CENTRAL–PROVINCIAL POLITICS AND INDUSTRIAL POLICY-MAKING IN THE ELECTRIC POWER SECTOR IN CHINA

by

Dan Wu

A dissertation submitted to

Fachbereich Politik- und Sozialwissenschaften,

Freie Universität Berlin

in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

Berlin, Germany

2023

First referee: Prof. Dr. Miranda A. Schreurs
Second referee: Prof. Dr. Genia Kostka

Date of defense: October 13, 2022

Declaration

I declare that this thesis has been composed solely by myself and that it has not been submitted, in whole or in part, in any previous application for a degree. Except where states otherwise by reference or acknowledgment, the work presented is entirely my own. I also declare that I have not submitted the dissertation in this or any other form to any other institution as a dissertation.

Abstract

In addition to the studies that provide meaningful insights into the complexity of technical and economic issues, increasing studies have focused on the political process of market transition in network industries such as the electric power sector. This dissertation studies the central–provincial interactions in industrial policy-making and implementation, and attempts to evaluate the roles of Chinese provinces in the market reform process of the electric power sector. Market reforms of this sector are used as an illustrative case because the new round of market reforms had achieved some significant breakthroughs in areas such as pricing reform and wholesale market trading. Other policy measures, such as the liberalization of the distribution market and cross-regional market-building, are still at a nascent stage and have only scored moderate progress. It is important to investigate why some policy areas make greater progress in market reforms than others. It is also interesting to examine the impacts of Chinese central-provincial politics on producing the different market reform outcomes. Guangdong and Xinjiang are two provinces being analyzed in this dissertation. The progress of market reforms in these two provinces showed similarities although the provinces are very different in terms of local conditions such as the stages of their economic development and energy structures. The actual reform can be understood as the outcomes of certain modes of interactions between the central and provincial actors in the context of their particular capabilities and preferences in different policy areas. This dissertation argues that market reform is more successful in policy areas where the central and provincial authorities are able to engage mainly in integrative negotiations than in areas where they engage mainly in distributive negotiations.

Acknowledgements

I owe a deep sense of gratitude to Prof. Dr. Miranda Schreurs, who is not only a supreme academic supervisor, but also a mother figure, a true friend and an awesome person. This thesis would not have been made possible if she did not support, inspire and meticulously guided me in every stage of my research and during my tough times in life. My gratitude is beyond words!

I would also like to express my sincere thanks to my second supervisor Prof. Dr. Genia Kostka, and committee members Prof. Dr. Cilja Harders, Prof. Dr. Sabine Kropp, and Dr. Maria Rosaria Di Nucci for their kind advice and timely suggestions to improve this thesis.

I am extremely thankful to Prof. Yongnian Zheng, who has been my mentor for more than ten years and a role model that I follow to pursue an academic career.

It is my privilege to study at Otto-Suhr Institute and the Graduate School of East Asian Studies at Freie Universität Berlin. I thank all the faculty members, staff and fellow students there, especially Dr. Katrin Gengenbach, Prof. Dr. Verena Blechinger-Talcott, Prof. Dr. Eun-Jeung Lee, and Ms. Daphne Stelter.

Finally, I dedicate this thesis to my parents, who have given me everything I have. Their unconditional love, care and tolerance is the ultimate motivation that drives me to move forwards in my life.

Table of Contents

List of Tables and Figures

Tables

Figures

List of Abbreviations

ACI	Actor-centered institutionalism
GDP	Gross domestic production
GW	Gigawatts
IPP	Independent power producer
kV	Kilo volt
kWh	Kilowatt hour
MEP	Ministry of Electric Power
MW	Megawatts
MWREP	Ministry of Water Resources and Electric Power
NDRC	National Development and Reform Commission
NEA	National Energy Administration
NEC	National Energy Commission
PV	Photovoltaic
RMB	Renminbi (Chinese currency)
SASAC	State-owned Assets Supervision and Administration Commission
SDPC	State Development Planning Commission
SETC	State Economic and Trade Commission
SERC	State Electricity Regulatory Commission
SGCC	State Grid Corporation of China
SOE	State-owned enterprises
SPCC	State Power Corporation of China
T&D	Transmission and distribution
TW	Terawatt
TWh	Terawatt hour
UHV	Ultra-high voltage
UHVDC	Direct current ultra-high voltage

Chapter 1. Introduction

1.1 Central–provincial Interactions in Industrial Policymaking Process

Although China is a unitary authoritarian state, it is difficult to make generalizations regarding national policies and their implementation across provinces because of the country's sheer size and diversity. Some of China's provinces are the size and population of major European countries. China's twenty-eight provinces and four municipalities directly under the central government control form the most important level of subnational administration in the Chinese political system. Provinces have the same administrative rank as the central ministries, and the provincial party secretaries and governors are important political figures holding the same ranks as the central ministers. Indeed, China's provinces are significant actors in managing the economic activities in their respective territories and also major players in promoting industrial development. Existing studies of public policymaking in China often focus on how different local conditions have led to different outcomes across provinces. This dissertation offers another perspective of how very different provinces share similar trajectories in electricity sectoral reform.

The relations between the central government and its local counterparts have been heatedly debated in studies of Chinese politics. While the central government aims to give operational autonomy and economic resources to local governments and enterprises so that they have the incentive and the wherewithal to stimulate economic growth, it also seeks to maintain macroeconomic stability, to achieve regional equity, and to fashion an industrial structure more compatible with the long-term developmental needs of the national economy (Huang 1996, p.1). This perpetual paradox between centralization and decentralization has dominated many aspects of

Chinese policymaking and therefore has a significant impact on the Chinese economy and industrial development.

Many scholars have described in detail the cycles of centralization and decentralization in different policy areas as examples of the political struggles that can ensue in maintaining a spatial power balance. Numerous works have examined the critical issues that the central and provincial governments tussle over, such as investment control (Huang 1996), government finance and taxation (Wong 1992; Wong, Heady and Woo 1995), regional policy (Yang 1997), social welfare (Zhu 2016), and foreign policymaking (Li 2014). There is, however, little research addressing central–provincial dynamics in the Chinese electric power sector.[1] This study aims to contribute to the scholarly literature on Chinese politics and industrial policymaking and derive a nuanced understanding of the central–provincial interactions in relation to market reform in the electric power sector.

Liberthal and Oksenberg (1988, p.350) regard Chinese provinces as gatekeepers that guard and provide access to the local level. The provincial government is the primary authority regulating the electricity system. Since the investment deregulation of the 1980s, provincial governments have played a major role in authorizing, administering, and financing power infrastructure projects in China. Provincial governments and provincial grid companies assume joint responsibility in guaranteeing reliable electricity supply. Provinces are also the key players for China in addressing the supply and demand imbalance in the power sector. While China's coal resources are abundant, quality coal for power generation is

[1] Some of the literature indirectly or partially touches upon this topic, e.g., Xu 2002, Chen 2010, Yeh and Lewis 2004.

concentrated in the north, far away from the load centers in the eastern and southeastern coastal areas. While China's hydro resources are also abundant, their distribution is predominantly in the west, and widely removed from the coastal centers of demand. Efficient power exchange between provinces is identified as a major solution to demand and supply imbalance in the power sector and a main objective of market reform.

Theoretically, the discussion of Chinese central–provincial politics and its influence on industrial policymaking contributes to our understanding of the political economy in authoritarian countries. China's non-democratic and less institutionalized political system may both simplify and make more complex various aspects of industrial policymaking. The literature on authoritarian politics tends to focus on the top-down and hierarchical nature of policymaking processes in China. This study attempts to supplement this literature with a focus on the bottom-up sources of policy change in China's authoritarian system, and to identify the modes of interactions between the central and provincial levels. In addition, this study adopts a research strategy that helps bridge studies of Chinese politics, especially sub-national governmental politics, with public policy research and policy analysis. Explanations of policies and their outcomes can shed light on which levels of the Chinese state have which kinds of capacity and what this means for Chinese adaptiveness and resilience in relation to its political system.

1.2 China's Electricity Sectoral Reform in the Context of Global Electricity Market Liberalization

Electricity is supplied from producers to end users through three basic processes: generation, transmission, and distribution. As large-scale electricity

storage is costly, electricity is generated at power plants and transmitted through a complex system of power grids that connect electricity producers and consumers simultaneously. Maintaining the stability of the electricity grid requires that electricity supply constantly meets electricity demand. In most countries, the electric power industry has long been structured as an industrial organization based on vertical and horizontal integration. Some utility companies have monopolized all three segments of the power sector, while others control only generation and transmission and distribution is independent. The integrated utility model can suffer from unnecessary high investment costs and inefficiencies due to cross-subsidization. Cross-subsidies between the power and other industries, and among different groups of power users were policies used to achieve goals of equity instead of economic efficiency. Government regulation and public ownership was not successful in correcting market failures or in ensuring equity of power supply (OECD 2001).

Since the late 1970s, the monopoly status of the electric power industry began to be challenged as a result of a shift in ideology in major Western countries against government intervention. As part of their neo-liberal economic movements, UK Prime Minister Margaret Thatcher and US President Ronald Reagan diminished the role of their governments in the economic sphere. Network industries such as transportation and telecommunication underwent processes of liberalization and deregulation. The Public Regulatory Policies Act (PURPA) enacted in 1978 in the United States, opened up power generation to independent power producers (IPPs), thus seriously challenging the validity of electricity generation as a natural monopoly.

In the late 1980s, efforts began to divide the electricity services of production from transmission. Competition was introduced into the production side by bringing

in multiple generators; power generation (producing electricity as a product) is not a natural monopoly. In contrast, it remained widely maintained that transmission is a natural monopoly because the real-time balance between supply/generation and demand/consumption has to be coordinated.[2] In order to establish market of scale and efficiency, textbook power market restructuring often includes the prescription that administrative boundaries be divided into regional markets and regulative authorities be restructured to ensure market competition. For example, in the UK, the electricity market was privatized upon the break-up of the previously integrated Central Electricity Generating Board (CEGB) into four companies in the 1990s.

Reacting to global electricity restructuring towards deregulation and competition, China started to follow this market liberalization trend in its power sector more than two decades after its general economic reform began. The idea of a market-based electricity industry structured around competition was accepted and endorsed by many policymakers. China's electricity production was 534 TWh [3] in 1990; by the end of 2017, production had reached 5683 TWh (Enerdata 2018). China is currently the world's largest electricity producer and consumer. The electric power industry has transformed from one that was centrally planned and tightly controlled to one with diversified players in the sector. Vertical integration has broken up to such an extent that generation is completely separated from the rest of the sector. In addition, the energy composition of Chinese electricity production and consumption has also gradually shifted, and renewable energy has enjoyed explosive growth. China has remained the world's largest investor in renewable energy since 2010.[4] From

[2] For examples of prominent literature on theory of electricity market liberalization, see Joskow and Schmalensee 1983; Crew and Kleindorfer 1986; Green and Newbery 1992; Bushnell and Stoft 1996; Sioshansi and Pfaffenberger 2006.
[3] TWh=terawatt hours.
[4] For annual investment volume, see reports by Frankfurt School-UNEP Centre/BNEF (2011–2017).

1990 to 2017, China's energy intensity drastically declined from 0.472 to 0.138 koe/$2015p (Enerdata 2018).[5]

These remarkable achievements would not have been possible without continual institutional reforms in the sector, and reforms are still on-going. The technical complexities of the industry are often not very well appreciated by more than a handful of government officials with technical backgrounds. Policy debates have involved questions of the most suitable structure for the electricity industry in order to achieve a reliable supply of cost-efficient electricity in an economically and environmentally sustainable way. Central and provincial actors have pathway preferences for sectoral reform based on their own interests. China has not followed all of the main textbook prescriptions for electricity market restructuring. Reform decisions have been influenced by actor interests and their interactions.

In October 2014, China's macroeconomic and industrial policymaking body – the National Development and Reform Commission (NDRC)–issued the "Notice for Transmission and Distribution Rate Reform Pilot in Shenzhen." The document officially marked the launch of a new round of market reform in the power sector. The pilot reform in Shenzhen was intended to accumulate experiences for wider adoption of a new transmission and distribution pricing system, and to lay solid groundwork for the further restructuring of the power sector. In March 2015 the Chinese State Council issued a document entitled "Opinions Regarding Further Deepening of the Reform in the Electric Power Sector" (popularly known as the Document no. 9). In this new

[5] Energy intensity is the ratio of primary energy consumption over gross domestic product measured in constant US dollar at purchasing power parities. koe/$2015p denotes kilogram oil equivalent per US dollar at constant exchange rate, price and purchasing power parities for 2015.

national reform, the specified priorities and routes for further reforms were centered on the orderly deregulation and liberalization of several aspects of the sector.

The market reform of China's electric power sector is an interesting case to study for a variety of reasons. First and foremost, some features of the Chinese power sector distinguish it from the power sectors of many other countries as well as from other industrial sectors in China. Unlike many other Chinese industrial sectors that are open to private and foreign investment, the power sector was characterized by a high degree of government planning and was dominated by state-owned enterprises (SOEs). In many cases, the SOEs still calculate the financial viability and risks of their investments differently from those organizations that pay market prices for capital. The high degree of government planning and state-ownership in the energy sector has created challenges that have consistently complicated market reform outcomes. There is also splintered and weak regulatory capacity (Cunningham 2015, p.3). The energy sector is one of the last sectors to be reformed. It is regarded as a "deep-water reform area", implying the complexity of the issue and the interests involved.

Second, the power sector is in the spotlight due to its important role in helping China transition to a low-carbon economy and in addressing air pollution problems. As of 2020, China was the world's largest coal consumer and its contribution to global CO_2 emissions grew from 10% in 1990 to 30% in 2020 (Global Carbon Project 2021).

China generated half of global coal power in 2020, and 68% of the country's electricity comes from coal in that year (China Electricity Council 2021); China's coal-based electricity sector alone produces at least 7% of global carbon dioxide

equivalent emissions, and around one-third of China's domestic emissions (Pollitt, Yang and Chen 2017, p.1). Improving the electric power sector's efficiency and environmental performance is key to fulfilling China's international commitment to emission reduction and fight against climate change.

1.3 Research Question

Given the significance of the relations between the central government and its local counterparts, it is interesting to ask how Chinese central-provincial politics influence the progress of sectoral reform in the electric power sector? There was some progress in the deregulation of planning in electricity generation and consumption, and liberalization of electricity tariffs. Electricity trading agencies with considerable independence have been established and there has been a rapid growth in electricity trading in the wholesale market for industrial users. By comparison, new market players have been given limited access to the electricity distribution market and retail businesses, and cross-regional market trading of electricity only accounts for a small percentage of all electricity traded. This study aims to explain the variations of reform outcomes in these different policy areas.

1.4 The Structure of the Dissertation

This dissertation is organized into nine chapters. The first chapter is an introduction with detailed descriptions of the research question. The second chapter describes the research design and the research methods used in realizing the research design. The third chapter reviews the literature relevant to the study of Chinese central-provincial politics in economic reforms and explains why *actor-centered institutionalism* is used as the theoretical framework. Chapter four offers a

comprehensive mapping of the previous reforms in the electric power sector to provide the historical context for the 2015 sectoral reform. Chapter five explains the governing structure of the Chinese electric power sector.

Chapters six to eight are comparative studies of the provinces of Guangdong and Xinjiang that cover the key policy areas in sectoral reforms, namely, planning and investment control, pricing and trading policies, as well as transmission and distribution policies. These chapters outline and discuss the changes in the balance of power between provinces and the central government, their modes of interactions and the nature of provincial discretion. Chapter nine analyses the major empirical findings of this study applying the theoretical framework and presents several propositions generated from the theoretical introduction. The chapter concludes with a short discussion on the limitations of the study and directions for future research.

Chapter 2. Research Methods

This section discusses the methodology employed in the dissertation. I first specify the strategy for the research design and the rationale why I use a sub-national comparative method. Then I explain my motivation for selecting and analyzing the two representative provincial cases. I also explain the data collection and data analysis methods I draw upon in this research.

I plan to make a causal inference in a factor-centric design, in which causal mechanisms and their effects on the dependent variable are focused on (Gschwend and Schimmelfennig 2007, p.8). In a factor-centric research design, the researcher is required to "control for", "account for" or "hold constant" the influences of all potential confounding factors in order to filter out those effects from the causal relationship, which in fact is the primary research interest (Gschwend and Schimmelfennig 2007, p.9). One strategy to conduct and comply with factor-centered design is to systematically compare only a few carefully matched cases.

2.1 A Comparative Study of Two Provinces

I employed the case study method and the comparative method as the primary research methods. Case study is widely accepted as "an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin, 2003, p.13). I also adopted the subnational comparative approach. The approach has some methodological strength vis-à-vis national-level analysis (Snyder 2001). First, it is an important tool for increasing the number of observations and for making controlled comparisons. Second, it helps to code cases accurately, avoids the "whole nation

bias", and corrects the "invalid part-to-whole mappings." I chose not to conduct a single case study because the traits or processes specific to a region or subnational unit will be improperly elevated to the status of national paradigm as though the whole nation possesses the set of attributes that characterize a specific region or locality. Third, the subnational comparative approach is able to better explore the spatially uneven nature of major political and economic processes, especially for a country like China of continental size and extreme diversity. Subnational comparison can be used to create bounded theories, to specify the "antecedent conditions" required for these theories to operate and to test the necessity of these background conditions, and to estimate the scope of generalizability of the theories inferred (Hurst 2010, p.163).

I use the "typical case study" approach (Gerring 2007) to select provinces that are representative of the subgroups in order to demonstrate how market reform policies have evolved over time in different regions, and identify the key factors that have contributed to the different policy outcomes in different policy areas. Comparative case studies of market reforms in the electric power sectors in the provinces of Guangdong and Xinjiang form the core empirics of my dissertation. Guangdong represents the more economically advanced energy importing regions in China, whereas Xinjiang represents the resource-rich energy exporting provinces with less developed economies. A comparison of major indicators between Guangdong and Xinjiang demonstrates the huge differences between the two regions in terms of economic development levels and energy structures (Table 2.1). This dissertation studies the similarities and differences in market reform outcomes in Guangdong and Xinjiang. I adopted a research design of "most different cases" (Przeworski and Tuene 1970, pp. 32–39; Przeworski 1987, pp. 38–41) for subnational comparative

analysis to search for the same potential causal antecedent conditions in the two cases that have similar outcomes. The case study approach stresses the importance of research context and will not attempt to make overgeneralizations.

Table 2.1: Economic and Energy Profiles of Guangdong and Xinjiang (2016)

	Guangdong	Xinjiang	China
Population (million)	109.99	23.98	1,382.71
Area (1000 km^2)	178	1,600	9,597
GDP (US$ billion)[6]	1,217.27	145.28	11,194.69
GDP per capita (US$)	11,143	6,107	8,126
Total energy consumption (Mtce[7])	312.4	163	4,051.44
Energy consumption per unit of GDP (tsce/RMB10,000)	0.39	1.62	0.74
Electricity installed capacity (GW)	104.57	81.09	1,650.51
Electricity installed capacity per capita (kW)	0.95	3.38	1.19
Electricity generation (TWh)	403.6	269.3	6,022.8
Electricity consumption (TWh)	561	231.6	5,974.7
Electricity consumption per capita (kWh per year)	5,100	9,658	4,321

Sources: National Bureau of Statistics of China, *China Electric Power Yearbook* 2017, *China Statistical Yearbook* 2017 and author's calculation based on these statistics.

The case studies trace the evolution of sectoral reform policies during the 2015–2021 period in Guangdong and Xinjiang in order to examine how central-

[6] Nominal rate: Chinese Yuan 6.6423 per US dollar (2016).
[7] Mtce denotes million tons of coal equivalent; tsce denotes tons of standard coal equivalent.

provincial interactions and the respective provincial policies have shaped the reform processes. They illustrate in greater detail the market reform outcomes and causal factors present in these cases, and develop explanations for the variations in market reform progress. I employ both within-case temporal variation and cross-case variation in market reform outcomes for my case studies. I use these comparative case studies to derive a fuller picture of the provincial sectoral reform outcomes and the multilevel political processes from which outcomes emerge.

2.2 Data Collection Methods and an Overview of the Sources

The primary sources for this dissertation include field interviews and official, legal and industrial documents in Chinese. Interviews are regarded as "one of the most important sources of case study information" (Yin 2003, p.89). The interview questions used were sufficiently open-ended to elicit relevant information on how the sector reform is rolled out but semi-structured enough to draw out more specific viewpoints of interviewees on central-provincial politics (Wengraf 2001, p.5). The interviewees included: (i) government officials who participated in formulating provincial policies in the reform of the electric power sector in Guangdong and Xinjiang; (ii) management personnel of key corporations in the sector, including national power grid companies, national and regional power generation companies and appliance suppliers in renewable energy industries; and (iii) energy studies researchers including those from state research institutes affiliated with the National Development and Reform Commission who serve as members of the policy consulting council in energy sector policymaking processes (see Appendix 1 for a detailed list of interviewees and questions asked).

The first two groups of interviewees are selected because they are the actual

policy makers and implementers in market reform and they are possible to help me to understand the objectives and preferences in their policy choices and the real challenges in policy implementation. The third group of interviewees provide me with an educational process to gain knowledge and insights of the specific technical issues of the electric power sector related to policy making. Another critically important aspect is that they are able to help me to establish contacts and connections with the first two groups of interviewees, especially government officials who are very difficult to reach to for interviews. The "snowball" technique is used in finding interviewees, through which I begun with a few known individuals and expanded the list of interviewees by asking these initial participants to identify others that might be interested in participating in the study.

In-depth individual interviews were conducted between 2017 and 2019 in Beijing, Xinjiang and Guangdong. Most interviews are based on face-to-face meetings and a few on telephone conversations, each of which lasted approximately 30-45 minutes. Some interviewees from the same organization were met and interviewed through group interviews. Other interviews were done on a one-on-one basis. I identified myself to the interviewees as a doctoral researcher and explained to them the purpose of this study. Consents were given by all interviewees for me to use the provided information in this dissertation and for future publication. At the request of the interviewees and for the purpose of protecting them from their personal or career related risks, the interviewees' anonymity is preserved in this dissertation by removing their personal information. Some interviewees also requested that their interviews not be recorded. The interviewees were also provided with my contact details so that they can verify or retract information should they wish to do so at a later stage.

