closure of coal-fired power plants (Table 3) and energy efficiency improvement levels (Table 4) in the Chinese power generation sector show that these instruments have, at least to a certain extent, been effective. However, under this approach, emission reductions result from the most penetrating form of traditional regulation, thus reducing the scope for the market (the ETS) to incentivise the decarbonisation of the energy supply.

This does not mean that performance standards and the forced decommissioning of carbon-intensive facilities are necessarily incompatible with an ETS. As seen above,[101] in the EU, Member States use—or are considering using—companion policies (eg subsidies, capacity tenders and forced decommissioning) to achieve the necessary decarbonisation investments that the EU ETS so far failed to deliver. Because the EU ETS is based on an absolute cap that is determined years in advance and can difficultly be changed *ex post*, the waterbed effect of companion policies and their impact on the demand for allowances must be estimated *ex-ante* and considered in the cap setting process.[102] For instance, the EU ETS cap and its yearly reduction rate to a certain extent anticipated the reduction of GHG emissions resulting from the EU's ambitious renewable energy policy.[103] However, the impact on the ETS of new national companion policies (eg the proposed decommissioning of coal-fired power plants in the Netherlands) is much more difficult to integrate in the EU ETS cap, given that this would require an amendment of EU law.

Building on this international experience, China must avoid that the emission reductions achieved with traditional regulation (eg the forced shutdown of inefficient installations) will simply be compensated by an increase of GHG emissions by other

99 See, eg Genia Kostka and William Hobbs, 'Local Energy Efficiency Policy Implementation in China: Bridging the Gap between National Priorities and Local Interests' (2012) 211 China Quarterly 765; Shi Dan, 'Regional Differences in China's Energy Efficiency and Conservation Potentials' (2007) 15 China and World Economy 96.

100 It must be noted that the scope of these funds is currently limited to the elimination of overcapacity in the steel and coal industry, not directly in the power generation industry. However, subsidies to the coal industry indirectly facilitate the acceptance of decommissioning coal-fired power stations in provinces depending on coal production. Notice of the Ministry of Finance on Issuing 'Measures for the Administration of Special Funds for Structural Adjustment of Industrial Enterprises' [关于印发《工业企业结构调整专项奖补资金管理办法》的通知] (Ministry of Finance Order No (2016) 253, 10 May 2016); Opinions of the State Council on Reducing the Over-capacity of Coal Production for the Purposes of Poverty Alleviation and Development [国务院关于煤炭行业化解过剩产能实现脱困发展的意见] (State Council Order No (2016) 7, 1 February 2016).

101 See sections 2.1 and 2.2 above.

102 The authors are grateful to William Acworth for his input on formulating this argument.

103 See Nicolas Koch and others, 'Causes of the EU ETS Price Drop: Recession, CDM, Renewable Policies or A Bit of Everything? — New Evidence' (2014) 73 Energy Policy 676.

installations under the ETS. In contrast to EU Member States that can only avoid this waterbed effect by agreeing at the EU level to a corresponding cancellation of EU allowances, the Chinese government can more easily deduct from the Chinese ETS cap the emission reductions that will be or were achieved by the forced shutdown of inefficient facilities.

Moreover, China can address the waterbed effect of its companion policies through the allocation of allowances. Under the output-based (or intensity) approach to the allocation of allowances, allowances are distributed in function of the actual production of ETS installations.[104] While this means that emissions might be increased, it also allows the ETS to be directly adjusted for interactions with companion policies, such as the forced decommissioning of power plants.[105] Emission reductions resulting from the closure of a carbon-intensive electricity installation will be compensated by the cancellation of allowances initially foreseen for that installation, thus triggering an automatic adjustment of the ETS cap.

4. ELECTRICITY PRICE FORMATION: INTERNALISING THE CARBON EXTERNALITY THROUGH REGULATED OR FREE MARKET PRICES?

Electricity price formation in China has undergone several stages of structural adjustments in parallel with the reform of the electricity market architecture. This reform process impacted on the use of environmental pricing. It is necessary to examine the electricity pricing reform in order to understand how environmental pricing mechanisms, and in particular the ETS, can contribute to the decarbonisation of the Chinese energy system. Are electricity prices determined by the state or formed on the basis of the forces of supply and demand, thus leaving scope for the market to reflect the carbon cost into electricity prices?