Apart from the data collection from field interviews and written official records, this study extensively relied on secondary literature on China's electric power sector, including academic publications and news articles from the media. The media sources used are mainly from the widely circulated state and industrial media, such as *South China Energy Observer* (subsidiary of Southern China Grid Corporation), the website of China Electricity Council, *China Energy* (newspaper by the *People's Daily* Press), and the industrial news website North Star Electric Power Network

2.3 Data Analysis Methods

Grounded theory and inductive method

Glasser and Strauss' grounded theory approach (1967) is used to derive a chain of evidence and inferences. Grounded theory is an inductive technique of analyzing and interpreting recorded data to build theories. Text data segments are classified and categorized into a set of codes (concepts), categories (constructs) and relationships. Theoretical interpretation is an iterative process of moving back and forth from pieces of observed empirical data to the entirety of the social phenomenon (context) to reconcile the apparent discord and to construct a theory that is consistent with the diverse subjective viewpoints and experiences of the participants which are embedded in social structure and relationships.

I used the inductive method to analyze the data in this dissertation. The inductive approach, in comparison to the deductive approach in theory-guided empirical research, starts from an empirical investigation of a phenomenon of interest. The goal of inductive reasoning is to gain a new perspective of the relevance of the empirical area of study by acquiring an "empathic" understanding of societal

phenomena from the viewpoint of the actors involved (Nachmias and Frankfort-Nachmias 1976, p.287). The empirical regularities are carefully described in the first step of this research. I summarized the major policy papers by the reform authorities and identified the policy objectives stated in these papers and keystone policy measures that were actually implemented in each stage of all previous reforms in China's electric power sector. I also identified the gaps between policy objectives and actual policy implementations, as well as the variations in reform progress in three different policy areas, i.e., investment and planning, pricing, and transmission & distribution (T&D).

In a next step, the empirical information is interpreted conceptually, i.e., the information is attributed to concepts that help aggregate and measure the data so that systematic patterns of variations can be identified. The concepts of the theoretical framework used in this dissertation are applied to identify the behavior patterns of the research targets (conceptualized as actors), i.e., reform authorities and policy implementers. The variations of behavior patterns of policy implementers in three different policy areas will then be posited in the form of hypotheses that can be systematically linked and subject to a standard method of hypothesis testing in future research (Glaser and Strauss 1967, p.104–105; Nachmias and Frankfort-Nachmias 1976, p.301–302).

Process tracing

Theory-guided process tracing is used to yield important insights into causal relationships among key variables in addition to providing a clear sense of historical context (George and Bennett 2005; Gerring 2007; Hall 2008). Process tracing is a procedure for identifying steps in a causal process leading to the outcome of a given

dependent variable of a particular case in a particular historical context (George and Bennett 2005, p.176). The technique provides a way of learning and evaluating the preferences and perceptions of actors and helps researchers take into account of the property of the phenomenon by making reference to its structures, and explain its conditions of possibility (Davis 2005, p.175–180). Tracing the reform processes from the beginning to the end allows to find a way to establish a causal chain of linkages between actors and policies. Comparisons between the variations of the dependent variables are tasks with the goal of identifying these linkages. The reform process of the electric power sector is traced utilizing the concepts borrowed from the ACI framework to establish linkages between actor preferences and policy objectives, as well as modes of actor interactions and implementation results.

Chapter 3. Theoretical Framework

3.1 A Review of Middle-range Theories on Chinese Central–provincial Politics

Searching for a causal linkage between the distribution of authority in national and subnational governments and economic and industrial policy-making of countries has been a recurring aim of political economy studies. Most scholars who conduct research on Chinese central–provincial politics have taken either a structural or a procedural perspective. They query (i) how central–provincial dynamics have been conducive to China's economic performance and political resilience; and (ii) how an understanding of power balances, the nature of local discretion, and the limits of local autonomy and central authority can be achieved (Rithmire 2014, p.168). I review the most important literature that delves into these two questions in the following section.

The "incentive for marketization" thesis

Some researchers that focus on the first question hold the viewpoint that decentralization provides effective incentives to trigger marketization. In the "market-preserving federalism" model, Chinese local officials formulate policy initiatives and innovations based on their given autonomy to make economic decisions that unleash market forces. It is argued that such economic decentralization is critical for the success of China's reform (Montinola, Qian and Weingast 1995). Chinese local governments also engage in economic activities to generate local revenues and enhance their financial capabilities due to the enabling fiscal policies, which Oi termed "local corporatism" (Oi 1992). In a similar vein, Xu (2011), Li and Zhou

(2005) argue that the incentives of career advancement have propelled local officials to engage in tournament competition for economic development.

Many scholars also recognize the negative effects of decentralization, such as local/regional protectionism and regional disparity (Xu 2011; Bernstein and Lu 2000, 2003; Wedeman 2003; Yang 1997). In contrast to Jin, Qian and Weingast's (2005) claim that decentralization is good for regional equity and provincial growth, Tsui (2005), Kanbur and Zhang (2005) find that regional disparity has worsened since the 1994 fiscal reform. The impacts of regional decentralization on both trade barriers among regions and regional inequality remain as unresolved theoretical debates.

The line of argument in the "incentive for marketization" thesis is not always applicable to analyzing the development of the electric power sector. In his example of grain price liberalization, Yang (1997) maintains that local governments have strong incentives to compete for liberalization in order to prevent the flow of resources to other regions that have liberalized. Electric power, in comparison to other commodities like grains, has some unique physical properties that make it fundamentally different. We do not observe any rush by Chinese local governments for "competitive liberalization" or any form of regional competition to form a well-functioning regional electricity market. Simply put, there was no market expected to be preserved in the power sector. It is not convincing to argue that political decentralization has led to success of market reform in every aspect in the electric power sector due to the extreme complexity of the sector. For this reason, it necessitates a more nuanced examination into the different policy areas in market reform to identify the conditions under which decentralization works for or against market reforms.

The "factional politics" thesis

Other authors suggest that local officials may serve as coalition partners of reformist central policy leaders and that economic development is the result of the political struggle between reformist and conservative factions (Shirk 1993; Cai and Treisman 2006). Based on the literature on factional politics, Chen (2010) argues that the conservatives have formed a united front to prevent real market reform in the electric power sector by feigning some pretentious pro-market reform gestures. As theories have suggested, the ideological stance of sectorial administrators and local officials pertaining to the electric power sector may not be that clear-cut. A conservative, in the general sense, might prefer certain market reform measures in the power sector, while a reformist at the local level might act contrarily to facilitate local protectionism to benefit local corporate interests. For example, Chai Songyue—a long-time associate of Li Peng, a conservative central leader—promoted market reform in the sector during his tenure as Zhejiang governor and as the chairman of the State Electricity Regulatory Commission. Therefore, it is not proper to identify factional politics as a major variable in determining sectoral reform outcomes in the electric power sector.

The "powerful center" image

On the second query related to power balance, many scholars believe that the central government maintains an upper hand and has the power to control central–local relations through mechanisms such as personnel management (Xu 2011) and reconfiguring the fiscal system to its advantage (Yang 2006). Studies have also shown that the central government has taken matters into its own hands to manage challenges such as inflation (Huang 1996) and regional disparity arising from economic

decentralization (Sheng 2007). As Huang has stated, “Although local officials do have preferences at variance with those of the Center, there are real limits on how much local officials are able or willing to pursue their own interests at the expense of those of the Center” (Huang 1996, p.317). In the same vein, Ma and He (2008) point out that the restructuring of the electric power sector is mainly a top-down process and “state entrepreneurialism” managed by the central government. Yeh and Lewis (2004) also emphasized the Party-state's ability to exert discipline in the electric power sector which is high up on the top leaders’ priorities.

Besides structural and procedural factors, some scholars have sought a cultural explanation to depict China as a unified and centralized nation state. They believe that there have always been powerful civilizational or cultural forces supporting the unity of China. For centuries, China as “a great systemic whole” (*da yi tong* 大一统) has been an important theme at the center of Chinese political values, and thus a significant cultural force behind the unity of the country (Bockman 1998; Wang 2013).

Even in scenarios whereby the provinces seem to be able to wield some influences, they are often regarded as instances of “delegated flexibilities”, meaning discretion at the provincial level is simply the result of voluntary self-restraint exercised by the center (Li 1998, p.24). Decentralization in this sense is seen as a development strategy chosen and initiated by the central government to achieve market reform by devolving authority and resources to local officials and thereby enabling them to pursue economic development.

Existing literature that accounts for China's energy transition process depicts it largely as a top-down process initiated by the centralized developmental state (Beeson 2010; Gilley 2012; Chen 2016). For example, in explaining China's rapid renewable energy expansion, Chen (2016, p.8) attributes the success to the "hybrid strategies for environmental protection measures that combine a cluster of developmental state features in an attempt to partially incorporate a modified, state-led strategy based on ecological modernization."

The Chinese central state has undeniably significant political power in many dimensions of Chinese politics; however, the recent development in the electric power sector portrays a picture different from the assumption of an all-time powerful center and disputes the claim of environmental authoritarianism. The recurring waves of power shortages and surpluses, and the recent renewable energy curtailment all suggest that the central government has limited policy tools to combat the overcapacity problem at the local level and to break down market segmentation in the power sector. Some central technocrats have been seen to openly ventilate their frustrations over the stagnation of market reform in the sector.[8]

The "fragmented/autonomous local" image

Challenging the "all-time powerful center" view, some scholars consider that provincial players have real discretion. Structurally, Zheng termed the Chinese political system as "de-facto federalism", in which "intergovernmental decentralization is institutionalized to such a degree that it is increasingly becoming

[8] For example, in May 2000, the then head of the Electric Power Division under the State Development and Planning Commission published a well-circulated article, entitled "Lingren jusang de dianli tizhi gaige (The Frustrating Reform in the Electric Power Sector)" in a Chinese newspaper called *jingji xue xiaoxi bao 经济学消息报 (Economics Information)*.

difficult, if not impossible, for the central government to unilaterally impose its will on the provinces and alter the distribution of authority between levels of government" (Zheng 1997, p.40).

Similarly, the "fragmented authoritarianism" model (Lieberthal and Lampton 1992) argues that the authority below the supreme echelon of the Chinese political system is fragmented and disjointed; therefore, the policymaking process in China is diffuse, protracted, and incremental, often involving extensive bureaucratic bargaining and consensus-building. Bargaining refers to "negotiations over resources among units that effectively have mutual veto power" (Lieberthal 1992, p.9). Lieberthal and Lampton's analytical approach is more from a procedural perspective, treating actors as rational game players trying to maximize their own interests. Andrew Mertha (2009) broadens the fragmented authoritarianism framework by including social actors that were previously excluded from the policymaking process. Similarly, both fragmented authoritarianism 1.0 and 2.0 depict policy processes as shaped by the fragmented and diversified interests of central and local actors.

In the field of environmental politics, the fragmented nature of policymaking is documented by Eaton and Kostka (2014) in their study. They argue that the high turnover of leading cadres at the local level has hindered state-led green growth initiatives, and the perverse effects of local officials' short time horizons give reason to doubt the more optimistic claims about the advantages of China's model of environmental authoritarianism. In another study, Kostka and Hobbs (2012) suggest that local government leaders only conform to national directives by "bundling" the energy efficiency policy with policies of more pressing local importance or by

"bundling" their energy efficiency objectives with the interests of groups with significant political influence.

Interestingly, some scholars also seek a cultural explanation for the prevalent local discretion throughout Chinese history, as reflected in the popular expression that "the emperor is far as the heaven is high" (*tiangao huangdi yuan* 天高皇帝远). The pluralist nature of Chinese political culture and its impact on national integration is emphasized in such literature as Friedman (1995), Goodman (1997), and White and Li (1993). For example, White and Li (1993) argue that economic reforms have reinforced the multiplicity of Chinese cultural identities, especially in coastal areas such as Guangdong province. A more assertive commercialized civil society enabled local identity to be prioritized over the state-centered one in these localities.

The powerful center and the autonomous local portray two contrasting images of Chinese central–provincial politics, depicting both centrifugal and centripetal tendencies in central–local dynamics. Either from a structural, procedural or cultural perspective, overemphasis on one end of the political spectrum over the other end risks missing the big picture that makes it possible to capture internal coordination mechanisms. Between these extremes, there is a distribution of power between central and local actors. The approach that treats central–local relations as a zero-sum game is inadequate to explain changes in power distribution between central and local actors in Chinese politics (Li 1998, p.22–26).

The objective of this study is not to assert which tendency or force is dominant in contemporary Chinese politics. Instead, this study focuses on addressing the underlying logic of central–provincial interactions, applies this logic to the empirical

analysis and seeks to understand the key dimensions of a very important issue area─ the reform of the electric power sector.

The "structure vs. agency" debate

Although the usefulness of cultural factors in explaining Chinese politics should not be denied, the cultural perspective inevitably suffers from problems in both conceptual and methodological terms (Chung 1995, p.489). In addition to the theoretical perspectives that are based on the research of multiple Chinese cultural elements which are utilized as explanatory variables, there exists an implicit debate in scholarly work between scholars who argue that political institutions are explanatory factors of central–local dynamics (the structure-centered approach) and scholars who focus on actors in political processes (the agency-centered approach). "Structure-based institutionalists have emphasized the ways in which institutions help define the interests that actors hold, while agency-centered approaches have focused on the ways in which actors behave given an exogenously determined set of goals" (Clark 1998, p.246).

The structural approach mainly studies the formal aspects of the political system, and is oblivious to the fact that formal organizational adjustments have often lagged behind informal behavioral changes. Although the structural approach has contributed in various ways to the understanding of the formal structure of Chinese political institutions, "its generally static macro-institutional focus very often fails to explicate the crucial role of local policy inputs and the dynamics of central-provincial interaction" (Chung 1995, p.492).

The procedural/agency-centered approach focuses on studying political

processes of intragovernmental conflicts created/resolved through strategic interactions between central and local actors. The underlining assumption of the approach is based on rational choice theory. Some scholars have pointed out that the procedural approach focuses predominantly on resource allocation between central and local actors with regard to particular policy issues, and thus fails to explain the ideational motivations that drive actors to utilize the resources in the way they actually did (Chung 1995, p. 493; Zheng 2007, p.24).

The empirical puzzle and theoretical gaps identified in previous discussions require a more systematic analysis of the political actors that drive the reform process in China's electric power sector. Due to the tensions in the reform process, queries abound whether China's electricity sector is able to undergo a major transition to become truly based on sustainability and green economy. The following section sets out the basic variables and introduces an analytical framework for understanding the spectrum of political economy conflicts that arise when introducing reform measures of market competition within a complex electric power system. This framework is then applied to China to analyze the behavior of Chinese provinces and central-provincial interactions in the sectoral reform process.

3.2 An Actor-centered Institutionalist Framework for Explaining Interactive Policy Processes

My aim is to combine structural and procedural explanations of central–provincial dynamics to study China's electric power sector. For this purpose, I adopt and modify the framework of actor-centered institutionalism (ACI) (Mayntz and Scharpf 1995; Scharpf 1997, 2000). Mayntz and Scharpf integrate elements from institutionalist approaches such as *historical institutionalism* (Steinmo and Thelen

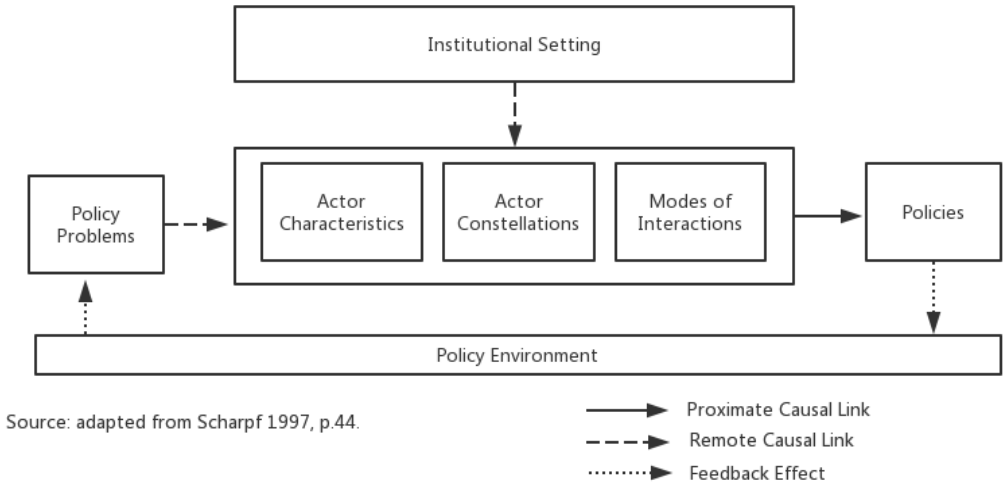
1992; Pierson and Skocpol 2002) and the rational choice *institutional analysis and development* framework (Ostrom 1990, 2007). Instead of assuming a dominant role for either institutions or actors, actor-centered institutionalism attempts to integrate both actor-centered and institutionalist perspectives (Scharpf 1997, p.36) with the fundamental idea of bridging structure and agency in policy analysis. The framework proceeds from the assumption that social phenomena should be explained as the outcome of interactions among intentional actors. These interactions are structured and their outcomes are shaped by the characteristics of the institutional settings within which they take place (Scharpf 1997, p.1). Methodologically, the framework preserves the principle of individualism while connecting it with institutionalism.

So far, ACI has been utilized to analyze energy transition in western countries such as the studies of Kriesi and Jegen (2001) on the Swiss energy policy and the comparative studies made by Suck (2002) on renewable energy policies in the UK and Germany. In the studies of Chinese politics, a variant of the ACI, the strategic group analysis (Heberer and Schubert 2012 and 2018) has been applied to identify composite actors such as county and township cadres and private sector entrepreneurs in China's public policy process. Applying the ACI framework to ’China’s energy politics is expected to reveal useful insights.

In explaining social phenomena, actor-centered institutionalism sees observable behavior by actors as a “proximate” cause, while the institutional context functions as a “remote” cause (Scharpf 1997, p.42) The proximate cause is influenced, but not determined by the remote cause. The institutional context constitutes actors and actor constellations. It structures actors’ disposal of resources and influences their preferences. The framework's underlining assumptions are

displayed in Figure 3.1.

Figure 3.1: Actor-Centered Institutionalism



Actors and Modes of Interactions

Actors are assumed to be capable of making purposeful choices among alternative courses of action (Scharpf 1997, p.7). They are assumed rational in the sense that they will attempt to maximize their own self-interest; but they are not assumed to be perfectly rational. The notion of "bounded rationality" implies that human action is not based on cognition of real-world data and causal laws, but on culturally shaped and socially constructed beliefs about the real world (Scharpf 1997, p.21). More often than not, actors do not have complete information on the situations they face. The framework assumes that actors do not only act on the basis of objective needs, but also on the basis of perceptions and preferences reflecting their subjectively defined interests and valuations, as well as their normative convictions of what is right or good or appropriate to act under certain circumstances.

The term "composite actor" is reserved for constellations in which the "intent"

and intentional action refers to the joint effects of coordinated action expected by the participating individuals (Scharpf 1997, p.54). The composite actor encompasses corporate and collective actors, which are capable of coordinating the intentional actions of their members to achieve a common purpose through collectivized resources and normative orientations. On one level, a composite actor has certain resources that it employs in strategic action vis-à-vis other composite actors; on another level, that same composite actor is an institutional structure within which individuals interact to produce the actions ascribed to the composite actor (Scharpf 1997, p.52).

Due to this multilevel nature of composite actors, researchers may study the same policy event both from the outside of a composite actor as a whole, and from the inside of a collective actor to understand the interactions between individual members or subgroups composing the composite actors (Scharpf 1997, p.52). In this study, provincial authorities are treated as collective actors in meso level analysis and the individual-level analysis of composite political actors will not be reached for the sake of analytical parsimony.

The courses of action available to an actor are labeled *strategic actions*. Strategic actions available to different actors in the same field are interdependent, in the sense that the outcome of a particular strategy chosen by an actor will simultaneously depend upon the choices of other actors, and vice versa (Scharpf 1997, p.7). When strategies of different actors are interdependent, what is important would be the *actor constellation* among the plurality of actors involved. The constellation describes the actors involved, their strategic options, the outcomes associated with strategy combinations, and the preferences of the actors over these outcomes (Scharpf

1997, p.44).

Outcomes reflect payoffs for actors, and payoffs represent the valuation of a given set of possible outcomes by the preferences of the players involved (Scharpf 1997, p.7). Strategic action implies that actors are aware of their interdependence and that in arriving at their own choices, each will attempt to anticipate the choices of the others, knowing that they in turn will do the same. *Equilibrium outcomes* are outcomes in which no player can improve its own payoff by unilaterally changing to another strategy (Scharpf 1997, p.10).

Actors have specific *capabilities* and *preferences*, and choose their strategic actions accordingly (Scharpf 1997, p.43). Capabilities describe all action resources that allow an actor to influence an outcome in certain respects and to a certain degree. In the context of policy research, what matters most are the action resources that are created by institutional rules defining competencies and granting or limiting rights of participation, of veto, or of autonomous decision in certain aspects of given policy processes (Scharpf 1997, p.43). From a theoretical point of view, capabilities appear to be highly contingent (Scharpf 1997, p.51). For most actors in reality, their capabilities are limited.

I follow the argument of historical institutionalism to assume that actor preferences are endogenously formed in the institutional context in which the actors are embedded (Steinmo and Thelen 1992, p.9). Preferences are not prefixed givens or determined exogenously to the institutions. Instead, it is argued that they are induced by strategic circumstances and human interaction. Significantly, “specific patterns of relationship and interaction within institutions and social processes encourage or persuade a given actor to possess a particular type of preference” (Katznelson and

Weigast 2005, p.3).

The preferences of composite actors are based upon quasi-objective organizational self-interests, and subjective role and interaction orientations as well as identities (Scharpf 1997, p.63–66). Institutional self-interest of collective and corporate actors for the purpose of organizational survival, autonomy, and growth must be granted a special place in explanations of policy interactions (Scharpf 1997, p.64). Normative role orientations are organizational goals and missions as well as limitations defined by an organization in policy processes. Interaction orientations are relationally defined preferences, i.e., the preferred payoffs resulting from certain interactions with other actors. In addition, actors have the possibility of defining a specific identity. In other words, actors have the possibility of defining specific interests and norms for themselves and selectively emphasize certain aspects of self-interest and certain rules among those that generally apply to organizations of their type (Scharpf 1997, p.65).

The actor constellation describes a static picture, rather than actual interactions. The actual interactions of actors can differ widely in character, meaning that any given actor constellation can correspond with a variety of *modes of interaction* (Scharpf 1997, p.45). The actual policy outcome is affected by both constellations and modes of interactions. The concept of actor constellations and modes of interactions provide us with a descriptive language to discover empirical regularities that otherwise might remain hidden.

The influence of institutions on actors

Institutions are defined as “the humanly devised constraints that structure

political, economic and social interaction. They consist of both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct), and formal rules (constitutions, laws, property rights)" (North 1991, p.97). Institutions "composed of cultural-cognitive, normative, and regulative elements that, together with associated activities and resources, provide stability and meaning to social life" (Scott 2001, p.45). The concept of institution is used in this study to include both formal and informal rules. The concept of "institutional setting" does not have the status of a theoretically defined set of variables and it needs to be systematized and operationalized to serve as explanatory factors in empirical research (Scharpf 1997, p.39).

Based on a regulative/coercive dimension, a normative dimension and a cognitive dimension (DiMaggio and Powell 1991; Scott 2001), institutions have three main effects on actors. First, composite actors are institutionally constituted, meaning that they were created according to preexisting rules and they depend on such rules for their continuing existence and operation. In a regulative dimension, institutions define not only the membership of composite actors and material and legal action resources they can draw upon, but also the purposes that they serve or the values that they embrace (Scharpf 1997, p.39). In turn, institutions also create constellations of actors involved in the political game.

Second, institutions constrain the feasible set of strategic options available for actors. In a normative sense, formal rules discourage actors from pursuing policy objectives that are clearly in conflict with the content of the rules. Moreover, institutions constitute "structures of incentives" that increase or decrease the payoffs associated with given strategies, and thus the probability of their adoption by self-

interested actors (Scharpf 1997, p. 39).

Third, institutions in a sociological sense and in a cognitive dimension shape and influence the preferences of actors. Social norms play a potentially large role in policy processes by influencing how actors think about their interests. Actors define their goals in a historically situated fashion based on prevailing and contingent interpretation of social situations, including institutionalized values, norms and power configurations (Jackson 2010, p.68). Rather than starting with a clean slate of preexisting actors with assumed or fixed sets of interests, "the games that are in fact being played in policy processes are to a large extent defined by institutions" (Scharpf 1997, p.40).

Despite the important roles that institutions play, it is important to note that actor-centered institutionalism does not have a determinist view on institutions. In this sense, institutions should be understood as a historical and non-deterministic context of actor interactions. Institutions influence repertoires of more or less acceptable courses of action that will leave considerable scope for strategic and tactical choices of actors (Scharpf 1997, p.42). Institutions create and constrain actor constellations, but actors may also deviate or reinterpret institutions in ways that change those institutions (Steinmo and Thelen 1992, p.10). Actors may also ignore formal rules in certain circumstances, use their powers illegitimately, or engage in informal interactions because not every action can be monitored and regulated. In short, actors "have the capacity to adopt idiosyncratic interests and to follow self-defined rules" (Scharpf 1997, p.65). As Aoki (2007, p.8) stresses, "an institution as a summary representation of equilibrium is produced and must be repeatedly reproduced as an endogenous outcome of the strategy interplays of all the agents in the domain."

In sum, actors and institutions are conceptualized as being mutually constitutive of one another. Actors are both "rule takers" and "rule makers." Actor-centered institutionalism offers a framework for how to proceed with empirical studies, rather than a fully specified theory (Scharpf 1997, p.37). In the following chapters of my empirical study, I will operationalize this framework and use it to analyze the actor constellations and modes of interaction among the collective actors that participate in the market reform process in the Chinese electric power sector.

Chapter 4. The Evolution of China's Electric Power Sector

In this chapter, I review the past reforms in the Chinese electric power sector and track the changes in the balance of power between the central and provincial governments. As issues concerning horizontal and vertical separation are often interconnected, horizontal management of the sector will also be discussed. The chapter provides a brief background to the various market models of the electric power system related to the discussion. Based on the empirical findings of the previous three rounds of market reforms, it is argued that the interactions between central and provincial governing authorities were repeated bargaining processes and non-zero sum games in nature. The central government's attempts to counter the negative effects of decentralization and local protectionism did not lead to market liberalization; on the contrary, market fragmentation in the Chinese electric power sector has intensified with attempts to reform cross-provincial market-building.

4.1 Market Structure Typologies in the Electric Power Sector

There are four main structural types within the electric power industry. The vertical and horizontal monopoly are the dominant models used during the early stage of electric power sector development. The purchasing agency model allows competition in generation. The wholesale competition model offers competition in generation and choice of distributors. The retail competition model is an ultimate form of competitive electricity market whereby consumers can choose their suppliers (Kirschen 2004, pp.4–7).

In the *single purchasing agency model*, all power generated is sold to a single wholesale buyer, which holds the monopoly over transmission and distribution

networks as well as sales to end users. Power producers are not permitted to sell to end users. This model is also known as a single-buyer-single-seller or a monopolistic model. Only one agency, typically a local or provincial or regional utility, controls the transmission grids. The utility buys electricity from its affiliated power producers (APPs) as well as independent power producers (IPPs).

The *wholesale competition model* is designed to allow competition among power generators and offer choices for distributors. Generators and distribution companies have open and equal access to transmission networks. Companies that own both the distribution networks and retail business are allowed to buy electric power directly from a producer and deliver it through a transmission network. The distribution/retail companies still have a monopoly over final customers. This opens up competition in that all power generators can now sell to many wholesale customers rather than to just one. A market with numerous competitive buyers is more open and dynamic than one that is dominated by a single or a few buyers. The building of new generation capacities therefore becomes contestable and encourages the utilities to contract for more efficient new capacity.

The wholesale competition model requires the transmission to be functionally unbundled from utilities. This requirement also applies to interconnected transmission grids. In this case, the operation of the transmission is provided by an independent system operator (ISO), which acts as a “traffic controller”, simultaneously coordinating power supply and demand. Utilities, producers and brokers buy and sell power at a power exchange, which is a non-profit trading platform.

The *retail competition model* makes the most of competitive forces by bringing all final consumers into the market. As there is open access to both

transmission and distribution grids, customers can decide which generator they would like to use, either directly or through their choice of retailer. This model extends the competitive pressures to retailers, and also greatly increases transaction costs with demands for more complex trading arrangements and metering.

Countries undertake to reform and restructure their power sectors principally in two dimensions, i.e., horizontally and vertically (Davidson et al. 2016, p.15). The horizontal organizational structure denotes the extent to which policy and regulatory functions are distinct and separate. The vertical organizational structure indicates the extent to which policy and regulatory functions are concentrated at the central level, or vested in subnational governments. On the one hand, an ideal power system design emphasizes the separation of horizontal and vertical structures to ensure that the system operation is free from interference by the regulated economic actors and the political actors that set the rules (Joskow 2008; Bushnell, Mansur and Saravia 2007). On the other hand, functions that are spread across different levels of government may come into conflict. To understand how a particular power sector model has come into form, it is necessary to understand the central–local politics and the centralization–decentralization dilemma.

4.2 The Chinese Electric Power Sector before 1978: Central Planning and Absolute Monopoly

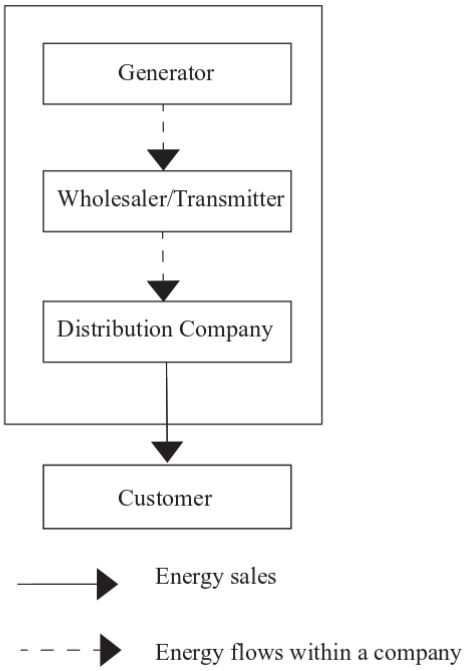
The economic system in the first 30 years of the People's Republic was characterized as a rigid system of central planning. During the First Five-Year Plan period, the fiscal system remained highly centralized. Local governments lacked discretionary spending power under the consolidated budget system. Revenues,

mainly from the profit remittances of state-owned enterprises (SOEs), were accrued to the center (Wong, Heady and Woo 1995).

All industries, including power utilities, were nationalized by the central government. Given the strategic importance of electricity in the economy, the central government directly allocated funds from central budgets to finance infrastructure expansion. The sector was organized as a single vertically integrated utility (Figure 4.1). Power generation, transmission and distribution were combined and exclusively owned and operated by the Chinese central government via the Ministry of Electric Power (MEP). The ministry was established in 1955 following the dismantling of the Ministry of Fossil Fuels.[9] The SOEs in the power sector were placed under the administrative supervision of the MEP. They were mere implementers of central planning and had no independent management responsibility. They had no autonomy in allocating assets and had no control over the expenditure of revenues. Indeed, all demand and supply relationships in the entire chain of electricity supply were planned allocations among government bodies. Tariffs were decided by government agencies and had little correlation to production factors.

[9] Three ministries—namely the Ministry of Electric Power, the Ministry of Coal and the Ministry of Petroleum—were established after the Ministry of Fossil Fuels was dismantled.

Figure 4.1 Monopoly/Vertical Integration Model (Before mid 1980s)



Source: Adapted from Kirschen and Strbac (2004, p.5).

For the purpose of developing hydropower, the Ministry of Electric Power was merged with the Ministry of Water Resources to form the Ministry of Water Resources and Electric Power (MWREP) in 1958. The merger did not result in a well-functioning bureaucracy because the electric power industry was centralized while water resources were decentralized (Xu 2002, p.85). To ensure a sufficient and stable supply of electricity for industrialization, the central government set favorable low end-user tariffs for high-priority industries and charged less important sectors, such as services, higher prices. Electricity production grew at an average rate of 15 percent per year between 1949 and 1978.[10] Despite the annual growth, the sector

[10] Author's calculation based on statistics from the China Electricity Council database.

suffered from the unavoidable flaws of the planning economy. The sector's low efficiency therefore led to chronic shortage of electricity supply.

4.3 The First Phase of Reform: Negotiated Decentralization (the Mid-1980s to Mid-1990s)

In December 1978, the Chinese government started market-oriented reforms after the pivotal meeting of the Third Plenary Session of the 11th Central Committee of the Communist Party of China. Following the division of the Ministry of Water Resources and Electric Power (MWREP), the Ministry of Electric Power was reinstituted in 1979 in order to restore the infrastructure devastated during the Cultural Revolution. Shortly after the separation, the persistent bickering between the Ministry of Water Resources and the Ministry of Electric Power forced the central government to combine them again as part of the government restructuring and streamlining efforts in 1982.

Since the 1980s, the fiscal contracting system granted provincial governments greater authority over their expenditure and the right to manage fiscal arrangements with sub-provincial governments. The system was dubbed "eating from separate kitchens" and was a dramatic departure from the previous "unified revenue collection and unified spending" policy. Decentralized revenue collection and spending incentivized provincial governments to achieve better economic performance.

While the economic reforms brought almost double-digit income growth, power shortages had caused major bottlenecks constraining Chinese economic development. The gap between electricity supply and demand therefore widened. According to government estimates, the electricity shortfall had grown to 15

gigawatts (GW) of capacity and 700 terawatt hours (TWh) in generation by 1986, about 17 percent of the annual power consumption (Zhang and Heller 2007, p.93)

Fiscal federalism further dampened fiscal power at the center. The late 1980s and early 1990s marked a continuing decline of the "two ratios", namely the budgetary revenue to GDP ratio and the central to total budgetary revenue ratio. The central government revenue plummeted from around 40 percent of total revenue in 1984 to 22 percent in 1993.[11] Consequently, the central government's ability to finance electric power projects also significantly declined.

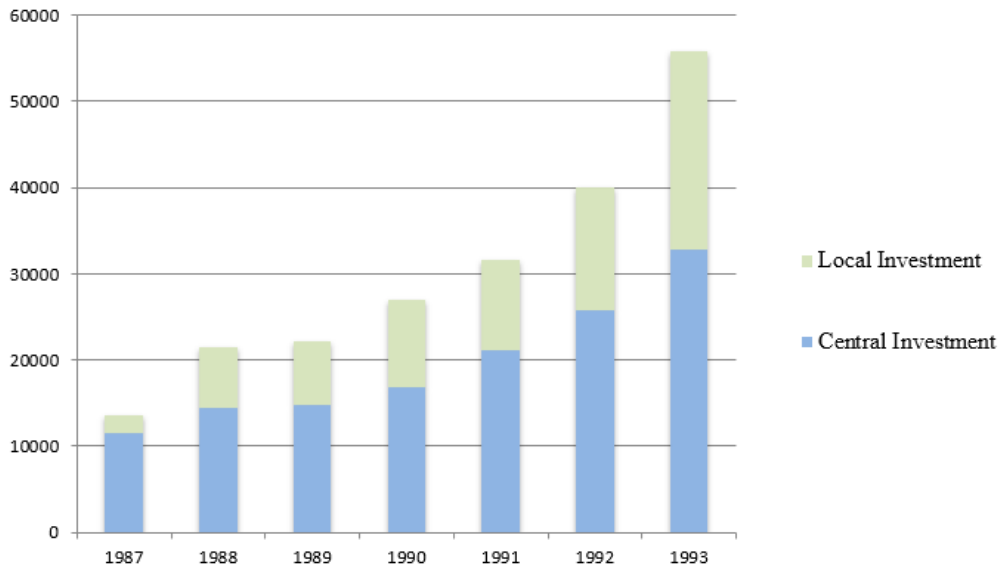
The reform has, since the mid-1980s, spread to the electricity sector. In 1987, then Vice Premier Li Peng elaborated on the reform guidelines that include separating government functions from enterprises (*zhengqi fenkai* 政企分开); delegating provinces as functional entities (*sheng wei shiti* 省为实体); integrating the grid systems (*lianhe dianwang*联合电网); unifying electricity dispatch (*tongyi diaodu*统一调度); and pooling capital investment for electric power projects (*jizi bandian*集资办电). Treating provinces as separate operating units enabled each province to develop an independent power sector in its territory. The administrative ministry and regional power bureaus were, on the other hand, granted more control in order to integrate the fragmented networks and to distribute power collectively. This guideline reflected the strategy for power sector development, which was "to mobilize provincial resources to build generation capacity and at the same time to retain power grid in central control" (*dianchang dajia ban, dianwang guojia guan*电厂大家办，电

[11] Calculation based on statistics from the National Bureau of Statistics of China.

网国家管).

Guided by this strategy, the central government partially decentralized investment authority in 1986 in order to increase power generation capacity to keep up with the burgeoning economic growth. The central government previously had the exclusive rights to invest and was, therefore, the only source of electricity investment financing. Following the reform, investment in power generation was opened to third parties besides the central government. Provincial and sub-provincial governments as well as private and foreign companies were also allowed to invest, thus gaining the rights to control and benefit financially from their investments. New sources of finance outside the state banking system were marshaled via this effort, resulting in a steady increase of local investment in the late 1980s and the early 1990s (Figure 4.2).

Figure 4.2: Central and Local Investments in Electric Power Projects (in RMB Million)



Source: Author's illustration based on statistics from the Ministry of Electric Power of China (1996, p.773, p.781).

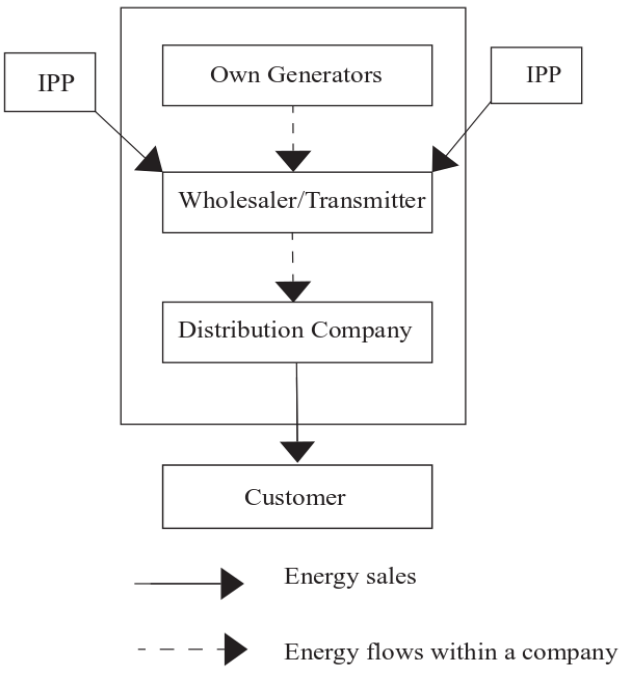
The reform involved the implementation of not only measures to broaden the source of financing but also a special two-track pricing scheme. For power plants built before 1985, the equipment and construction costs were already covered by state grants. Tariffs were set in a business-as-usual approach that covered only the operating cost and the transmission and distribution (T&D) costs. For new power plants, a "cost plus" tariff was adopted. The new pricing scheme acknowledged that new plants were more costly because they were not entitled the benefits of subsidized capital and of cheaper fuel supplies offered to plants built by the central government.

Also, starting from the mid-1980s, a surcharge of RMB0.02 per kWh was imposed to end-user prices to raise funds for construction of electric power projects nationwide. Half of the collected funds were utilized to expand the generation, transmission and distribution capacity of the state system while the remaining funds were channeled to the provincial governments for local investment in the sector. In addition to this national fee collected for general purpose, various construction and user fees were included in the end-user tariffs, for example, the fees collected to finance the Three Gorges hydropower project.

The new policy of diversification underpinned the investment success and led to a surge of investment at the local level and raised much-needed finances for the sector. The new sources of capital supported 226 GW of electricity generation capacity between 1986 and 2000, more than double the total installed capacity of 96 GW in 1986 (Zhang and Heller 2007, p.97). The reform gave rise to a group of semi-independent power producers. By the end of the 1990s, these new power producers accounted for 54 percent of the nation's installed capacity (Zhang and Heller 2007, p.93).

Although the reform at the first phase was mainly related to alleviating constraints on capacity expansions and marked no real shift toward competition or other elements of marketization, it transformed the sector from a system that was exclusively owned and controlled by the central government to a dual system involving both central and local players. The emergence of new actors changed the actor constellation and their modes of interaction. The relations between central and provincial governing authorities were transformed from a principal-agent relationship with central control to a decentralized system characterized by frequent bureaucratic negotiations. In the Chinese power market, a single purchasing agency model gradually took shape (Figure 4.3).

Figure 4.3 Single Purchasing Agency Model (before 2002)



Note: IPP denotes independent power producer.

Source: Adapted from Kirschen and Strbac (2004,p.5).

Following the reform, provincial governments were authorized to approve projects with generation capacities lower than 50 MW. The opening up of various investment channels at the local level led to the proliferation of small thermal power plants, which required less capital and shorter construction time. These power plants were often less efficient and caused more environmental pollution and energy waste than large thermal power plants. In 1987, 86 percent of the power in China was generated by plants with less than 100 MW generation capacity (Blackman and Xu 1999, p.698).

The increased provincial government control over investment resources led to their growing autonomy from the central government and a diminished role for the central administration. In 1988, the Ministry of Energy (MOE) was formed by merging the Ministry of Coal Industry, the Ministry of Petroleum Industry, the division of electric machinery in the Ministry of Machinery Building and the division of electric power in the MWREP. The merger of these administrations into one ministry was part of the central government's efforts to recentralize control over energy policymaking and investment distribution. However, the MOE was no more than an umbrella organization with the same personnel, allegiances and vested interests (Chow 1997, p.406). The unsolvable difficulties of coordinating and managing various industries resulted in the abolition of the MOE and the re-formation of the Ministry of Electric Power (MEP) in 1993.

As different types of organizational structures existed in the power sector across the provinces, provinces were grouped by categories based on the different relationships they shared with the central government. The electric power industries in 19 provinces were grouped into five regional power networks, namely Northeast,

North China, East China, Central China and Northwest.[12] They were interconnected by cross-provincial grids and were put under tighter vertical control by the central ministry compared to the financially independent provinces. Electric power entities in Heilongjiang, Jilin, Liaoning, Beijing and Tianjin were branches of the MEP and were under its direct control. In other provinces, the MEP owned the assets but the management of the entities was independent from the ministry.

The provincial power bureaus in Shandong, Fujian, Guangxi, Guizhou, Yunnan and Sichuan belonged to the provincial governments, but were under the dual jurisdiction of the MEP and their provincial governments. Historically, these provinces had independent transmission grids. The financial status of Inner Mongolia's power sector was independent from the MEP, but that of the eastern territory was under the Northeast power network and the western region under the North China power network. Guangdong, Hainan, Xinjiang and Xizang (Tibet) had not only independent transmission grids but also financial independence from the MEP. Their provincial power bureaus were owned and operated by the provincial governments. The decisions of the provincial governments on investment approval and pricing were subject to the approval of the State Development and Planning Commission (SDPC) instead of the MEP (Appendix 2).