4.1. The Deregulation of Electricity Prices in China

Following the 1985 electricity reform, the first priority of the government's tariff policy was to address the pressing shortage in electricity supply by mobilising investments in coal-fired production capacity.[106] The prices at which power plants sold the output of their installations (the 'on-grid tariffs') had to recover the cost of electricity production, with a minimum return on investment.[107] Typically, electricity tariffs were negotiated on a project-by-project basis. By ensuring to investors the recovery of their capital and operating expenses, this 'cost-plus' tariff approach contributed to the development of China's electricity production capacity. However, the guaranteed

104 'Similarities and Differences of the Allowances Allocation Method in China's National and Pilot ETS' (n 3).

105 The authors are grateful to William Acworth for his input on formulating this argument.

106 Notice of the Ministry of Electric Power and Hydro Resources, National Economic Commission, and State Pricing Bureau on Implementation Measures of Multiple On-grid Electricity Tariffs [水利电力部 国家经济委员会 国家物价局关于多种电价实施办法的通知], Ministry of Electric Power and Hydro Resources Order No (1987) 101, 28 November 1987.

107 Electric Power Law of the People's Republic of China [中华人民共和国电力法], Standing Committee of the National People's Congress (adopted on 28 December 1995, amended on 27 August 2009 and 24 April 2015), art 35, para 2.

recovery of costs did not incentivise producers to save costs and improve the energy efficiency of their operations.[108]

In 2004, China moved away from the project-to-project cost-recovery-based approach to electricity tariff regulation to benchmark pricing, in which generators coming into operation after 2004 and falling into the same technology class (eg coal thermal) receive the same tariff.[109] The tariff is decided by the Department of Pricing under the NDRC and it is based on an estimate of the average cost of industry-wide technologies and performance in each province.[110] Provided the benchmark tariff is based on sufficiently efficient installations, it can drive energy and carbon efficiency improvements.[111] Installations that underperform are not able to recover their operating expenses (eg coal cost) and thus have to improve the efficiency of their operations. Installations that already perform well have an incentive to improve their operations, as long as the capital costs of these efficiency improvements remain below the increased profit they can obtain by saving operating costs.

In 2015, the NDRC announced the gradual deregulation of pricing.[112] The objective is to phase out regulated electricity tariffs (both on-grid and retail) for industrial users, and instead to promote direct trading between industrial users and power generators at prices freely negotiated and agreed by both parties.[113] By 2020, a spot electricity market should be established to facilitate electricity trading and the formation of the equilibrium electricity market price.[114] Residential users, the agricultural sector, and key public utilities remain regulated.[115] Moreover, industrial users that do not opt for direct contracts with utilities will continue to pay benchmark prices. Benchmark tariff regulation thus remains relevant for a significant segment of the market.

4.2. Environmental Pricing Incentives before the Deregulation Reform

Long before discussions started on the introduction of an ETS, China started to use environmental pricing incentives as a 'carrot' to steer investments in the improved environmental protection of electricity production.[116] Increasing recognition of the

108 Jinlong Ma, 'On-grid Electricity Tariffs in China: Development, Reform and Prospects' (2011) 39 Energy Policy 2633, 2635.

109 Notice of the NDRC on Further Resolving the Contradictions of Electricity Tariffs and Improving Regulation of Electricity Prices [国家发展改革委员会关于进一步疏导电价矛盾规范电价管理的通知], NDRC Order No (2004) 610, 16 April 2004, pt 3, para 1.

110 ibid.

111 Wang Xuan and Fredrich Kahrl, 'Reform of China's On-grid Electricity Tariffs' [中国上网电价机制改革研究] (The Regulatory Assistance Project (RAP), February 2016) <http://www.raponline.org/wp-content/uploads/2016/05/generationdispatchcompensationreform-cn-2016-mar.pdf> accessed 6 October 2017.

112 Opinions of the State Council on Further Reforming the Electric Power System [中共中央国务院关于进一步深化电力体制改革的若干意见], State Council Order No (2015) 9, 15 March 2015, pt 3.