Provinces, because of their different levels of economic development, choose different strategies to meet the increasing demand for electricity. In China's three northeastern provinces where centrally owned enterprises were concentrated, the provincial governments were able to extract funds from these enterprises to finance

[12] Northeast power network includes: Heilongjiang, Jilin and Liaoning; North China power network includes: Beijing, Tianjin, Shanxi and Hebei; East China power network includes: Anhui, Jiangsu, Shanghai and Zhejiang; Central China power network includes: Henan, Hubei, Hunan and Jiangxi; Northwest power network includes: Shaanxi, Gansu, Ningxia and Qinghai.

local power projects. The enterprises were asked by provincial governments to either share power generated from their own power plants with the localities or pay a higher price to use local power. For provinces with less financial resources due to their relatively lower level of economic development, local enterprises were encouraged to develop small generating units for their own use. These provinces, at the same time, imposed stricter electricity rationing and issued various bonds to raise funds.

In fast-growing regions such as Guangdong and Fujian, the provincial authorities were able to secure sufficient funds or ways of soliciting funds to develop local power projects. As a pilot for the national economic reform program, Guangdong has been granted substantial autonomy since the early 1980s. Instead of returning all revenue from taxes and state enterprises to the central government, Guangdong was allowed to retain a fixed amount of the revenue every year. It was also given control of foreign trade and could retain the majority of remittances. Benefiting from these fiscal favors, Guangdong could therefore afford to spend billions of dollars to expand its generation capacity, which later became China's largest at the end of 1999.

In summary, the decentralization policy implied that each provincial government should be responsible for building its own generation capacity to meet local demand. However, decentralization had also led to regional diversity and disparities. Provincial governments were allowed to decide their own electricity tariffs to account for the regional variations in generation costs. Increased local discretion consequently reinforced the fragmentation of transmission and distribution networks along the geographic lines of provinces. Variance in the pathways of power market development in provinces proves that actor capabilities can cast significant constraints

on actor preferences and their positions in negotiations. Provinces with fewer local resources and capabilities have to financially rely more on central support in electric power development. By contrast, those with stronger actor capabilities, such as Guangdong province, were able to negotiate for more autonomy.

4.4 The Second Phase of Reform: Corporatization and Brief Re-centralization (Mid 1990s–2002)

The economic chaos in 1987 and 1988 as a result of severe inflation, and the subsequent 1989 Tiananmen Square incident (or the June Fourth incident) led to the purge of Zhao Ziyang, a key figure in the reformist group. With the conservatives gaining the upper hand, general economic reforms, including reforms in the power sector, stalled but only for a short time. Deng Xiaoping however revitalized pro-market reforms during his 1992 southern tour. Shortly after, the 1994 14th Party Congress marked China's historical shift to a *socialist market economy*. Reformists led by Zhu Rongji pushed for the separation of government functions from business operations and the restructuring of many sectors of the economy.

Until the mid-1990s, most Chinese SOEs, including those in the power sector, were still subject to pervasive government interference in their commercial decisions. Mounting losses and inefficiencies prompted the central government to launch nationwide reforms of SOEs in 1997. Owing to political concerns, the central government chose corporatization policy over privatization for large-scale SOEs. Corporatization in the Chinese context means separating government functions from the commercial activities of enterprises and transforming SOEs into independent economic entities that are accountable for their own profits and performance.

With the enforcement of corporatization came an extensive restructuring plan for the power sector in 1997. In the same year, the State Power Corporation of China (SPCC) was formed with independent legal status. It took over all of the MEP's assets and was intended to become an economic entity that performs only business functions. As a colossal enterprise fully owned by the State Council, the SPCC managed most of the infrastructure, including about 50 percent of power generation and nearly the entire network system in China (Tsai 2014, p.458).

In 1998, the central government dismantled the MEP and transferred its administrative functions to the newly established State Economic and Trade Commission (SETC) and the reorganized State Development and Planning Commission (SDPC). The SETC and SDPC subsequently became the two major regulators of the power sector. The SETC was responsible for supervising the management and operation of the industry, while the SDPC controlled the pricing system and the rights to authorize investment projects.

A parallel separation of government and business was carried out at each level of government. Provincial power bureaus were converted to power companies. Five cross-provincial regional power groups (Northeast China, North China, East China, Central China and Northwest China) and six provincial power companies (Shandong, Sichuan, Fujian, Yunnan, Guangxi and Guizhou) became the direct subsidiaries of the SPCC. Through these subsidiaries, the SPCC strengthened the vertical integration of power groups in each region and province. As expected, the power sector in Guangdong, Hainan, Inner Mongolia[13] and Tibet stayed independent from the SPCC.

[13] The SPCC took over the power sector assets in Inner Mongolia in its internal restructuring effort in 1999 and 2000.

Historically these provinces have had more autonomous control of their power sector and the provincial governments were responsible for making policies on the development and management of the sector.

While the SPCC was, in principle, supposed to be an independent state corporation, it nevertheless acted like a "corporatized ministry" of the same rank as the SETC and the SDPC. The former employees of the MEP were transferred to either the SPCC or the Electric Power Division of the SETC, thereby producing a tightly connected coalition between the two organizations (Chen 2010, p.83). Despite being replaced by Zhu Rongji as premier in 1998, Li Peng still maintained strong control over the power sector. Li's long-time protégé, Gao Yan[14] was appointed general manager of the SPCC. Li Peng's son, Li Xiaopeng, later became the deputy general manager of the SPCC.

Shortly after its corporatization, the SPCC proposed large-scale infrastructure projects to construct and improve cross-provincial transmission and distribution (T&D) networks, claiming that well-connected interprovincial grids were the precondition for introducing market competition. Through this project, the SPCC was able to reconsolidate its power over its provincial subsidiaries. Centralization also occurred in the process of upgrading the T&D networks in rural areas that was executed by the SPCC and began in1998. Economically, it was costly for the SPCC to upgrade the rural infrastructure; rather, this was a political decision and a political priority of the central government.

Before the corporatization, power bureaus at the county level in some

[14] After embezzling and misallocating the state funds estimated at RMB3.28 billion, Gao fled to Australia in September 2002. His whereabouts remain unknown until today.

provinces had become powerful political actors in local politics. Out of 2,400 county power bureaus, 760 had their power supplies directly from the SPCC and were therefore under the direct jurisdiction of the SPCC. Another 600 county power bureaus depended solely on local small hydro and thermal plants. Their electricity supply was distributed through low-voltage T&D lines built by local governments. The largest group covered 1,040 counties, which were wholesale customers of the SPCC; the T&D facilities belonged to local governments or their agencies (Xu 2002, p.190).

Perennial shortages of power supply provided opportunities for county power bureaus and local officials to seek rents from the decisions as to who was to have access to the power supply. Often, positions in local power bureaus were filled at the discretion of local officials inviting rampant corruption and the appointment of people with connections to them. As retailers and local distributors, these county power bureaus were able to determine electricity rates for rural end users. They used their authority to charge rural end-users exuberant prices. Electricity tariffs in some rural residential areas could be as high as 10 times the normal tariff (Xu 2002, p.190).

Patron–client networks and abuse of power at county and lower levels of power bureaus became so prevalent that it not only impeded the development of the electric power industry but also undermined the legitimacy of the local governments. Through the top-down corporatization process of the county-level bureaus and the upgrading of rural T&D networks, the SPCC was able to take over the control of the management and personnel of these entities. Redundant employees in township and village electric power supply stations were laid off, and the economic performance of the enterprises improved thereafter.

Further efforts at centralization involved reorganizing the regional power groups to make them branches of the SPCC. Sandwiched between the central level and the provincial level, the regional power groups were, in reality, hollowed out and without any substantial role in decision-making. In 1999 and 2000, the SPCC created five regional branches (*diqu fen gongsi* 地区分公司)to replace the original five regional power groups. With this reorganization, the SPCC gained direct control of its branches. It also managed to make a clear division between state assets and provincial assets, and reclaimed the assets that had ambiguous ownership status.

In the Northeast region, the SPCC took control of all 500 KV high-voltage transmission lines, all cross-province 200 KV transmission lines and all T&D assets in Inner Mongolia (Xu 2002, p.182). The provinces owned only those power generation plants that they had invested in and operated. For power plants that the central and provincial governments had jointly invested in, the SPCC and the provincial governments remained as joint stakeholders. In this episode of re-centralization, it can be inferred that central and provincial governing authorities engaged in closed-door negotiations in order to reach compromises regarding the distribution of turf and interests.

In 1999, the SPCC began to experiment with wholesale market competition among generators on a very limited basis in five provinces and one municipality (Liaoning, Jilin, Heilongjiang, Zhejiang, Shanghai, and Shandong). The economic slowdown after the Asian financial crisis caused a declining demand for electricity. The unexpected arrival of a power surplus resulted in serious conflicts of interests among different power producers and their owners: central, provincial, and local governments, as well as private firms.

Designed as a response to the saturated market, the experiment followed a very crude model of the power pool used in England and Wales (Zhang and Heller 2007, p.100). Each province adopted its own scheme. For each power plant, the total power capacity was divided into two parts. A contractual part was allocated through the conventional dispatch system and a smaller quantity, typically 10% of the total capacity, was required to be sold competitively in the market. The contractual part was dispatched as usual at the government-set tariff. The other part, i.e., the power beyond the contractual amount, was bid into the grid at market price on a daily basis. Simulation of the market competition began in July 2000, but with no actual financial settlements.

The experiments in all six provinces were suspended after two years. Factors contributing to the failure included unfair competition, macroeconomic recovery that extinguished excess capacity, and the announcement of prospective new government policy initiatives (Zhang and Heller 2007, p.101). The market reform would have disproportionately benefitted the more efficient, larger-scale SPCC generators. Therefore, smaller and dirtier local power producers that were backed by local governments resisted the reform. All in all, the wholesale market reform trial was short-lived and inconsequential.

In the second phase of the reform, the mode of interaction between central and provincial governing authorities displayed a mixture of integrative and distributive strategies. The reform primarily consisted of pragmatic policy measures that aimed to improve system efficiency and protect the economic position of the newly corporatized central government assets. The central actors sought to alter their status vis-à-vis provincial actors by introducing more centralization policies. However,

integrative negotiations and agreements were not realized when actors at both levels did not converge in their preferences. Although the reform, like its predecessor, did not fundamentally restructure the sector, it altered some organizational incentives. Administrative interference receded to some degree in the wave of corporatization. The newly chartered SPCC pursued policies to improve sectoral performance by enhancing vertical integration in the provinces, and centralizing electricity service at the township and village levels.

Instead of a partial withdrawal from the business, the central government merely switched its role from direct ministerial administration of central SOEs to indirect control over investment, project approval and appointment of key corporate managers in the core industrial firms concentrated under the umbrella of the SPCC (Zhang and Heller 2007, p101). Nevertheless, the brief recentralization efforts did not solve the problem of market fragmentation in a more diversified system. The marketization experiments were in part reactions to the incipient divisions of interest between businesses owned by multiple levels of governments. In response to the economic slowdown that reduced demand and exposed inefficiencies in the system, the central government fostered some competition at the margins. Yet, the small-scale market reform trial failed largely because central SOEs, and provincial and local enterprises were not on a level playing field.

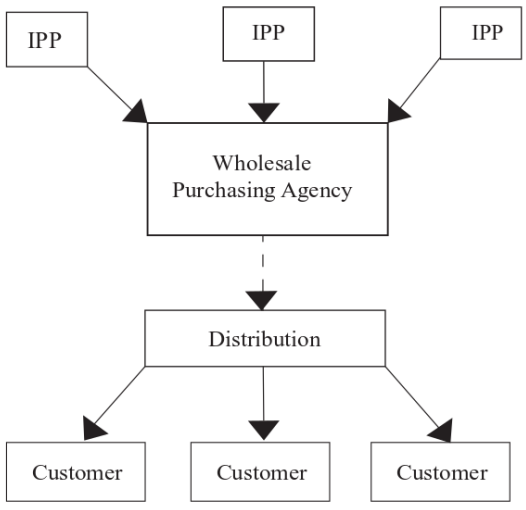
4.5 The Third Phase of Reform: Breaking up the Monopoly and Building the Market (2002–2015)

In December 2002, the central government announced the “Power Sector Reform Scheme” (the State Council Document [2002] No. 5) with an intent to create truly competitive power markets. The decision to reduce monopolistic control was a

direct response to the failure of the SPCC-led system in the late 1990s to cope with power market fluctuations. The difficulties of dispatching power produced by the Ertan Hydropower Station due to the SPCC monopoly was controversial, highlighting the tension between different stakeholders and interests in the sector. Ertan was built in Sichuan province in the late 1990s. In light of the power surplus after the Asian financial crisis, the provincial subsidiary of the SPCC gave preferential treatment to its own power plants. Since its commission, Ertan was only able to sell two-thirds of the contracted power and at a very low tariff of less than RMB0.2 per KWh ("Ertan" 2000). The problem epitomized in Ertan was common in many other localities in China at the time. Provincial power companies often engaged in discriminatory dispatch to favor their own power plants over the independent producers in situations of power surplus.

With the failure of the vertically integrated system, the central government was determined to break up the SPCC and disintegrate the system. At the end of 2002, the SPCC was dissolved into five state-owned independent power generation companies (Huaneng, Datang, Huadian, Guodian, and China Power Investment Group) to hold the generation assets of the corporation. The newly established State Grid Corporation of China (SGCC) took over most of SPCC's T&D assets across northern China. The SPCC's T&D assets in three southern provinces, namely Guangxi, Yunnan, and Guizhou, were merged with the previously independent Guangdong and Hainan provincial grids to form China Southern Power Grid Corporation. The restructuring changed the sector into a different version of the single purchasing agency model (Figure 4.4).

Figure 4.4 Single Purchasing Agency Model (after 2002)



Source: Adapted from Kirschen and Strbac (2004,p.5).

The provincial subsidiaries of the SPCC underwent a parallel shuffling of assets. The SPCC's provincial subsidiaries' generation assets were reallocated to the five state generation corporations. The T&D facilities in the north were relabeled as provincial subsidiaries of the State Grid Corporation, and in the south, China Southern Grid Corporation.

The spun-off corporations from the disintegrated SPCC came to be legally owned and controlled by the same central government body — the State-owned Assets Supervision and Administration Commission under the State Council. In 2003, the State Economic and Trade Commission (SETC) was abolished and its functions were partly incorporated into the Ministry of Commerce and partly transferred to the newly founded National Development and Reform Commission (NDRC), a

reincarnation of the State Development and Planning Commission (SDPC). The NDRC not only became the most authoritative decision-making body for China's macroeconomic policy but also took over the SETC's industrial policy-making function.

That same year, the central government created a regulatory commission — the State Electric Power Regulatory Commission (SERC) — under the State Council. The SERC was designed to set rules for competitive electricity markets, to oversee market operations and to supervise the establishment of trading platforms for the electricity market. Originally, it was supposed to function as an independent regulatory body to be free from the political influence of the ministries and industrial enterprises.

In reality, the commission lacked meaningful authority and independence. The SERC became another "decoration" under continued government control. It was comprised of many former SPCC employees and shared the same office building with the State Grid Corporation (Chen 2010, p.90). Organizationally, the SERC's authority was substantially overshadowed by the NDRC's decisive authority over the approval of projects and regulation of electricity prices. In March 2008, the National Energy Administration (NEA) was established under the NDRC. The SERC was dissolved and its functions were incorporated into the NEA in 2013.

To address regional disparities in economic development and imbalances in electricity supply and demand, the newly established State Grid Corporation, like its predecessor, the SPCC, continued to propose nationwide power grid interconnection projects. In addition, the West–East Electricity Transfer Project (*xidian dongsong* 西

电东送), associated with the central government's Western Development Strategy in 2000, continued to be implemented. The interconnection of the electric power grids is expected to serve interregional cooperation and development. It is often perceived by central policymakers as an important building block for national political unity and control (Yeh and Lewis 2004, p.461).

Alongside an aggressively expansive approach to infrastructure construction, China continued to explore specific measures for a thorough operational restructuring toward further marketization in the power sector. The first renewed attempt in 2003 was focused on the development of regional electricity markets based on a single buyer model. The second attempt starting from 2004 reformed the retail market, with direct transactions between power generation companies and large industrial users. (Ho, Wang and Yu 2017, p.18).

In 2003, the central government outlined its plan for developing six regional wholesale power markets to facilitate the efficient exchange of power between regions (Figure 4.5). As the grids and the dispatch of generation had functioned largely on a provincial basis, there was little exchange of power across provinces even when one province had a surplus of power and another a shortage. One major goal of the reform plan was to integrate the transmission grids across provincial boundaries in order to develop unified management and operation.

Figure 4.5 China's Planned Regional Power Markets for 2005

Source: Adapted from Yeh and Lewis (2004, p.447).

The Northeast region was selected to pioneer the effort of building competitive markets for electric power. The region was one of the few areas in China that experienced a surplus in generating capacity at the time. Moreover, the infrastructure of the transmission system in the region was relatively good. The three provinces, Liaoning, Jilin, and Heilongjiang, have relatively comparable levels of economic development. Their retail tariffs were also relatively comparable. These are the factors that contribute to the choice of the Northeast region as the pilot of the wholesale market reform.

Simulated bidding in the Northeast was conducted in 2004, and trial operations began in 2005. The simulated and trial operation involved the participation of 28 plants (Zhang and Parsons 2008, p.13). Initially, a portion of the participating

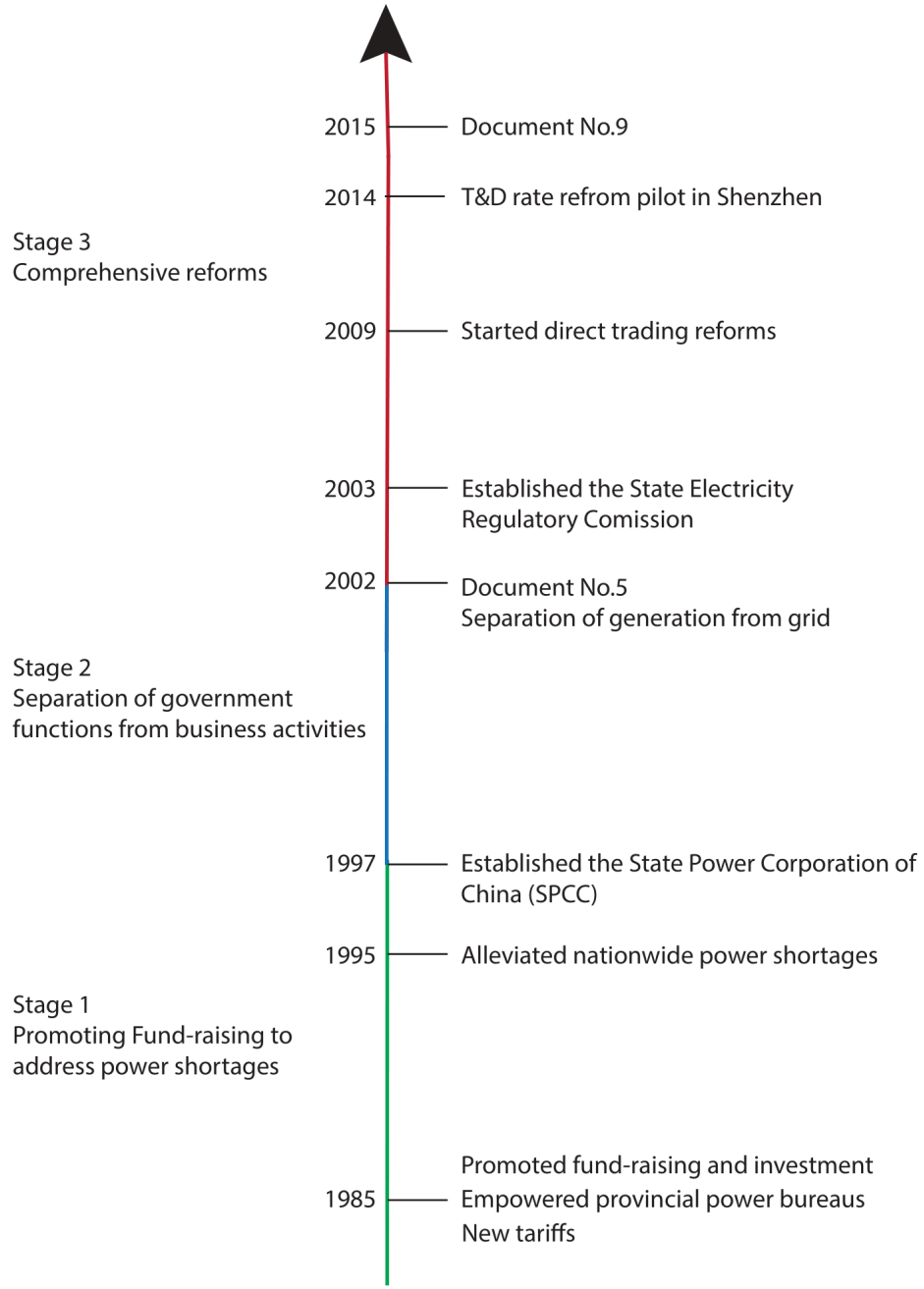
plants' normally planned volume of generation was offered for bidding in the market, and later the entire capacity was put up for bidding. In China's eastern regional market, simulated operation began in 2005 and trial operations in 2006. A market had also been created in South China with simulated operation starting in November 2015. Full-scale operation of these pilot programs was, however, never realized. In 2006, shortly after the unsuccessful trial operations, attempts to reform regional electricity markets in all regions were terminated. The failure was partly due to the reoccurrence of power shortages in some provinces and in part due to local protectionism and conflicts of interest among provinces in negotiating tariffs. The 2000–2001 California electricity crisis also reminded central policymakers of the risks associated with market liberalization (Yeh and Lewis 2004, p.449).

In 2009, a decision was made to replace the regional power markets with direct contracting as the dominant option for reforming the electricity market. Direct contracting was introduced for the first time in 2004 as an interim measure. Negotiations and contracting were organized by provincial governments, validated by power gird companies and carried out within provinces. The negotiated price later became the feed-in-tariff for electricity generators, replacing the official tariffs set by the central government. Starting from 2004, the direct contracting process was carried out at the beginning of each year in a handful of provinces. The number of participating provinces grew steadily as more provinces became keen to experiment with the new mechanism. The driving force behind their interest in participating was that provincial governments gained the discretion to select eligible participants and supervise trading outcomes. However, the scale of competition in direct contracting is rather limited and often regarded as a conservative approach to power market reform (Dupuy and Wang 2016).

Meanwhile, the two grid corporations did not stop their scheme of connecting regional grids. They argued that the extra high-voltage (EHV) and ultra-high-voltage (UHV) grids could provide the basic condition for optimal allocation of resources based on “market forces”, even though they were not truly devoted to regional market-building. Certain provincial governments targeted for UHV projects have been skeptical about the return on investment of the costly UHV projects (Downie 2018). Many provinces still believe they get larger boosts to GDP, employment, and revenue from building their own power plants than importing power from other provinces.

The reforms made until this point in time largely repeated the experiences of the last phase. Enterprises in the core state system were reorganized but there was little redesign of system operations. A potential first step toward competition in the wholesale market was hindered by the rising tides of economic growth, power shortages and easy finance through expansive public and private investments. The power sector once again witnessed a surge in investment in new capacity. In the wake of enthusiastic provincial infrastructure investments into the power sector , the central government lost much of its control over the size and shape of the power sector. Market competition was put off because of segregation of markets along provincial borders. Further institutional reforms, such as the objective of separating transmission from distribution that were originally planned at the time of the dissolution of the SPCC, were not implemented. Figure 4.6 summarizes the timeline of reform in the sector over the past three decades.

Figure 4.6 Timeline of Power Sector Reform in China



Source: Adapted from Pollitt, Yang and Chen (2017)

4.6 Conclusion

This chapter examined the history of market reforms in China's electric power sector from 1985 to 2015, highlighting the changes in central–provincial relations in the governance of the electric power sector. Over the 30 years between 1985 and 2015, there had been three major rounds of reform which combined have significantly changed the landscape of the Chinese electric power sector. The governance and institutional framework of the sector have changed considerably. While decentralization provided provincial governments with strong economic and political incentives for local economic development, it also had important implications for the development of the electric power sector.

Provincial actors now play indispensable roles in the sector and have contributed to the pluralization of actors involved in what had become an increasingly fragmented policy arena. Decentralization encouraged provincial and local governments to invest in their own power generation capacity and thereby enabled them to gain more control and bargaining power over resource allocation and local industrial development. The first phase of reform facilitated the entrance of new provincial actors into the sector and the development of a partially decentralized process of sector decision-making. What was once a centrally controlled and unified sector has gradually transformed into a sector which is now a horizontally fragmented but vertically integrated monopoly.

Fiscal decentralization made introducing market competition in the sector more difficult. Consensus has to be reached before a policy decision concerning market reform can be made among the many concerned bureaucracies and divergent interest groups involved in negotiating processes. For the outside world, these

negotiations occur in a black box. Provinces that were rich in power supply preferred to promote domestic industrial development and especially development of energy-consuming heavy industries rather than to participate in interprovincial energy exchange. Hence, market fragmentation along provincial borders prevailed in the power sector.

The SPCC, in initiating centralization and restructuring at the second phase of reform, did not bring about structural changes but instead further enhanced the vertical integration within provinces. Without the right pricing signal and reform of dispatch practices, increased grid interconnectivity between regions could not mitigate the discrepancies between the central and provincial players.

The establishment of political and economic partnerships between provincial authorities and associated businesses enabled them to participate in the subsequent reform processes. The interprovincial barriers inherited from the previous stages of reform were sustained following the failure of regional market-building. When the preferences of provincial and central authorities did not converge and the conflicts of interests could not be solved by negotiations in some policy areas such as regional market building, market reform reach a deadlock.

This chapter identified the central–provincial interaction as a significant factor impacting the outcomes of sectoral reform. In a fragmented yet unified system, both the center and the provinces act as institutional constraints on one another (Li 1997, p. 266). The cyclical centralization and decentralization of regulatory authority signifies the central government's attempt to search for a coherent national strategy for power sector regulation. It also accentuates the central government’s limited capacity to regulate the sector. I argue that the provincial discretion in the power sector is

endogenously rooted in the evolving sector structure rather than one that is delegated by the central government. Though not fully institutionalized, the provincial discretion over sectoral regulation in the electric power sector is more concrete and durable than has been discussed in the literature on central–local relations in China.

Chapter 5. Governing the Chinese Electric Power Sector

Due to the legacy of the planned economy, government involvement in the planning, investment, and project approval processes is extensive in China. Government control in the electric power sector has persisted even longer than in many other sectors because of the concentration of state-owned enterprises in the sector. This chapter first explains the Chinese system of bureaucratic administration and how it governs the electric power sector. It then briefly introduces the economic development status of Guangdong and Xinjiang and the general features of the respective province's electric power sector.

5.1 Chinese System of Bureaucratic Administration

In China's unitary political system, local governments derive their authority and decision-making rights solely from the central government. In this sense, local governments perform duties on behalf of the central government. There are four levels of subnational governments below the central government: provincial, municipal /prefecture, county and township (Table 4.1). The institutional design at the local level is meant to mirror that at the central level rather than to accommodate local conditions (Huang 1996, p.28). For this reason, the majority of central economic ministries have provincial equivalents.

The authority relationship between the central ministries and their provincial counterparts is complex. The relationship between the central leadership and top officials in the provincial governments is one of direct subordination. Yet, the relationship is complex and there is even a special word describing the relationship: the "tiao–kuai"system (条块体系). Tiao (Chinese term for "line") refers to the vertical

relationship between the central ministries and their corresponding departments at lower levels of governments. Kuai (Chinese term for "area") refers to a territorial authority such as a provincial or a county government. In the Chinese political system, central ministries and provincial governments share the same bureaucratic rank (Table 1). Therefore, central ministries cannot issue documents to provincial governments unless specifically authorized. A functional department in a provincial government is usually subordinate to both the provincial government (the "kuai" authority) and to the pertinent central ministry (the "tiao" authority).

Table 4.1: Rank Equivalents among Government Organizations

Center	Province	County
Ministry (*bu*)	Province (*sheng*) Centrally Administered Cities (Beijing, Tianjin, Shanghai, Chongqing)	
General Bureau (*zongju*)	Commission	
Bureau (*ju* or *si*)	Provincial Department (*ting* or *ju*) Prefecture	
Division (*chu*)		County (*xian*) County-level Municipality
Section (*ke*)		County Department

Source: Lieberthal and Oksenberg 1988, p.143.

The Chinese bureaucratic system formally distinguishes between so-called administrative leadership relations (*xingzheng lingdao guanxi* 行政领导关系) and professional leadership relations (*yewu lingdao guanxi* 业务领导关系) (Huang 1996, p. 29). A higher-ranking unit can issue binding orders to its subordinate units if both parties share an administrative leadership relationship. The relationship also gives the superior unit the authority related to appointments, removals, the transfer of cadres at

lower levels, major budget decisions, and payroll expenditures for personnel. Professional leadership relations exist between a superior unit and a subordinate unit in interrelated areas of activities that require frequent consultation and cooperation among agencies. In such relations, the superior unit can issue non-binding directives in the form of guidelines, instructions or opinions to the subordinate unit, but the subordinate unit does recognize that these documents are only for reference and can be modified or neglected (Lieberthal and Oksenberg, p.149).

It should be noted that how administrative and professional leadership relations are structured can affect the vertical authority relationship (*tiao*) between a central ministry and a corresponding provincial department in the same sector (Huang 1996, p.30). Often, these two types of relationships do not converge—i.e., the provincial departments do not necessarily take orders from the central ministries in Beijing, although nominally they are clearly lower in bureaucratic rank than their central counterparts.

Except for those agencies that are directly administered by the central government via the "vertical management" (*chuizhi guanli* 垂直管理) mechanism,[15] many provincial departments do not have a vertical and administrative leadership relationship with a central ministry. Instead, they receive commands directly from the provincial authorities (*kuai*) and only maintain a professional relationship with the central ministries. In most situations the central ministries can only govern the operations of their corresponding provincial departments by way of non-binding

[15] Sectors such as taxation, banking, insurances, securities trading, customs administration, auditing, national and public security, quarantine duties, and railway are under the strictest system of "vertical management" (Chung 2017, p.153).

instructions and guidelines. This is not to say that these instructions and guidelines are not obeyed, but the consequences of not obeying them are obviously less severe than they are under a more vertical arrangement (Huang 1996, p.32). The relations between central ministries and provincial functional departments imply that there is considerable operational autonomy vested in provincial governments and that instructions from the central ministries are less binding than they would be under a more centralized system.

5.2 Governance Structure of the Electric Power Sector

As the highest decision-making body of the Chinese economy, the State Council has the ultimate authority over the electric power sector for its development and operation. Although it does not directly involve regulating the power sector, the State Council oversees provincial governments, and assigns functions and tasks to them. The National Development and Reform Commission (NDRC) under the State Council functions as an agency of macroeconomic management. It is the body that formulates national policies for social and economic development, designs action plans for economic reforms, and guides the restructuring of China's economic system.

The NDRC plays the role of formulating and overseeing the implementation of key energy policy initiatives even though it no longer directly controls the supply and demand of energy. The National Energy Administration (NEA), established as a subordinate department of the NDRC in 2008, integrated the functions of the National Energy Leading Group, a special task force created in 2005 on national energy strategies. The National Energy Commission (NEC)— and set up in January 2010 and chaired by the prime minister —further integrates energy-related institutions and functions. It is currently administered by the NDRC and reviews energy strategies and

major policy issues. As a high-level decision-making body, the NEA functions as a standing body of the NEC, handling the commission's daily tasks. In part through the NEA, the NDRC produces five-year energy development plans that set out the overall development objectives and targets for the energy sector. The NEA also has the authority to approve investments in the energy sector, although part of its authority has been delegated to the provinces.

The other important agency is the State-owned Assets Supervision and Administration Commission (SASAC). The SASAC represents the central government as owner of the state-owned enterprises (SOEs), overseeing the performance of the centrally owned SOEs and their senior management. State-owned enterprises are often classified according to the level at which administrative supervision takes place. Central enterprises (*zhongyang qiye* 中央企业) are those whose responsibilities for personnel, finance, and other administrative affairs rest with the central government. They are China's largest and most important companies often known as "national champions." Local enterprises (*difang qiye* 地方企业), as the name suggests, are those whose aforementioned responsibilities belong to provincial or sub−provincial governments (Huang 1996, p.33). The supervisory authority that local governments exercise over a significant percentage of state-owned enterprises empowers them with a direct form of economic control. The SOEs themselves are able to exert influence over policy-making due to their close links with government bodies. The chief executives of most centrally owned SOEs are of ministerial or vice-ministerial rank.

Other relevant agencies in charge of energy governance at the central level include the Ministry of Ecology and Environment[16], which sets and implements environmental regulations and standards; the Ministry of Natural Resources[17], which governs the management and use of land and natural resources including oil, natural gas and coal; the Ministry of Science and Technology, which sets standards for science and technology research and development; the Ministry of Water Resources, which governs the use of hydroelectric resources; the Ministry of Finance, which is responsible for fiscal policy; and, the Ministry of Commerce, which oversees foreign trade and investment (Andrews-Speed 2018, p.37).

Reflecting on the institutional features of the "tiao-kuai" system, the setup of the electricity sector's administration in the provincial governments appears to mirror that of the central government. The NDRC, the NEA and the other various agencies all have equivalent agencies at provincial and lower levels of government. However, the type of relationship that provincial NDRC and NEA agencies maintain with their provincial governments is "administrative leadership relations", whereas their relationship with the national NDRC and NEA agencies is entirely "professional leadership relations" in nature . This implies that the decentralization of economic management has greatly weakened the vertical links and granted local governments more independence.

Interestingly, although the NEA is at the national level, it established six regional regulatory bureaus and twelve provincial regulatory offices to perform

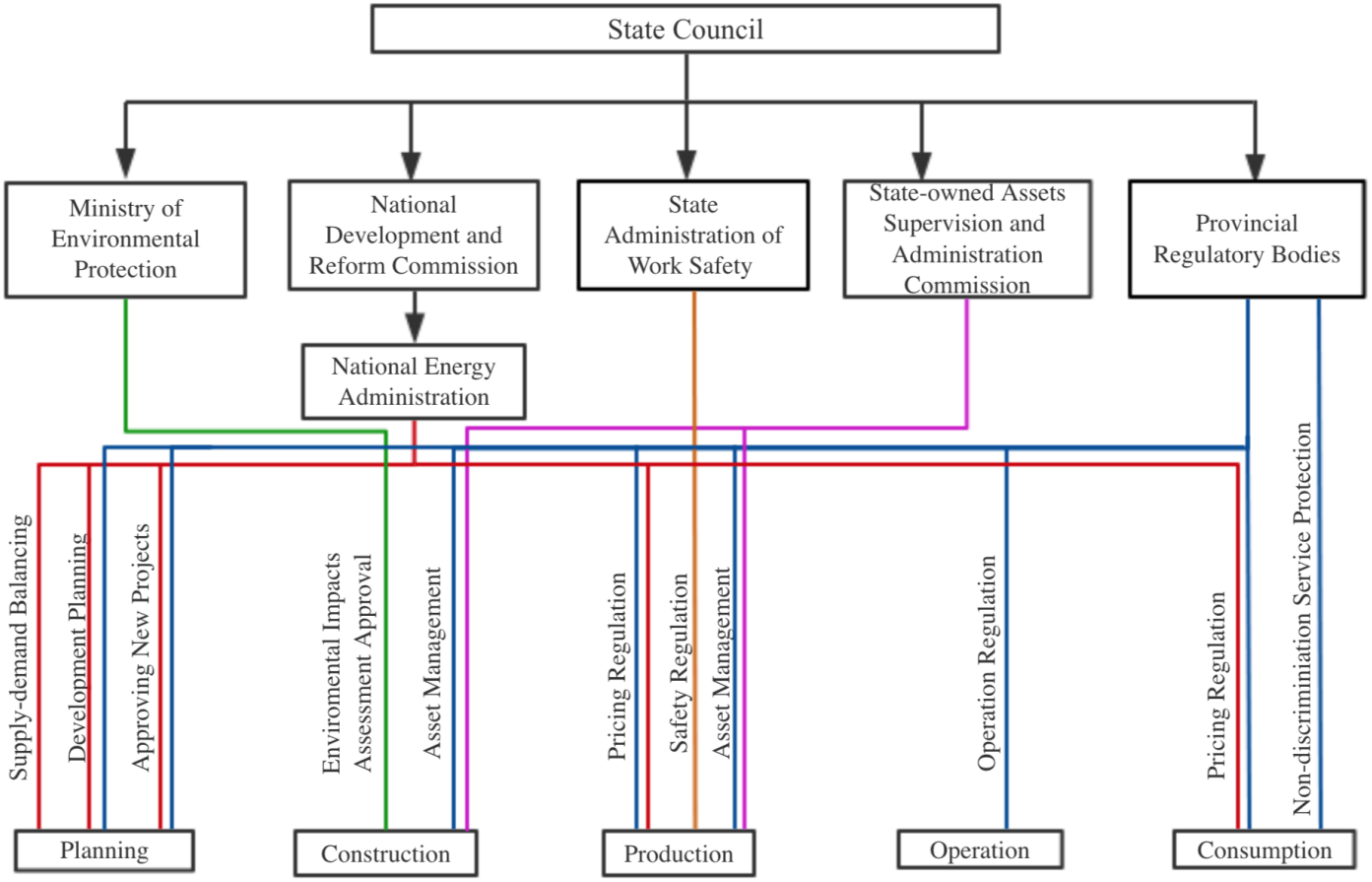
[16] The Ministry of Ecology and Environment superseded the Ministry of Environmental Protection in 2018.
[17] The Ministry of Natural Resources was established in 2018 by merging the functions of the Ministry of Land and Resources, State Oceanic Administration, and the State Bureau of Surveying and Mapping.

regulatory functions over the energy sector in 2013[18]. These agencies are actually the remaining bodies of the failed State Electricity Regulatory Commission (SERC). These regional bureaus and provincial offices have vertical and "administrative leadership relations" with the NEA and are directly administered by the central government. They have overlapping authorities with the provincial NDRC and NEA agencies, both of which often tend to overshadow them.

As Figure 5.1 shows, Chinese regulatory oversight of the electric power sector is dispersed among several agencies. Despite some level of coordination provided by the NEC which is comprised of members from the central ministries, the governance of the sector remains fragmented. None of the agencies has exclusive power over the coordination of industrial policies. Maintaining a balance across the actions of different government agencies is still difficult. Moreover, there is no clear separation of policymaking, planning or regulation. Central and provincial agencies have overlapping responsibilities for regulating the sector.

[18] The six regional bureaus are: the Northwest Regulatory Bureau, the Northeast Regulatory Bureau, the North China Regulatory Bureau, the East China Regulatory Bureau, the Central China Regulatory Bureau, and the South China Regulatory Bureau. The 12 regulatory offices are located in Shanxi, Shandong, Gansu, Xinjiang, Zhejiang, Jiangsu, Fujian, Henan, Hunan, Sichuan, Yunnan, and Guizhou.

Figure 5.1: Governance Structure of China's Electric Power Sector



Source: author's illustration

5.3 The Provincial Governance of the Electric Power Sector in Guangdong and Xinjiang

Guangdong—a province covering an area of 178,000 km^2 in the southeast of China on the South China Sea coast—is the most populous province in China with a total population of 126 million in 2020, accounting for 8.9% of the country's population (Figure 5.2). Guangzhou, the provincial capital, and Shenzhen, the economic hub, are among the most populous and largest cities in China. Guangdong is geographically adjacent to Hong Kong and Macao, and has close ties with overseas Chinese.

Figure 5.2 Location of Guangdong and Xinjiang

Source: Author's illustration

Guangdong was granted pilot province status by the central government for its market reform experiment in 1979. The provincial government enjoyed greater economic decision power and less policy constraints, compared to other provinces. Since then, Guangdong has led China in economic growth. Since 1989, Guangdong has topped the total GDP rankings among all provinces in mainland China.

Guangdong's nominal GDP in 2020 reached US$1.928 trillion, and its per capita GDP at US$15,238;[19] the province contributes approximately 10.8% of China's total GDP in 2021. (National Bureau of Statistics of China 2022)

For a long time, Guangdong's growth was constrained by a severe shortage of electricity. Following the central government's policy change of decentralization in the mid-1980s, Guangdong's electric power sector expanded rapidly. Guangdong has made many firsts in China's history of electric power development. For example, Guangdong introduced the first build-operate-transfer (BOT) power project in China. The Shajiao B generation plant (700 MW) was built in 1987 and owned by Shenzhen Energy Group. China's first commercial nuclear power plant was also built in Guangdong. Construction of two nuclear reactors of large unit power (944 MW) began in 1987 and became operational in 1993 and 1994, respectively. China General Nuclear Power Group[20] was established in 1994 to manage the Daya Bay plant. The precursor of this new player was initially introduced in 1985 to accommodate the cooperation among various stakeholders of the Daya Bay nuclear project, including the government of Guangdong province, Hong Kong investor, and the Ministry of Water Resources and Electric Power.

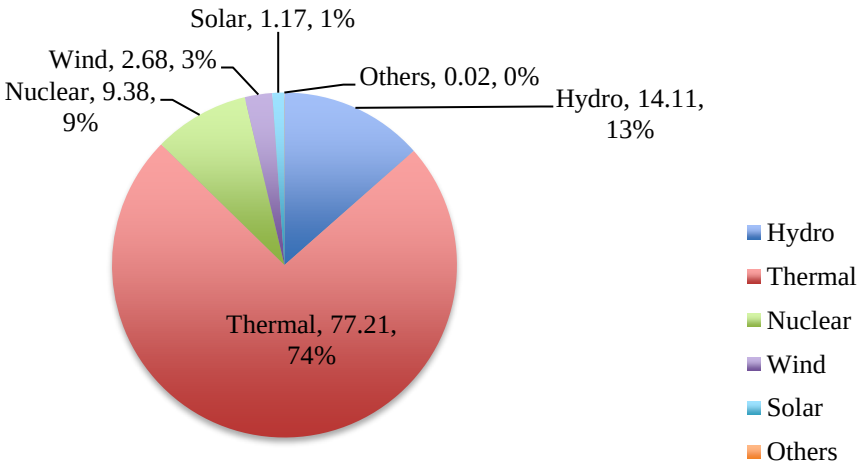
Between 1990 and 2016, the provincial installed capacity increased from 8.3 to 104.6 GW, an average annual growth of 7.3%; electricity consumption grew 7.9% per year on average, from 35.9 to 561 TWh.[21] Total electricity production was 403 TWh in 2016. That same year, the industrial sectors accounted for 65.4% of total

[19] Nominal rate: RMB 6.3527 per US dollar (2021).
[20] The group was first established under the name China Guangdong Nuclear Power Corporation in 1994. It was renamed China General Nuclear Power Group in 2013.
[21] Author's calculation based on statistics from *China Electric Power Yearbook* and *China Energy Statistical Yearbook*, various years.

electricity consumption. The primary, tertiary and residential sectors accounted for 1.6%, 16.9% and 16.1% of the total consumption, respectively.[22] In 1990, thermal and hydro power constituted the two main electricity sources, accounting for 67.6% and 32.4% of the installed capacity, and 77.6% and 22.4% of generation.[23] Since the mid-1990s, nuclear, wind power and solar power have become new sources of electricity. By 2016, the share of renewable sources was 12.7% of the installed capacity (nuclear power 9%, wind power 2.6%, solar power 1.1%) and 18.9% of generation (nuclear power 17.5%, wind power 1.2%, solar power 0.2%) (Figure 5.3 and Figure 5.4).