113 ibid. pt 3 (2); see also Zhong Qiu, 'The Impacts of Electricity Sector Reform on China's Electric Grid Companies' [电力体制改革对电网企业的影响] (2016) 9 Contemporary Economics [当代经济] 48

114 The 13th Five-Year Plan for Electricity Development (n 66), 35.

115 State Council Order No (2015) 9 (n 112) s 3, pt 1.

116 Banban Wang and Shaozhou Qi, 'Innovation and Emissions Reduction Effects of Command-and-Control and Market-based Instruments' [市场型和命令型政策工具的节能减排技术创新效应] (2016) 6 Journal of China Industrial Economics [中国工业经济] 91; Yuan Xu, 'China's Functioning

acute challenge of environmental degradation has reinforced the importance of pricing in shaping the environmental outcome of China's power generation sector.[117] The use of pricing incentives must be understood against the background of the reform of China's electricity sector. As seen above,[118] the government no longer imposes investment decisions on electricity companies; the provincial authorities approve only those investment proposals that are made by the companies. To stimulate companies to propose investment projects that contribute to achieving the government's energy policy objectives, the central government provides additional financial incentives to environmentally friendly technologies.[119]

To incentivise electricity companies to reduce their emissions of SO_2, the NDRC increased the on-grid tariff of coal-fired installations equipped with desulphurisation facilities.[120] Similarly, the NDRC financially rewards the operators of facilities that release less NO_X emissions and ashes than the environmental norm by increasing on-grid tariffs for that category of installation.[121] Collectively, these additional financial incentives for environmental protection purposes are known as the 'environmental on-grid tariff'.[122]

Environmental on-grid tariffs have become an increasingly important part of the general tariff structure of the Chinese electricity sector. The size of the disbursements of the environmental on-grid tariffs required the NDRC to lower the overall benchmark electricity tariffs in order to keep the financial system in balance.[123] Along with the drop of benchmark tariffs, the NDRC increased the environmental on-grid tariffs for coal-fired generation with 'ultra-low emissions'.[124]

Market for Sulfur Dioxide Scrubbing Technologies' (2011) 45 Environmental Science & Technology 9161.

117 Xuan and Kahrl (n 111).

118 See section 3.1 above.

119 These financial incentives also aim to ensure the financial viability of energy investments, according to the principle of cost-recovery under China's Electricity Law, art 35, para 2.

120 A surcharge is applied to the benchmark tariff of the type of power generation facility concerned. See Interim Measures for the Operation and Management of Desulphurization Facilities for Coal-fired Generating Units and the related Electricity Price [燃煤发电机组脱硫电价及脱硫设施运行管理办法（试行）] (NDRC and the State Environmental Protection Administration Order No (2007) 1176, 29 May 2007) art 4.

121 Notice of the NDRC on Relevant Matters Concerning the Adjustment of the On-grid Tariffs for Power Generation Enterprises [国家发展改革委关于调整发电企业上网电价有关事项的通知] (NDRC Order No (2013) 1942, 30 September 2013).

122 Notice of the NDRC and the Ministry of Environmental Protection on Issuing the 'Regulatory Measures of Environmental On-grid Tariffs and Operation of the Environmental Protection Facilities for Coal-fired Generating Units' [国家发展改革委 环境保护部关于印发《燃煤发电机组环保电价及环保设施运行监管办法》的通知] (NDRC Order No (2014) 536, 28 March 2014).

123 Notice of the NDRC on Further Balancing the Benefits of Environmental On-grid Tariffs [国家发展和改革委员会关于进一步疏导环保电价矛盾的通知] (NDRC Order No (2014) 1908, 20 August 2014); Notice of NDRC on Reducing the On-grid Electricity Tariff for Coal-fired Power Generation and Reducing the Electricity Price for Small Industrial and Commercial Use [国家发展改革委关于降低燃煤发电上网电价和一般工商业用电价格的通知] (NDRC Order No (2015) 3105, 27 December 2015).

124 Notice of the NDRC, the Ministry of Environmental Protection and the NEA on the Implementation of the Pricing Policy so as to Support the Ultra-low Emissions of Coal-fired Power Plants [国家发展改革委 环境保护部 国家能源局关于实行燃煤电厂超低排放电价支持政策有关问题的通知] (NDRC Order No (2015) 2835, 2 December 2015).

4.3. Environmental Costs after Deregulation: Tax and ETS

The 2015 deregulation reform of electricity prices reduces the scope for tariff incentives (a 'carrot') to reward the use of environmentally friendly technologies. With the exception of the market segment that continues to operate with benchmark tariffs, the NDRC will no longer have the power to fix prices and thus to provide financial benefits to cleaner technologies. Instead of financial rewards, China is moving towards financial penalties (a 'stick') to internalise the environmental externalities of power plants in a deregulated market environment. China's ETS and China's new environmental tax play a significant role in this new regulatory context.

With the objective of influencing the business case of polluting facilities (including coal-fired power plants), China's 2016 Environmental Protection Tax Law creates 'sticks' by imposing taxes on the emission of specified pollutants (eg SO_2, NO_X and ashes).[125] For large coal-fired power plants, the introduction of an environmental tax system is not expected to be a significant burden, as earlier efforts have steered them towards energy efficiency improvements (Table 4), and partial desulphurisation, denitrification and removal of ashes.[126] However, with the environmental tax, the small and energy-inefficient coal-fired generating units will face increasing financial difficulties and will thus be under increasing pressure to close down, in line with the central government's electricity investment planning.

Carbon emissions are not included in the list of taxable items under the Environmental Protection Tax Law.[127] This is due to the complexity of incorporating the carbon tax under the existing bureaucracy implementing the new environmental protection law,[128] and the necessity to avoid the overlap of policies on carbon.[129] When established, the national ETS will be the main instrument for internalising the carbon externality in the economic transactions of carbon-intensive installations.[130] The Chinese government sees the ETS as an essential instrument for creating the market environment necessary to achieve the government's environmental objectives in the electricity sector.[131] More specifically, China can use the ETS to eliminate the more inefficient coal-fired installations.

Following the theory on ETS in liberalised electricity markets, deregulated electricity prices reflect the cost of carbon and thus reduce the profit margin of the carbon-intensive modes of electricity production.[132] In China, the spot electricity market (power exchange) will be launched in 2020, simultaneously with the

125 Environmental Protection Tax Law of the People's Republic of China [中华人民共和国环境保护税法], Standing Committee of the National People's Congress (adopted on 25 December 2016 and effective on 1 January 2018), art 9, para 1,

126 See, for example, State Council Order No (2016) 2744 (n 65) special column 6 on page 25.

127 Shan Ye, 'Benefit Measurement in the Design of Environmental Protection Tax' [环境保护税法设计中的利益衡量] (2016) 3 J of Xiamen University [厦门大学学报] 46.

128 Tianbao Qin and Shaofeng Hu, 'Comparative Analysis on Environmental Protection Tax and Pollution Discharge Fees' [环境保护税与排污费之比较分析] (2017) 2 Environmental Protection [环境保护] 24.

129 Hongyan Chen, 'Analysis on the Taxation Scope of Environmental Protection Tax Law in China' [《环境保护税法》征税范围之检视], (2017) 2 Environmental Protection [环境保护] 37.

130 ibid.

131 State Council Order No (2016) 74 (n 2).

132 See section 2.2 above.

completion of the first trading period of the ETS (2018–20).[133] With deregulated power prices and a liquid spot market, the operators of power plants can pass through the cost of carbon to electricity consumers. In principle, internalising the cost of carbon into the power market should lead to the exclusion from the market (ie the 'merit order') of the most carbon-intensive installations that produce electricity at a cost (including the carbon cost) that exceeds the marginal market price.

Price deregulation will require adjustments to the allocation of allowances. With regulated electricity prices, the tariff regulator could exclude the 'opportunity cost' of freely allocated allowances from the electricity tariff basis.[134] With deregulated electricity prices, the free allocation of allowances[135] will generate a 'windfall profit' for power plants because electricity companies will reflect the opportunity cost of holding allowances allocated free of charge (ie the cost of refraining from selling these allowances on the carbon market) into the electricity market price.[136] Auctioning of allowances avoids the windfall profit associated with the free allocation of allowances in a deregulated electricity market, but increases electricity prices in comparison to free allocation in a context of electricity price regulation.[137]

In practice, the effectiveness of China's ETS in internalising the carbon externality of coal-fired electricity production will depend on the political acceptability of price increases resulting from the internalisation of the carbon cost in electricity prices.[138] The government initiated the electricity price deregulation reform in a context of overcapacity and decreasing electricity prices.[139] When prices start going up again, the government will most likely come under pressure from energy-intensive consumers to return to price control mechanisms.[140] The government explicitly retained the right to control prices and maintain them within a 'reasonable range' to protect consumers' interests,[141] thus potentially jeopardising the internalisation of the carbon cost into electricity prices.[142]

133 See The 13th Five-Year Plan for Electricity Development (n 62) 35; and 'Timeline of China's National ETS' [全国碳交易市场时间表] (Tanpaifang website, June 2016) <http://www.tanpaifang.com/tanguwen/2016/0625/54020.html> accessed 6 October 2017.