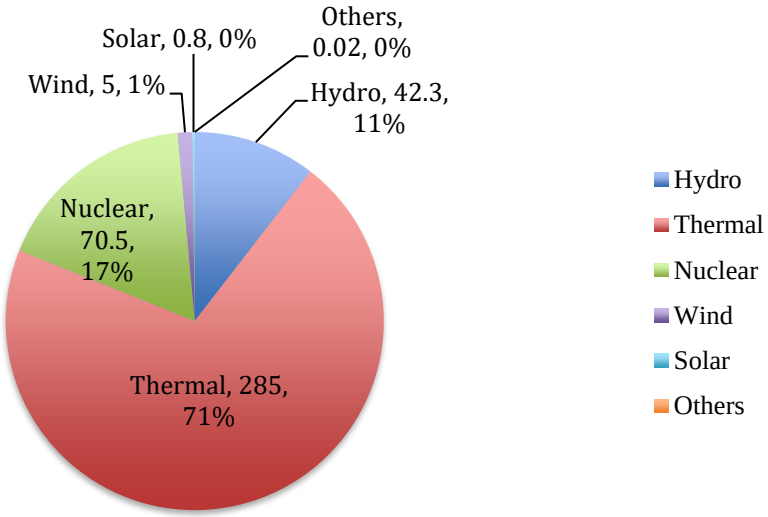
[22] Ibid.
[23] Ibid.

Figure 5.3 Installed Capacity (GW) in Guangdong (2016)



Source: *China Electric Power Yearbook* 2017.

Figure 5.4 Generation (TW) by Type in Guangdong (2016)



Source: *China Electric Power Yearbook* 2017.

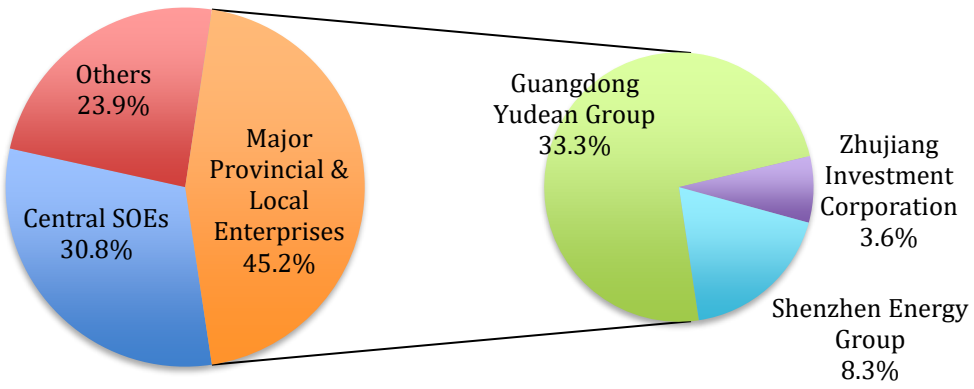
The status of Guangdong's economy as one of the most market-oriented in China today can be attributed to the liberal economic policy and the exposure to the international economy. The private economy accounted for about 54.6% of the

provincial economic output in 2019 (Guangdong Bureau of Statistics 2020). Nevertheless, despite growth of the market and its influence, the province is still constrained by central government policies and institutional arrangements, especially in important industries such as electric power. Guangdong is poorly endowed in energy resources. Coal production in the province was insufficient to meet demand. In mid-2006, Guangdong closed the last of its coal mines and stopped coal production in the province. Costs of long-distance transportation of imported coal became an important factor contributing to higher electricity prices than in other provinces in China. The province could only supply less than 20% of its energy need from indigenous production in 2012 (Guangdong Bureau of Statistics 2013). Guangdong has been a significant importer of electricity from neighboring provinces, particularly from Yunnan. Electricity imports amounted to 157 TWh in 2016, equivalent to 28% of total consumption.[24]

Provincial and central SOEs jointly dominate the generation market in Guangdong with provincial enterprises enjoying a slightly higher percentage of the market share (Figure 5.5). Yudean Group, which was renamed Guangdong Energy Group in early 2019, is the biggest player in Guangdong generation market, taking up 33.3% of electric power generation in 2017. The market giant is owned and supervised by the State Assets Supervision and Administration Commission of the Guangdong provincial government. The other two major local enterprises are Zhujiang Investment Corporation with a market share of 3.6% and Shenzhen Energy Group with 8.3%. In sum, 30.8% of the generation market is taken up by five central SOEs, each of which has a market share ranging from 4% to 8%.

[24] Author's calculation based on statistics from *China Electric Power Yearbook,* 2017.

Figure 5.5 Generation Capacity Market Share in Guangdong (2017)



Source: Huang 2017.

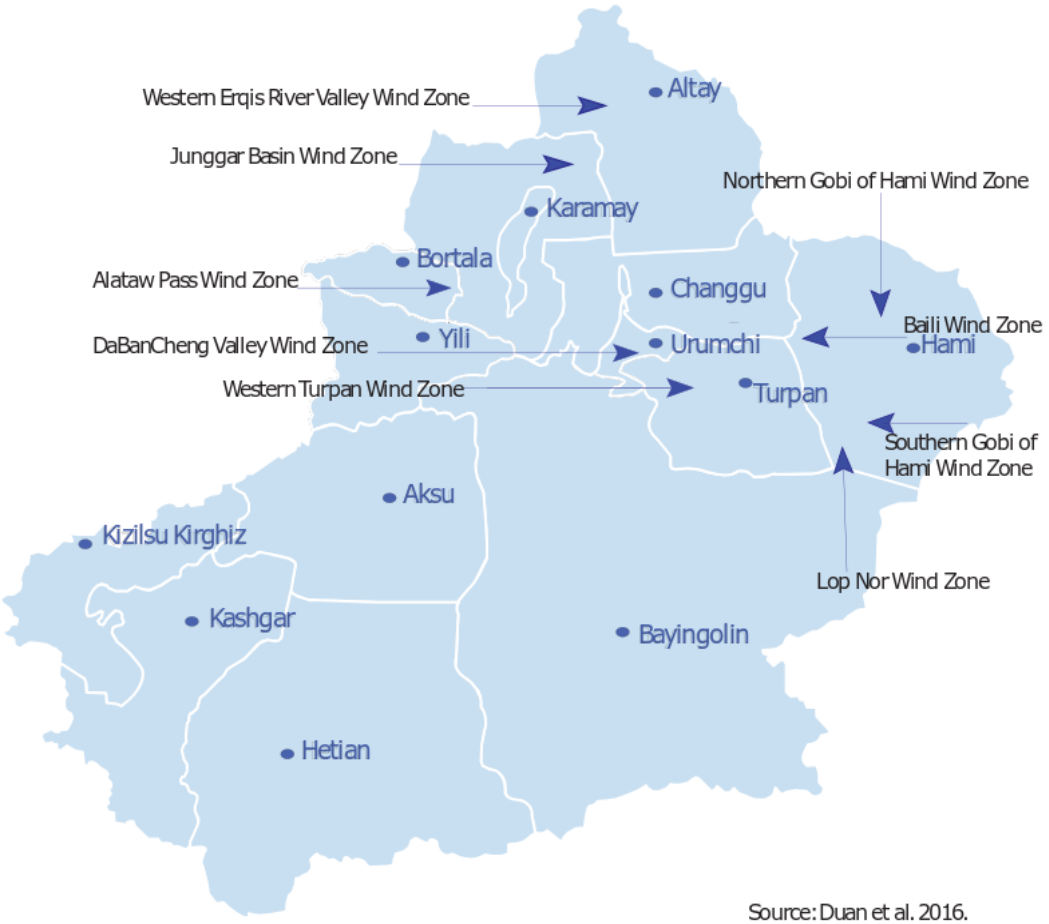
Xinjiang, officially known as the Xinjiang Uyghur Autonomous Region, is a provincial-level autonomous region located in the northwest of China. Xinjiang is the largest Chinese administrative division, spanning over 1.6 million km^2, and taking up about one-sixth of the country's territory and a quarter of the country's boundary length. The historical Silk Road ran through Xinjiang's territory from the east to its northwestern border. The population was 25.85 million in 2020, accounting for 1.8% of mainland China's population. Xinjiang's GDP in 2021 was US$199.97 billion and per capita GDP was US$7,767 in 2020 (National Bureau of Statistics of China 2021).[25]

Abundant oil and mineral reserves have been found in Xinjiang in recent decades, making it one of the most resource-rich provinces in China. It is estimated

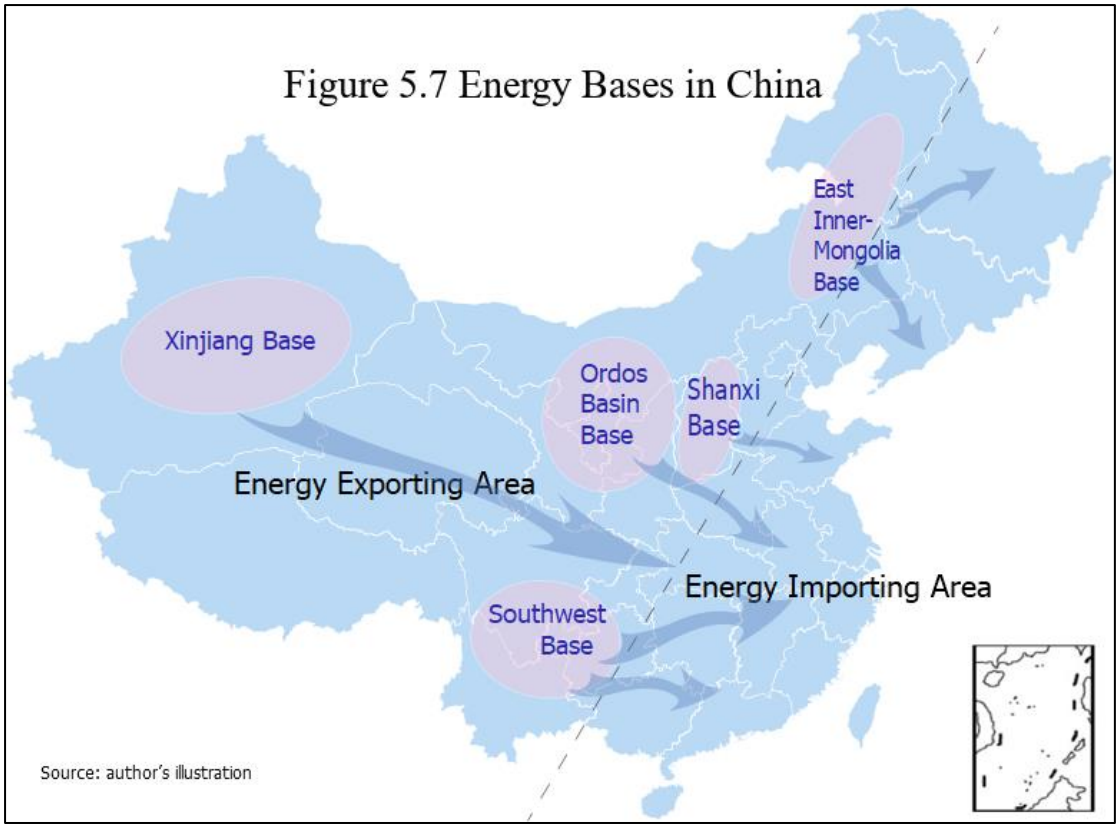
[25] Nominal rate: 6.6423 yuan per US dollar (2016).

that about 25% of China's natural gas and oil reserves as well as 40% of coal reserves are found in Xinjiang. The province was the second-largest producer of natural gas among all Chinese provinces in 2016. Xinjiang's production of crude oil and coal is also ranked among the largest producing provinces in China. Before 2012, the petroleum and petrochemical sector accounted for over 50% of Xinjiang's local economic output. Xinjiang also has huge exploitation potential in terms of renewable energy. Wind energy is mainly distributed in nine high-wind areas in northern and eastern Xinjiang (Figure 5.6). Wind power reserves amount to 960,000 MW theoretically, of which 134,300 MW can be technically exploited; annual radiant energy is 5,430–6,670 MJ/m^2 with a sunshine duration of about 2,550 to 3,500 hours per year (Duan, Wei, Zeng and Ju 2016). The region is taking lead in China's renewable energy push.

Figure 5.6 Wind Zones in Xinjiang



In the national 12th Five-year Plan, Xinjiang was positioned to become one of the five comprehensive energy bases for China by 2015 (Figure 5.7). Due to its relatively low level of economic development, Xinjiang's energy demand and utilization has been below its energy supply capacity. The province is designated to develop a capacity for energy delivery to eastern provinces—one of the major initiatives of the central government's Western Development Strategy. Various power gird construction projects have been implemented and new projects were proposed to transmit power outside of Xinjiang.



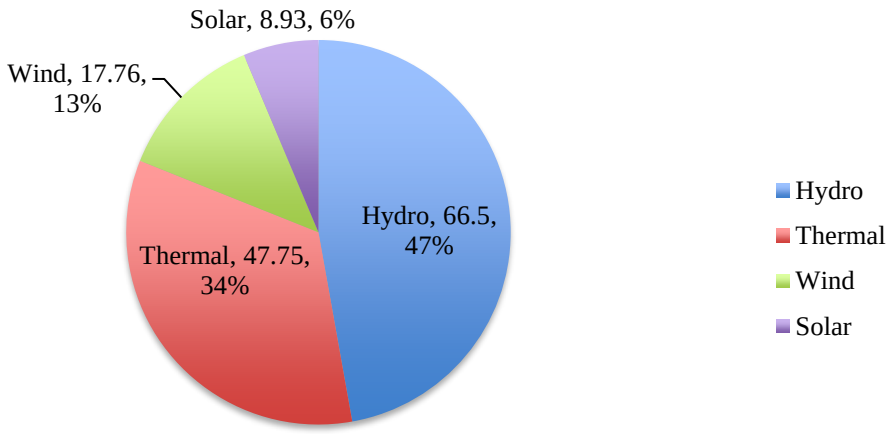
Meanwhile, new generating capacity in the province continues to grow. Between 1990 and 2016, the provincial installed capacity increased from 1.9 to 81 GW, an average annual growth of 11%; and generation grew 10.7% per year on average, from 6.98 to 269.3 TWh.[26] Total electricity consumption in Xinjiang was 231.6 TWh in 2016 and 36% of the production was exported to other provinces. The industrial sectors accounted for 85.4% of the electricity consumption in 2016. The primary, tertiary and residential sectors accounted for 6%, 4.9% and 3.6% of the total consumption, respectively.[27]

In 1990, thermal and hydro power constituted the two main electricity sources, accounting for 76.6% and 23.4% of the installed capacity, and 79.5% and 20.5% of generation, respectively. Since the mid-1990s, wind power and solar power have

[26] Author's calculation based on statistics from *China Electric Power Yearbook*, various years.
[27] Ibid.

grown steadily to become new sources of electricity. By 2016, the share of renewable sources was 32.9% of the installed capacity (wind power 21.9%, solar power 11%) and 10.7% of generation (wind power 8.2%, solar power 2.5%) (Figure 5.8 and Figure 5.9).[28] It is evident that despite the huge renewable potential, Xinjiang's energy structure is heavily inclined towards thermal energy. In addition, the gap between renewable energy capacity and generation indicates the existence of a curtailment problem, a recurring phenomenon, although it shows some signs of improvement in recent years.

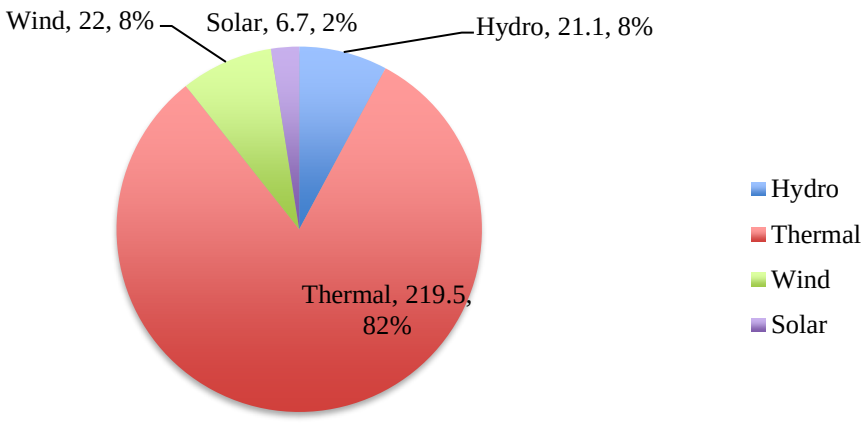
Figure 5.8 Capacity (GW) in Xinjiang in 2016



Source: *China Electric Power Yearbook* 2017.

[28] Ibid.

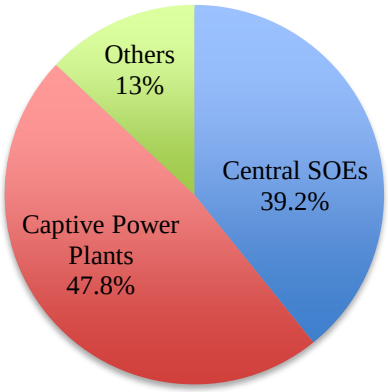
Figure 5.9 Generation (TWh) by Type in Xinjiang in 2016



Source: *China Electric Power Yearbook* 2017.

Another unique feature of Xinjiang's electricity generation industry is the high percentage of captive power plants, which made up 46.8% of total thermal generation capacity by the end of 2016 (Yu 2018, p.42). Captive power plants are owned and operated by energy-intensive industries such as petroleum, aluminum and chemical industry. Starting from 2009, a large number of captive power plants were built. Capacity grew from 1.74 GW in 2008 to 22.33 GW in 2016 (Yu 2018, p.42). The explosive growth indicates the trend of industrial transfer of heavy and backward industries from the eastern to western regions of China. It also suggests the provincial authorities' strong motivation for economic growth regardless of the environmental costs. Besides captive power plants, central SOEs account for the majority of the share of the other generation market in Xinjiang. Central SOEs owned 39% of thermal plants (Figure 5.10). The "big-five" generation groups and four other major central SOEs in the generation market all have their presence in Xinjiang market.

Figure 5.10: Thermal Generation Market Share in Xinjiang (2016)



Source: Xinjiang Commission of Economy and Informatization 2017.

5.4 Conclusion

This Chapter explains how the Chinese electric power sector is governed in China's system of bureaucratic administration. Due to the unique feature of the "tiao-quai" system, the regulatory oversight of the electric power sector is dispersed among a series of agencies both at the central and provincial level. As a result, the governance of the sector remains fragmented. This governance structure is the same in Guangdong and Xinjiang, although the two provinces differ in many other dimensions such as their economic profile and resource endowment. The cases of Guangdong and Xinjiang thus offer a good opportunity for a most-different-systems design.

The following three chapters trace the evolution of sectoral reforms in three policy areas in Guangdong and Xinjiang during 2015-2021 to analyze the implications of central-provincial politics for reform processes.

Chapter 6. Policy Reform in Planning and Investment

6.1 Reform of Planning Policies in the Electric Power Sector

The planning of electric power development in China is conducted in the five-year planning process in which China's industrial policies are formulated. The process functions along hierarchical layers set by government plans. At the highest level, the national five-year plan provides a "planning framework" (*guihua gangyao* 规划纲要) that lays out the overall principles, development priorities, and major economic targets for the whole country. However, the national plan provides few specifics and detailed implementation strategies. Based on the national plan, specialized plans at the national level (*zhuanxiang guihua* 专项规划）outline the principles, targets, priorities, and implementation strategies for specific sectors across the economy. For example, for the electric power sector, a section in the national five-year plan lists the overall goals that reflect the priorities of energy policies, while the specific plans for each industry in the sector stipulate the concrete targets, either binding or non-binding, for energy production and consumption (Table 6.1).

Table 6.1: From Planning Framework to Sector Plan

13th National Five-Year Plan	13th Five-Year Electric Power Development Plan (2016–2020)			
		2015	2020	
• Non-fossil fuel energy accounts for 15% of primary energy consumption • 15% reduction in energy intensity • 18% reduction of CO_2 intensity • 15% reduction in total SO_2 emissions • 15% reduction in total NO_X emissions	Total installed capacity (GW)	1,530	2,000	Non-binding
	West-to-East transport capacity (GW)	140	270	Non-binding
	Total electricity consumption (TWh)	5,690	6,800–7,200	Non-binding
	Share of electricity in final energy consumption	25.8%	27%	Non-binding
	Per capita installed capacity (KW)	1.11	1.4	Non-binding
	Per capita electricity consumption (KWh)	414	4,860–5,140	Non-binding
	Sector Structure			
	Share of non-fossil energy consumption	12%	15%	Binding
	Share of non-fossil generation capacity	35%	39%	Non-binding
	Conventional hydropower (GW)	297	340	Non-binding
	Pumped storage hydro (GW)	23.03	40	Non-binding
	Nuclear Power (GW)	27	58	Non-binding
	Wind Power (GW)	131	210	Non-binding
	Solar Power (GW)	42	110	Non-binding
	Share of fossil-based generation capacity	65%	61%	Non-binding
	Share of coal-fired generation capacity	59%	55%	Non-binding
	Coal-fired power (GW)	900	<1,100	Non-binding
	Gas-fired power (GW)	66	110	Non-binding
	Energy Conservation			
	Average (net) coal consumption of newly built coal-fired power plants (g of sce[29]/KWh)		300	Binding
	Average coal consumption of existing coal-fired power plants (g of sce/KWh)	318	< 310	Binding
	Transmission loss rate	6.64%	<6.5%	Non-binding
	Livelihood Use			
	Construction of charging facilities	Meet charging needs of 5 million electric vehicles		Non-binding
	Electricity replacing other energy sources (GWh)	-	450000	Non-binding

[29] sce=standard coal equivalent.

Table 6.1 Source: National Development and Reform Commission 2016a, 2016b.

Chinese provinces are expected to implement national industrial policies and the national five-year plan. At the provincial level, planning agencies draft provincial five-year plans that lay out the provincial priorities and goals for economic development according to the national plan. Five-year plans at the provincial and sub-provincial levels should align with those of a higher hierarchy to concretize goals. Generally, the provincial authorities have discretion in the decisions and design of concrete plans and implementation measures.

For the energy sector, the NEA develops a five-year national energy development plan. The plan identifies the basic principles for the sector such as prioritizing energy conservation, setting the key binding (*yueshu xing* 约束性) or prospective (*yuqi xing* 预期性) targets, implementing strategies, and monitoring actors responsible for implementation. In addition to a five-year plan for the overall energy sector, the NEA also issues five-year development plans for industries of every specific energy resource, including coal, natural gas, hydropower, nuclear power, and renewable energy.

The first national-level government regulation on electricity planning was published in December 1997, more than 40 years after the establishment of the People's Republic. The regulation was issued by the then Ministry of Electric Power Industry shortly before it was abolished. Nearly 20 years after the first regulation document, the NEA issued another "Regulation on Electric Power Planning" in May 2016. According to the new regulation (NEA 2016a), electricity planning is divided into national planning and provincial-level planning.

The NEA is responsible for formulating five-year plans for the building of large hydropower plants (including pumped storage hydropower) and nuclear power plants, and also for determining the level of capacity development of renewable energy and fossil fuels. As for power grid, the NEA plans the construction of interprovincial power grids and power grids that are higher than 500 kV in the provinces. In comparison, provincial-level authorities are responsible for drafting five-year plans for the construction of mid-size hydropower plants and power plants of other types within their provincial territory. They also plan the construction of power grids of voltage higher than 110 kV (66 kV) and lower than 35 kV for the provinces.

Provincial-level electricity planning should be carried out according to the national plan based on the "two-ups and two-downs" (*liangshang liangxia* 两上两下) principles as stipulated in the new regulation. The first “up” refers to the proposal and submission stage of provincial plans by provincial authorities to the NEA. The NEA then proceeds to draft the national plan based on the accumulation and balancing of provincial plans, thus posing possible limitations to provincial plans.

After the drafting process, the NEA reaches down to touch base with the provinces to give feedback. The provincial authorities report “up” again to submit to the NEA their second proposal that has been revised based on the NEA draft. The NEA, for the second time, reaches “down” to the provinces to offer them another round of feedback, and the provinces proceed to draft their provincial plans accordingly. Two years after the implementation of the electricity five-year plan, the NEA would appoint a third party to evaluate the implementation and publish a mid-

term report on the implementation of electricity planning. After the five-year period, the NEA would publish an evaluation report on the implementation.

The central authorities have the final say in approving provincial plans, although the provincial planning agencies have the freedom to decide the plan details. There is considerable diversity in both the format and content of provincial plans of the electric power sector. Neither the drafting process nor the methods for assessing investment needs and decisions is transparent (Kahl and Wang 2015, p.16). The current planning system of investments on generation and transmission are not based on reliability or cost metrics, but largely driven by the supply side in a top-down approach. Generation adequacy planning and transmission reliability planning are two common planning processes in the international paradigm. However, planning in China differs significantly from the international paradigm. A specific installed generation capacity is targeted by provincial planning agencies because provincial governments have strong incentives to target capacity expansion to boost investment and GDP, thus generating local jobs and tax revenues. The emphasis on capacity expansion has resulted in large wasteful investment because the added capacity has not been used efficiently. To put the situation into perspective, China's addition of 1 TW in generation capacity between 2000 and 2014 was equivalent to the capacity level of the entire electric power system of the United States of America.

The provincial planning agencies are also responsible for formulating the five-year plans for energy conservation and emissions reductions. These plans are formulated to implement national energy policies and development targets. The provincial plans, of varying names and formats among provinces, typically include the overall targets for energy intensity and CO_2 intensity, as well as measures to

reduce energy consumption and emissions in key sectors, including the electric power sector. Such measures are largely a qualitative assessment of the priorities and they are not necessarily the most cost-effective ways to achieve energy conservation goals. Guangdong's five-year plan follows the general format of the national plan on energy conservation and emission reduction, and selects similar policy areas to set targets, including both binding targets of energy intensity and nonbinding targets of energy production (Table 6.2).

Table 6.2: Major Targets in the 13th Five-Year Energy Development Plan of Guangdong

Targets	2015	2020	
Energy consumption			
Total energy consumption (Mtce[30])	301	338	Binding
Coal consumption (million tons)	175	175	Non-binding
Total electricity consumption (TWh)	531.1	670	Non-binding
Share of non-fossil-fuel energy in total consumption	20%	26%	Non-binding
Share of electricity in final energy consumption	30.8%	37%	Non-binding
Energy Structure			
Total installed capacity (GW)	98.17	133.9	Non-binding
Coal-fired installed capacity (GW)	57.95	64	Non-binding
Gas-fired installed capacity (GW)	14.27	23	Non-binding
Nuclear power (GW)	8.29	16	Non-binding
Conventional hydropower (GW)	8.42	8.42	Non-binding
Pumped storage hydropower (GW)	5.12	7.28	Non-binding
Wind power (GW)	2.46	8	Non-binding
Solar power (GW)	0.85	6	Non-binding
Others (GW)	0.81	1.2	Non-binding
West-to-East electricity Transmission	35	40	Non-binding
Livelihood Use			
Energy Consumption per capita (tons of standard coal/per year)	0.4	0.47	Non-binding
Electricity Consumption per capita (KWh/per year)	780	1100	Non-binding
Energy Conservation			
Energy intensity per unit GDP	21%	17%	Binding

Source: Guangdong Provincial Development and Reform Commission 2018.

[30] Mtce denotes mega ton of coal equivalent.

Xinjiang did not publish its 13th five-year plan for energy development. The plan was supposed to have been released in 2017 by which time most other provinces had published their plans. Interview sources from Xinjiang revealed that the draft plan submitted to the NEA was deemed to be impractical in terms of its planning and therefore was rejected. Information in the draft plan suggests that some targets for development were set very high. With the NEA's rejection of the draft plan, the Xinjiang provincial authorities had to alter their original targets. As a consequence, the amended targets contributed to little or no real growth in the energy industries. For this reason, the final plan was not made public so that the authority could save some "face."

In the 12th five-year plan phase, renewable energy in Xinjiang experienced growth at breakneck speed and curtailment was triggered in the industry when there was so much renewable electricity and insufficient transmission infrastructure. The NEA statistics shows that the rate of curtailment in Xinjiang reached historic highs of 32% and 38% in 2015 and 2016, respectively. In early 2017, the NEA designated Xinjiang, Inner Mongolia, Heilongjiang, Ningxia, Gansu, and Jilin as "red areas" for wind energy expansion in its annual monitoring system of renewable energy investment. The color red denotes that curtailment problem had reached such a level that new projects should be overhauled until the problem could be alleviated. Xinjiang continued to be marked as a "red area" in 2018. As is evident in Xinjiang's hidden 13th five-year energy development plan, the central authorities have plenty of leverage to manage the planning practice of the provincial authorities based on the institutional arrangement of the "two-ups and two-downs" principle.

The problem that beset the planning in the electric power sector is that most targets are non-binding, given that there is a large degree of flexibility in carrying out the plans in the implementation phase by various actors in the sector. The consequence of such flexibility leads to discrepancies between actual developments in the sector and the achievement of planned targets. For example, in the 10th five-year plan, the annual growth of electricity generation forecast in the plan was 5.2% for the electric power sector, but the actual growth of generation was 13% (Sun, Li and Wang 2016). The inconsistency between the development plans and actual results is due to a lack of linkage between planning and investment approval. Project approval is used as the ultimate policy mechanism for investment control and has more relevance than development planning in determining the actual development scenario in the sector. As such, which bureau has the authority over the project approval in fact tells a great deal about its power in the political system.

6.2 Reform of Investment Policies and Project Approval in the Electric Power Sector

In the early years before 2004, based on investment size, different government agencies were responsible for the review and approval of investment on infrastructure projects. The central government was responsible for reviewing large projects, and provincial and sub-provincial governments were responsible for smaller projects. There were potential loopholes in this system because of the arduousness of the central-level approval process. China suffered a power supply surplus in the four years of stagnation from 1998 to 2001, thereby resulting in tight control on investment projects. During power shortages in 2003 and 2004, many provincial governments

supported the building of small-scale coal-fired power plants. Some of these projects were never approved and hence technically illegal (Oster 2006).

In 2004, the State Council issued the document *Decision on Reforming the Investment System*[31], stipulating three main changes to the project approval system. First, state-invested projects should obtain authorization (shenpi 审批) from the government after a review process. State-invested projects are generally large-scale, important to the national economy and might concern national security. Projects that receive direct government subsidies, preferential interest rates or preferential loans from foreign governments and financial institutions, on the other hand, require only the review of their funding applications for authorization. Second, large projects that do not utilize state funds need to be approved (*hezhun* 核准) by relevant authorities. These projects are listed in the "catalogue of investment projects that require government approval"[32] and are deemed important and "restricted." The catalogue stipulates the approval authority at different levels of government. Third, projects that do not require government approval at any level are required only to be registered (*beian* 备案) with relevant local government agencies, based on rules set by provincial governments.

The NDRC created a "pass" (*lutiao* 路条) system along with the 2004 *Decision* in order to reduce investment risks during the lengthy approval process. In the electric power sector, generation and transmission projects were required to obtain permission, i.e., a "pass", from the NEA before applying for the formal approval

[31] The State Council of the People's Republic of China (PRC), 2004, *guanyu touzi tizhi gaige de jueding* 关于投资体制改革的决定 (Decision on Reforming the Investment System).
[32] The State Council of the PRC, 2004, 2006, 2013, *zhengfu hezhun de xiangmu mulu* 政府核准的投资项目目录 (Catalogue of Investment Projects that Require Government Approval).

process. This pass is an indication of the NEA's intent to approve. The system granted vast discretionary authority to the NEA. The unchecked decision-making power and the lack of a transparent process and criteria for approval decisions facilitated large-scale corruption. Several top officials of the NEA and various members of its senior leadership were arrested and convicted of corruption charges over the past 10 years.[33]

Due to the difficulty of obtaining a pass, the provincial governments continued to support the construction of generation projects that do not require central government approval. Many strategies have been developed to circumvent the central approval process. An interesting phenomenon is that many wind power projects of 49 MW were built in many localities before 2013 because it was stipulated that projects of 50 MW and higher capacity had to be approved by the NEA. The proliferation of local investment as well as the lack of transmission facility contributed to the curtailment of wind energy in northern China.

Several rounds of administration reform after 2004 have empowered provincial governments greater jurisdiction over project authorization. In practice, most new infrastructure projects in the electric power sector do not require central government funding and therefore are not required to undergo the authorization process, but they are required to obtain approval from relevant government authorities because the investment involved is large and the project has significance to people's livelihood.

[33] The top officials of the NEA that were charged with corruption and removed from office are director Liu Tienan and Nur Bekri, deputy director Wang Xiaolin and Xu Yongsheng. In total, 12 officials of ranking equal to or higher than bureau (*ju* or s*i*) were convicted of corruption since the establishment of the NEA.

In 2013, the State Council revised the national catalogue of investment projects that require government approval, institutionally decentralizing the approval authority for several types of electric power infrastructure projects to provincial and local governments (Table 6.3). The project types include wind farms of less than 50 MV, distributed natural-gas-fired thermal plants, back pressure coal-fired thermal plants, and AC transmission power line projects of 500 kV and below. In September 2014, the NEA further decentralized the approval process for all types of coal-fired power plants to provincial authorities. These changes are part of a larger effort in the administrative reform intended to "simplify governance and decentralize authority" (*jianzheng fangquan* 简政放权).

Table 6.3: Changes in Approval Authority of Electric Power Projects

Electric Power Generation								
Generation Type	**2004**		**2013**			**2016**		
	Project Type	**Approval Authority**	**Project Type**	**Approval Authority**		**Project Type**	**Approval Authority**
Reservoir Hydropower	Major river, ≥ 250 MW	NDRC	Major river	NDRC		≥50MV	NDRC
						≥300MV, requiring ≥10,000 population relocation	State Council
	Other hydropower	Local investment planning agencies	Other hydropower	Local governments		Other hydropower	Local governments
Pumped Hydropower		NDRC		NDRC			Provincial governments
Thermal	All central station	NDRC	Central station	NDRC		All thermal including captive power plants.	Provincial governments
			Distributed natural gas	Provincial governments			
Combined Heat and Power (CHP)	Coal	NDRC	Back pressure coal-fired	Provincial governments		Extraction-condensing coal-fired	Provincial Governments
	Other CHP	Local investment planning agencies	Other coal-fired	NDRC		Other CHP	Local Governments
			Non-coal-fired	Local governments			
Wind	≥50 MW	NDRC		Local governments			Local governments
	< 50 MW	Local investment planning agencies					
Nuclear		State Council		State Council			State Council

Electricity Transmission and Distribution									
2004			**2013**				**2016**		
Voltage Level	**Approval Authority**		**Jurisdiction**	**Voltage Level**	**Approval Authority**		**Jurisdiction**	**Voltage Level**	**Approval Authority**
≥ 330kV	NDRC		Interregional, interprovincial	≥±400 kV DC, 500 kV AC	NDRC		Interregional, interprovincial	≥±500 kV DC, 500 kV AC, 750 kV AC, 1000 kV AC	NDRC[34]
< 330kV	Local investment planning agencies		Provincial	≥±400 kV DC, 500 kV AC	NEA		Provincial	≥±500 kV DC, 500 kV AC, 750 kV AC, 1000 kV AC	Provincial governments
			Provincial	< 500 kV AC	Local governments		Provincial	Other levels	Local governments

[34] Projects of ±800kV AC and 1000kV DC and above should be registered by the State Council.

The decentralization resulted in a surge of coal power capacity. From January to September 2014, the NEA only approved 32 coal-fired power plants with an installed capacity of 35 GW. Following the decentralization, 149 projects with a capacity of 151 GW were approved by the provincial authorities within 15 months from October 2014 to December 2015 (Shearer et al. 2016, p.29). Coal capacity grew by 39.5 GW in 2014 and by 51.9 GW in 2015. (Shearer et al. 2016, p.25).

In some cases, local authorities have shown greater leniency than central authorities, moving in quickly to grant permits to projects that had been on the waiting list of the central authority for many years and even approving coal power plants that had been illegally operating for years without permits. A typical case in point is the Leizhou thermal power project operated by Datang Group in Guangdong province. The project was approved by Guangdong provincial government in early 2015 as a key project of the provincial 13th five-year plan after being on the waiting list of the NDRC without approval for 10 years.

Meanwhile, as a result of accelerated capacity growth, the utilization rate for thermal plants — the percentage of maximum output actually achieved — reached an all-time low in 2015, falling to 49.4% (4,329 hours), compared to 60.4% in 2011 (Shearer et al. 2016, p.29). The extremely low utilization rate of thermal plants indicates coal overcapacity and at the same time, poses challenges to the power system in accommodating the rapid growth of renewable energy.

Recognizing the overcapacity problem, the central government imposed a series of restrictions on further expansion of coal power capacity starting from 2016. In March 2016, a “traffic light system” was implemented to monitor the coal overcapacity situation with monitoring results to be published at the beginning of

every year thereafter. Provinces that were labeled red were not allowed to approve new coal power projects. Provinces that were labeled orange were advised to approve new coal power projects with caution

In March 2016, the NEA decided to suspend provincial government approvals of new coal power plants except those for residential heating in 13 provinces, and the construction of those already approved were halted in 15 provinces (NDRC and NEA 2016b). Fifteen new coal power projects with 12.4 GW in total capacity were canceled in September 2016 (NEA 2016d)[35]. In 2017, the central government continued to suspend coal power projects, with 98 GW shelved in January and 93 GW in September (21 GW are overlapping capacities of the two figures) (Shearer et al. 2018, p.9). Guangdong and Xinjiang were both labeled as red area in 2016, 2017 and 2018. In 2018, only three provinces out of 33 were given the green light.

In January 2017, in order to specifically address the overcapacity problem of coal power, the NEA issued special documents to the planning authority of 13 provincial governments. In the document issued to Guangdong province, the province was required to control its new coal capacity addition to within 3.9 GW during the 13th Five-Year Plan period (NEA 2017), 2.15 GW less than the 6.05 GW target in Guangdong's original energy development plan. The recommendation is that two projects of 3.2 GW that were included in the original plan and seven projects of 9.02 GW which were already approved or under construction should be postponed for inclusion in the 14th Five-Year Plan.

[35] The list of projects that were canceled can be found on the NEA website, <http://zfxxgk.nea.gov.cn/auto84/201609/t20160923_2300.htm 错误!超链接引用无效。 (accessed 18 October 2018).

The 2016–2017 restrictions have altogether effectively led to the suspension of an estimated 444 GW of coal-fired capacity under various stages of development in China (Shearer et al. 2018, p.9). While over 16 GW of coal power projects appear to have proceeded in violation of the restrictions, the measures have radically slowed China's coal plant pipeline, from 708 GW under active development (i.e., pre-construction and construction) in 2015 to 211 GW in 2017; growth of newly commissioned coal plants have dropped from an average of 61 GW per year during the 2006–2015 period to 47 GW in 2016, and 34 GW in 2017 (Shearer et al. 2018, p.9). In addition, the NEA ordered the retirement of outdated coal power plants, giving priority to the phasing out of straight condensing units that have operated for over 30 years and supercritical extraction-condensing units that have operated for over 25 years (NDRC and NEA 2016b). There was some relaxation in coal-power expansion after 2018, but the NDRC still controls the "traffic light system" and does not give its power of project approval to provincial authorities.

In contrast to the restrictions targeting coal power, the NDRC further relaxed the approval process in 2016 to accord provincial and local governments more discretion in decision-making related to other energy projects. Provincial governments are entitled to issue their respective provincial project approval catalogues and to further delegate their approval authority. According to the NDRC regulation, projects that are included in major development plans and require allocation of major resources within a province shall generally be approved by the provincial government instead of local governments. After this policy change, the local governments obtained the full authority to approve wind power projects of all sorts. Provincial governments have the rights to authorize pumped hydropower projects. In addition,

the approval of more types of transmission lines is decentralized to provincial governments and local governments (Table 4.4).

6.3 Conclusion

In principle, the provinces have to implement national development plans and achieve the binding targets set for industrial development and energy efficiency. They are entitled to discretion in designing the strategies for plan implementation. As observed, there are similarities in the approaches that the central government uses in its interactions with provinces in streamlining planning processes. The diversity among provinces is manifested in the policy process which often involves behind-the-door negotiations and mid-term policy adjustments to suit different local conditions.

Often, project approval has superseded development planning in determining the level and composition of investments in generation and transmission in China's electric power sector. Project approval is an important mechanism for the national government to regulate the electric power sector and achieve the goals of industrial development. Increased local investment and diverse financial sources, apart from the state budget, have contributed to the empowerment of administrative control of investment at the subnational level.

The allocation of authority for project approval across different levels of government has evolved in the context of a struggle between national industrial and economic policy and local government development priorities. While the stated goals of decentralization were to reduce administrative interference and raise market efficiency, in practice after 2014, it resulted in an unprecedented surge in permits, as provincial authorities raced to approve projects they believed would stimulate local

economies. The rapid expansion of coal power projects in 2014 and 2015 was in direct competition with China's ambitious goals in renewable energy, thus leading to severe problem of electric power overcapacity, which equates to billions of dollars of wasted capital.

In order to tackle the system's defects and problems, the central government has developed a new approach in investment control that coordinates project approval with the national planning process. Despite the center's reduced direct administration of investment activities at the provincial level, central control over local projects remains substantial. Most importantly, the central government retains the capacity to decentralize or recentralize investment control as it deems fit. The central government's retention of the final decision-making power enables it, specifically the NDRC, to exercise meaningful control over industrial sectors and the overall economy without substantially changing the economic institutions.

The fact that investors do not receive sufficient cost or price signals to efficiently guide new investments is the fundamental cause of wasteful investment. As a result, there is an ongoing disconnect between electricity supply and demand, and between policy goals for the sector and actual investment (Kahrl and Wang 2015, p.22). In order to improve economic efficiency, China has embarked on new market reforms to transform its fully centrally planned approach to one that allows market coordination to play a stronger role in the electric power sector.

Chapter 7. Policy Reform in Pricing and Trading in the Electric Power Sector

This chapter examines the evolving role of provincial governing authorities in electricity pricing and trading. The market reform process of pricing and electricity trading is traced based on the types of electric power, namely, thermal, hydro, wind, solar and nuclear power. Except for a few failed market trial attempts, electricity prices in China were determined entirely by central planning and government administration before the 2015 reform. The market reform gradually transformed the electric power sector into a market-based economic model, and at the same time, enhanced the role of provinces in setting market and trading rules in the electricity market. Both Guangdong and Xinjiang have made steady progress in market reform.

Traditionally, the allocation of administrative authority among central and provincial agencies over the power sector was based on the level of electric power dispatch. Power dispatch in China was conducted at five different levels within a hierarchy of jurisdictions: national, regional, provincial, prefectural, and county. The *on-grid tariffs* for electric power that was produced by power plants dispatched at the provincial or higher levels were determined by the central regulatory authorities. The central authorities also determined the scope of the *end-user tariffs* for electric power produced and dispatched at above-provincial levels. The provincial authorities were able to decide the specific end-user prices based on the centrally stipulated general scope.

Before the 2015 market reform, provincial authorities had the autonomy to determine the on-grid tariffs and end-user tariffs for electric power that was produced by power plants dispatched at the sub-provincial levels. Following the reform, a dual-track pricing system, whereby both market prices of electric power and

administratively determined prices coexist, had been implemented. The dual-track pricing system is considered a transition phase that will eventually lead to market-based electric power prices in the future. During the transition, provincial authorities were the major stakeholders that set market trading rules and regulations within their respective jurisdictions. The changes in China's electricity tariff pricing mechanism are exemplary of a decentralization process in administration and regulation. The pricing system has been transformed from a unified nationwide tariff to diversified tariffs regulated by provincial pricing authorities.

7.1 Pricing of Electricity from Coal-fired Power Plants

Nationwide Tariffs (Before mid-1980s)

During the 1950s and 1960s, China gave strategic priority to heavy industries. In order to facilitate their development, electricity prices were kept low by the central government. Actually, standard nationwide electricity tariffs in China remained basically unchanged from 1949 to the 1970s. Historically, coal was sold to power plants at subsidized prices, sometimes at half, or even less than half, of the production cost. Subsidized coal prices enabled power companies to charge low electricity tariffs. Before the mid-1980s, electricity tariffs in China were far below the costs of generation and transmission. Low electricity prices forced power companies into deficit, and they had to be financed by government subsidies and by extensive borrowing from the government and state banks at low interest rates.