134 See eg Richard Baron and others, 'Policy Options for Low-Carbon Power generation in China: Designing an Emissions Trading System for China's Electricity Sector' (IEA 2012) 9.

135 The free allocation of allowances will be adopted in the first phases of China's national ETS, covering up to 70% of the power plants emissions. See Similarities and Differences of the Allowances Allocation Method in China's National and Pilot ETS' (n 3).

136 Bruno Lanz and Sebastian Raush, 'Emissions Trading in the Presence of Price-Regulated Polluting Firms: How Costly Are Free Allowances' (Graduate Institute Geneva – Centre for Intern ational Environmental Studies, Research Paper 34, 2015) 33.

137 See eg, Kim and Lim (n 11) 84–90.

138 Boute (n 11) 85.

139 Yongsheng Feng, 'Understanding the Marketisation and Institutional Background of the Reform of China's Electric Power System' [理解中国电力体制改革的市场化与制度背景] (*China Reform Forum*, 30 November 2016) <http://www.chinareform.org.cn/Economy/price/refer/201611/t20161130_258454.htm> accessed 6 October 2017.

140 On the political sensitivity of electricity pricing in China, see eg Ma (n 108) 2644. On previous failed attempts to reform the Chinese electricity market on the basis of competition, see eg Philip Andrews-Speed, 'Reform Postponed. The Evolution of China's Electricity Markets' in Fereidoon Sioshansi (ed), *Evolution of Global Electricity Markets* (Elsevier 2013) 531–70.

141 Several Opinions of the State Council on Promoting the Reform of Pricing Mechanisms [中共中央国务院关于推进价格机制改革的若干意见] (State Council, 12 October 2015).

142 Baron and others (n 134) 9; Kim and Lim (n 11) 85.

5. CONCLUSION

To address the pressing environmental challenges associated with the country's dependence on coal-fired electricity production, China has so far relied on traditional regulation. In a context of the decentralisation of licensing authority to the provincial authorities, the central government uses the Five-Year Plan to impose on provinces' and power companies' binding energy efficiency targets and emission performance standards. Moreover, the government used its control over electricity prices to incentivise companies to invest in cleaner technologies and facilitate the recovery of investment costs in emission-reduction measures. The use of traditional environmental regulation and the direct regulation of electricity prices has proven to be effective. Significant capacity of inefficient coal-fired power plants has been decommissioned and the average efficiency of power plants has significantly improved, leading to GHG emission reductions.

With the introduction of a national ETS, China is now opting for the market-based approach to environmental protection. The introduction of the ETS is taking place simultaneously with the market-based reform of the electricity sector. If China effectively implements its electricity price deregulation policy and creates a liquid spot electricity market, the ETS can internalise the carbon externality into electricity prices and contribute to the objective of phasing out inefficient coal-fired power plants (in particular, the small and inefficient facilities) by pushing them out of the merit order. Although the state (provincial authorities) still approves investments in electricity production, energy companies take the initiative to make investment proposals and thus they have the flexibility to integrate the cost of carbon into their business plan.

However, replacing traditional regulation with the market can put at risk the decarbonisation of China's energy supply. As highlighted by the EU's experience, many obstacles prevent the ETS from driving low-carbon investments. Traditional regulation (eg clean energy targets, emission performance standards and mandatory decommissioning of inefficient installations) has a role to play in accompanying the ETS in driving investments into the transition of energy systems towards sustainability.

In China, existing traditional environment regulation is not incompatible with the ETS, and it should be continued beyond the 13th Five-Year Plan (2016–20) to support the ETS in the decarbonisation of the electricity sector. The forced decommissioning of power plants that fail to comply with emission performance standards will not result in higher emissions in other ETS sectors if a corresponding amount of allowances are cancelled (eg based on the output-based approach to allowance allocation).

China's ETS is introduced in the context of the central government's return to central planning to steer electricity investments, following the transfer of licensing authority to the provincial authorities. Addressing the overcapacity of coal-fired power plants and their environmental impact is a political priority. Carbon price signals and deregulated electricity prices are unlikely to replace central planning, but they will complement it in incentivising electricity companies and provincial authorities to make and approve investment decisions that contribute to achieve the central government's planning objectives.

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