Before the launch of comprehensive market reform in 1978, China's operations of the power sector were not market-oriented. There was no separate on-grid tariff for power generation because the entire power sector was operated as

vertically integrated, state-owned utilities. All tariffs were simply set as internal transaction prices, solely for accounting purposes tied to the operation of power companies and not for efficient resource allocation. Under central planning, all enterprises including power generation companies were not financially independent. As quasi-government bodies, there was no separate evaluation of the financial performance of these utilities. Investments in power projects were not subject to market price signals; rather, they were decided by the central government according to the five-year plan.

Diversified Cost Recovery Tariffs (Mid-1980s to 1996)

From the mid-1980s, a groundbreaking policy of decentralization in investment paved the way for power sector reform. Local-government-owned enterprises and nongovernmental entities were allowed to invest and participate in power project development (*jizi bandian* 集资办电). The reform brought changes to the original unified pricing system for power tariffs. Besides the policy implemented from 1987 to 1996 that imposed a surcharge of RMB0.2 per kWh for end users, a multiple on-grid electricity tariff system was introduced on the basis of the financial sources and ownership of power projects.

The new pricing system took effect in 1987 when "Guidance for the Implementation of Multiple On-grid Tariff" was issued by the then Ministry of Water Resources and Electric Power of China (1987). The policy outlined the principles for a tariff scheme that ensured cost recovery of particular power projects (*huanben fuxi dianjia* 还本付息电价). The pricing scheme offered end-user prices for electricity that were based on the cost for repayment of principal and interest plus a reasonable profit margin for the power projects which had been locally invested in.

The decentralization of investment stimulated the development of independent power producers (IPPs). These IPPs were normally selected via negotiation processes between project developers and related provincial government agencies but not via competition. In practice, specific contracts for power purchases with agreed on-grid electricity tariffs and other related conditions were negotiated for these power projects and the on-grid electricity tariffs were approved by provincial government agencies. A “reasonable rate of return” ranging from 12% to 15% was allowed for power generation projects. Changes in fuel costs, particularly coal prices and associated transportation costs, were factorized into the on-grid electricity tariffs. Essentially, the new tariff scheme secured financial returns for investors and guaranteed that on-grid electricity tariffs were subject to the costs of each individual project. The 1987 policy also specified that after the principal repayment period, a reduced tariff would apply.

The cost-recovery electricity tariffs for IPPs coexisted with regulated utility prices for the state-owned power plants which operated as usual in the central planning system. This parallel system led to the diversification of on-grid tariffs and the phenomenon of "new plant, new price" (*xindian xinjia* 新电新价). In reality, every new IPP project had its own on-grid tariff. It was not uncommon that different tariffs were applied to different units of the same power plant. The prices for electricity produced by new power plants were significantly higher than those for old plants. Great confusion ensued due to the lack of guidance for the implementation of the 1987 tariff policy. Estimated costs of power projects varied greatly, resulting in an extensive range of on-grid electricity tariffs.

The introduction of a cost-plus pricing scheme provided economic incentives to promote growth in investment but did not contribute to efficiency of allocation.

Incentives for cost control and efficiency improvements were very weak because the tariffs were linked to accounting costs and cost fluctuations could be passed on to electricity prices. The tariff policy also created a condition which made it possible for IPPs to jack up their costs and thus enable higher prices to be offered. It led to high energy prices and suboptimal capacity expansion. As a result, average on-grid electricity tariffs increased at an unprecedented pace in the late 1980s and early 1990s (Ma 2011, p. 2635).

Operating Period Tariffs (1997–2004)

After the formation of the State Power Corporation of China (SPCC) in 1997, a new mechanism of operating period tariffs (*jingyinqi dianjia* 经营期电价) was introduced in order to achieve a more uniform electricity tariff system. The tariffs for existing power plants were determined based on average costs of power generation, with a specific rate of return on investment over the plants' remaining economic life. The pricing scheme was essentially still in line with the principle of "cost recovery plus return". On-grid tariffs were usually high during the repayment period, after which, the price was reduced for the remaining operating period. For latecomers and new players, this pricing scheme specified a uniform on-grid tariff that reflected average costs of technologically advanced generation units.

Province-by-province Benchmark Tariffs (2004 to 2019)

The 2002 Document No.5 initiated another major reform. The introduction of competition among generation companies effectively mobilized investments in power projects and contributed to sustained expansion in generation capacity and electricity supply. In 2004, the NDRC introduced the ‘‘benchmark on-grid electricity tariff’’

(*biaogan dianjia* 标杆电价) for coal-fired power plants. For new power projects launched after 2004, provincial governments set the on-grid electricity tariffs, which ultimately required approval from the NDRC through its Pricing Department. Although the benchmark tariffs were provincially differentiated, the mechanism reduced the autonomy of provincial governments given that the NDRC had become the final decision-maker on pricing.

For existing plants, tariffs were also adjusted in 2004 considering the original sources of project financing in order to reflect the actual costs of the power projects. Lower on-grid tariffs were assigned to those power plants with investments from the central government, and therefore with lower or no financing costs. For power plants which were invested in by local, private or foreign sources with higher financing costs, higher tariffs were applied. For coal-fired power plants built after 2004, the benchmark on-grid electricity tariff was applied regardless of ownership and the source of project financing. One exception was that power plants for cross-regional power supply did not follow the benchmark tariff scheme. In these cases, electricity prices were subject to negotiations between the provinces and the power grid owners.

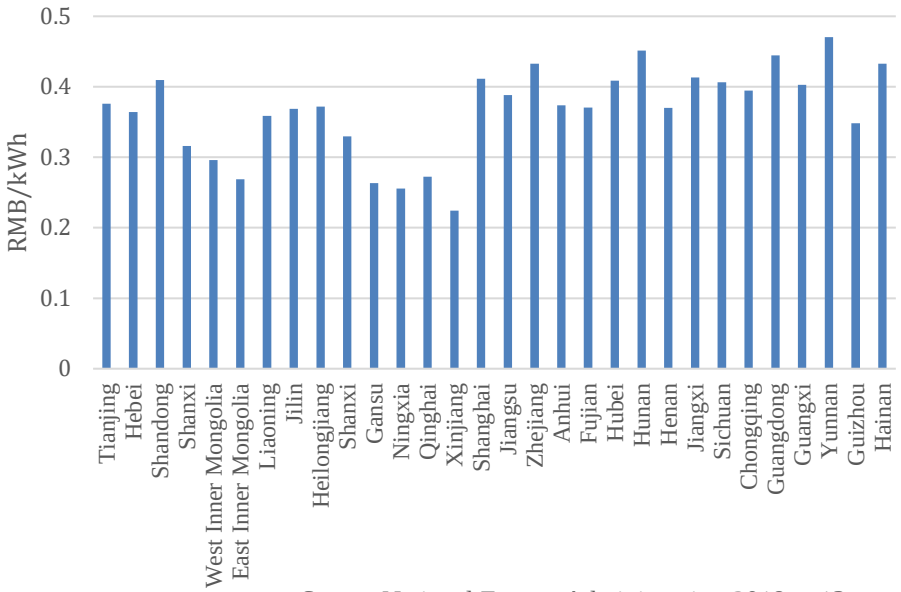
The benchmark on-grid tariffs were based on average costs for power generation, which were province-specific and calculated based on the performance of technologically advanced generation units in the province. The objective of introducing benchmark on-grid tariffs included incentivizing power producers to control costs of projects and simplify the tariff system toward a more uniform tariff for each province. Various factors were taken into account in determining the tariff levels. Coal prices and the associated transportation costs had significant influence on tariff levels. Although the rate of investment returns for determining the tariff levels

was not officially published, a “reasonable return” to the investment, i.e., 8%–10% of return to equity was used for most tariff settings, with the highest rate reaching 15% in exceptional cases.

The 2004 benchmark tariff policy had unified prices within provinces; however, prices across regions and provinces remained differentiated. Province-specific benchmarks on-grid tariffs reflected the varying social and economic development levels across provinces and their differing situation of fuel, and in particular coal supply. On average, on-grid tariffs in eastern and southern China have been consistently higher than the tariffs in inland and western regions. For example, average on-grid electricity tariffs in 2008 in eastern China were about 60% higher than those in the northwest region (Ma 2011, p. 2638).

In addition, the benchmark tariff policy was implemented according to a province-based catalogue of retail electricity tariffs (*fenlei dianjia* 分类电价). Average retail prices of electricity manifested similar trends as on-grid electricity tariffs, i.e., retail electricity prices were lower in western and inland provinces than in the eastern and coastal regions. The prevailing trend continues to persist. The national average on-grid electricity tariff for coal-fired plants in 2017 was RMB0.37 /kWh. Guangdong and Yunnan were two provinces with the highest prices, which were RMB0.44 /kWh and RMB0.47 /kWh respectively, double that in Xinjiang, which was RMB0.22 /kWh (Figure 7.1).

Figure 7.1 Average On-grid Tariffs by Provinces, 2017



Source:National Energy Administration 2018, p.13.
The tariffs apply to coal-fired power plants only.

A benchmark tariff is not a market-based pricing mechanism and is therefore not optimal for achieving system efficiency. Prior to the implementation of full liberalization of generation planning for industrial and commercial users in June 2019, provincial governments were responsible for allocating annual generation quotas based on the national plan. Toward the end of each calendar year, provincial governments made forecasts of their respective electricity demand for the next year, and then allocated quotas to generators in the provinces and determined the quantity to be imported from other provinces if total local production was inadequate. Generators in each province charged benchmark tariffs based on their long-term contracts and sold to a single buyer, i.e., the transmission and distribution monopoly, in the province.

After annual generation plans were made, power grid companies were responsible for detailing them into quarterly, monthly, and daily schedules of unit

commitment based on updated load forecasts. Grid companies were instrumental in designing these unit commitment schedules so that year-end utilization hours of generators could best approximate their allocated generation quotas. Due to their compliance with a unified benchmark tariff, only power plants that fulfill the operating hours at a certain level, i.e., the so called basic operating hours, were able to achieve expected returns. Therefore, the common practice was to first ensure that local power plants had met the specified operating hours, regardless of the overall efficiency performance of the system.

Environmental Surcharge

In response to environmental pollution caused by SO_2 emissions from coal-fired power plants, a policy that promoted the installation of desulphurization equipment was officially introduced in 2004. A surcharge of RMB0.015 /kWh on top of the benchmark on-grid electricity tariffs was approved for newly developed power plants with desulphurization facilities as well as existing power plants after their installation of the required equipment. The environmental surcharge of desulphurization has led to a substantial reduction of SO_2 emissions from coal-fired power plants, and effectively alleviated acid rain problems in many parts of China.

Trials of Two-tier On-grid Tariffs (2003–2006)

The benchmark tariffs were intended as a transitional measure blueprinted in the 2002 Document No. 5 prior to the introduction of regional electricity markets. In the trial operations of regional markets in northeast, east and south China in 2005 and 2006, a two-tier on-grid tariff including capacity and energy charges was implemented. The capacity prices were determined by provincial government

agencies according to the average investment costs of different categories of generation units. Marginal costs of generation were used to settle the electricity prices and energy charges were formulated via competitive bidding processes. The lack of clearly defined rules and codes for system operations had created a chaotic situation in tendering processes. All market trials had thus failed and had to be terminated by 2006. As a result, participating generation and grid companies returned to their old operation routines.

Coal and Electricity Price Covariation

In 1985, in response to the increasingly strong demand for coal, the Chinese government classified coal production into two categories: in-plan coal (*jihua nei yogmei* 计划内用煤） and out-of-plan coal (*jihua wai yongmei* 计划外用煤). The two-tier coal prices were applied via these two production schemes. While the prices and volumes of in-plan coal were still controlled by the central government, those of out-of-plan coal were deregulated and subject to the administration of provincial and local governments. Price-setting for out-of-plan coal were market-based, which was normally higher than the price of in-plan coal. Upon fulfilling quotas set by the central government, provincial and local authorities pursued a higher level of production for greater economic benefits and tax revenue, leading to the proliferation of many local small- and medium-sized coal mines. The two-tier pricing policy for coal and the rapid expansion of coal production helped ease the pressure on coal supply.

As fuel costs account for 50% to 70% of generation costs for coal-fired power plants (Ma 2011, p. 2638), variations in coal prices have been a sensitive issue for the power sector. Due to the differing pace of economic reform in the coal mining and

power generation industries, various conflicts of interest occurred over the course of development. As coal supply became abundant, reform in the coal mining industry made some progress. The coal market, except for coal for electricity generation, was fully deregulated in 1993. To protect the electric power industry and maintain low electricity tariffs, prices of coal (in-plan coal) sold to power plants, mostly centrally owned generation companies, were deliberately kept low. Meanwhile, prices of market coal (out-of-plan coal) increased sharply, mainly driven by factors such as insufficient transportation capacity, rising labor and equipment costs as well as new and stricter safety standards for coal mines.

Most new IPPs lacked the political influence to qualify for the in-plan coal purchase and they therefore had to seek higher-priced coal in the market. Conflicts thus arose when coal prices fluctuated but electricity prices remained relatively stagnant. This type of situation created unfair competition between the new IPPs and the centrally owned power generation giants. The coal market was fully liberalized and opened up in late 2002 when the government relaxed its control on coal prices. Coal prices continued to rise rapidly due to huge market demand. Electricity tariffs, on the other hand, remained unchanged under full government regulation and were not permitted to rise dramatically despite soaring fuel costs. The increasing fuel costs and control on electricity prices put tremendous pressure on power generators.

In order to address this issue, the NDRC introduced the “coal and electricity prices covariation” (*meidian liandong* 煤电联动) policy in December 2004. The mechanism of price covariation aimed to establish a linkage between electricity tariffs and coal prices. The price covariation mechanism is based on the principles that an increase in coal prices should correspond to an increase in on-grid electricity tariffs,

and that an increase in generation prices should correspond to an increase in electricity retail prices. Under this mechanism, when the average coal price rises by more than 5% over a six-month period, 70% of costs due to price increases should be passed to the end-users by increasing the on-grid tariffs. Power producers should bear the cost of the remaining 30% of the coal price increase. If coal price fluctuations do not exceed 5% over a six-month period, the fluctuation should be accumulated and factored into the calculation in the next six months.

The covariation mechanism helped ease some economic burdens in the electric power sector caused by the rapid increase of fuel costs, and enhanced its viability in the short and medium term. However, the mechanism has a time lapse effect because it is not a complete market measure. The mechanism was intended to periodically regulate electricity tariffs to avoid potential extreme price fluctuations. The on-grid tariffs were adjusted for the first time under this mechanism in May 2005, increasing end-user tariffs by RMB0.0252 /kWh. The arbitrary use of the covariation mechanism in the course of implementation has actually weakened the credibility of the policy because for political reasons, the mechanism was not always applied and electricity tariffs sometimes remained unchanged despite increases in coal prices. For instance, on the eve of the Beijing Olympic Games in 2008, the mechanism was not activated to maintain economic stability.

In 2012, the State Council (2012) updated the mechanism rules to extend the coal price fluctuation time period to one year and the cost coverage by end-users. The new rule stipulates that for average coal price increases of more than 5% within a period of one year, 90% of costs caused by such increase should be passed on to the end-users by increasing the on-grid tariffs. It should be noted that market reform in

electricity pricing has rendered the coal and electricity price covariation mechanism obsolete. In January 2020, the mechanism was officially abolished together with the benchmark on-grid tariffs.

Problems with government pricing

China's electricity pricing mechanism was seriously distorted. Grid companies purchased power from generation plants at on-grid price and sold it at final end-users' electricity price. The on-grid price and the final price were determined at various levels of government. This approach of government-stipulated electricity prices contributed to several significant problems that the country's power sector still faces today.

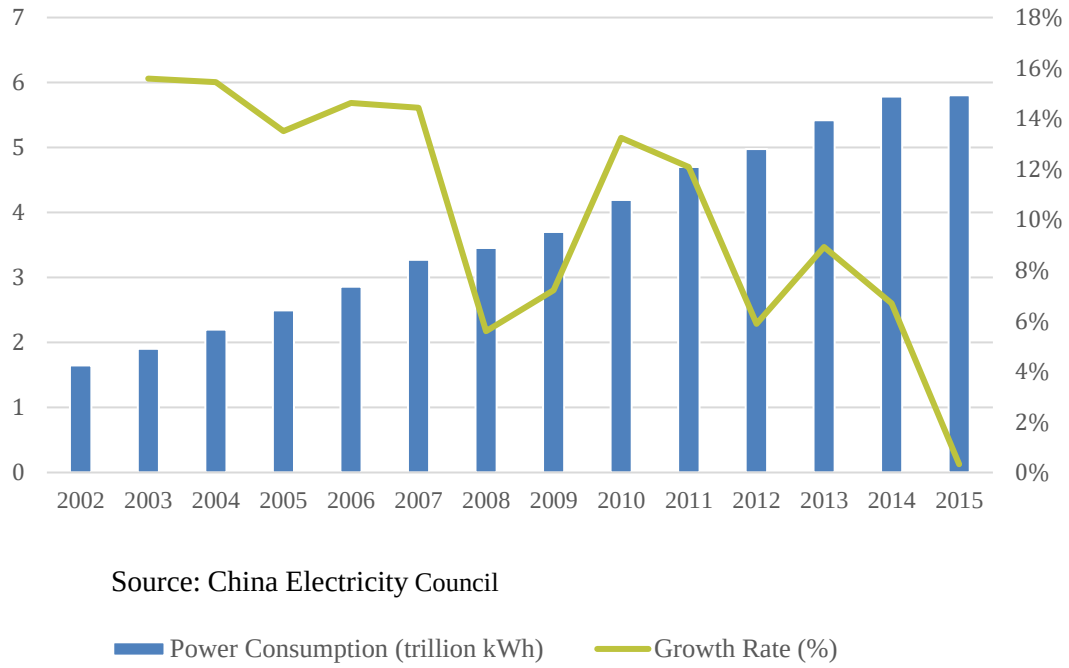
First, the lack of a robust link between prices and costs is systemic throughout China's electric power sector. Wholesale generation prices assigned to power plants were based on estimates of building and operation costs of different types of plants. Therefore, wholesale generation prices do not reflect the actual cost of running plants. Dispatches from power plants were conducted without taking costs into consideration. Furthermore, power plants were assigned the same approximate number of operating hours, which meant that the least efficient plants could operate just as many hours as the most efficient ones.

Indeed, there was no direct correlation between generation costs and electricity prices. Prices were set with little reference to economic efficiency and consumers' willingness to pay. Instead, they were based on political and macroeconomic concerns such as income redistribution and inflation control. Contrary to common practices of most market economies where residential and small commercial consumers pay the

highest prices for electricity, Chinese residents pay lower prices than commercial and large industrial users. While the market approach is intended to reflect costs, the Chinese approach is targeted to provide key industries support and to maintain social welfare and stability.

Second, electricity prices were not adjusted to reflect changing economic conditions or shifts in the government's overall policy goals such as renewable energy integration. For a significantly long period of time, wholesale electricity prices had overcompensated investment in coal power, failing to adjust in the face of weakening growth in demand, declining coal prices and a worsening coal overcapacity. The national growth in demand for electricity averaged 11.7% from 2002 to 2012, but fell to 4.5% between 2012 and 2017, bottoming out at 0.5% in 2015 (Figure 7.2). The weakening of demand also deepened the problem of overcapacity in China's power sector, which was assessed to be 35% by Bloomberg New Energy Finance in 2016 (Zhou and Lu 2017). A significant proportion of current coal-fired capacity is simply not needed, meaning that if generators operated according to the merit order, some power plants probably would not be run at all.

Figure 7.2 China's Power Consumption and Growth Rate (2002-2015)



Source: China Electricity Council

7.2 Pricing of Hydropower

Hydropower is the second source of electricity in China, accounting for 16% of total national electricity supply in 2018; the installed capacity of hydropower accounted for approximately 18% of total national installed capacity[36]. Before 2004, on-grid tariffs for electricity from hydropower plants were determined on a project-by-project basis and no benchmark tariffs were used. The pricing scheme was similar to the cost repayment scheme applied to thermal power plants from the mid-1980s to mid-1990s. Typically, approximately 8% of returns to investments were allowed for hydropower projects.

The NDRC approved tariffs of large hydropower projects, and provincial and sub-provincial governments were responsible for deciding tariffs of smaller projects

[36] Author's calculation based on data from the *2019 Statistical Yearbook of Electric Power in China*.

within their territories. The differentiation approach in tariff policy was to cater for varying attributes of each hydropower project, such as different hydrological and geological conditions, differences in water adjustment capabilities of reservoirs and specific requirements for population resettlement. One-tier on-grid electricity tariffs were used for most hydropower plants, except for a small number of plants which implemented two-tier tariffs of wet and dry seasons.

In 2004, the NDRC implemented benchmark tariffs for hydropower in 10 provinces that have abundant hydropower resources. In 2008, on-grid tariffs for hydropower were in the range of RMB0.2–0.3 / kWh compared to that of coal-fired power plants in the range of RMB0.4–0.5 / kWh. In general, with no pressure from fuel price increases, on-grid tariffs for hydropower plants were not seen as a pressing issue, compared to coal-fired plants. The situation began to change toward the end of the 2000s due to the rapidly rising construction costs of hydropower plants exacerbated by the increasing costs of population resettlement. In November 2009, pricing policy was reversed again to the old practice of determining tariffs on a project-by-project basis.

In 2014, the NDRC (2014b) began to impose new regulations on hydropower electricity prices. The new pricing scheme differentiates hydropower based on spatial factors. Hydropower prices for cross-province power transmission should be negotiated between the provinces. While the transmission cost is subject to approval by the NDRC, calculations of on-grid tariffs are expected to take into consideration such factors as the benchmark on-gird tariffs for thermal plants in the power-receiving province, construction costs of projects, and costs of population resettlement and environmental protection. Given that imported hydropower prices are normally lower

than the average on-grid tariffs for thermal plants in power-receiving provinces, imports of hydropower therefore present an attractive alternative.

For hydropower consumed within a province, a benchmark on-grid tariff is supposed to be implemented. Price determination is based on the benchmark on-gird tariffs for thermal plants of the province and also factors in project costs. Provincial pricing agencies are able to propose tariff levels to the NDRC which must then determine if they are to be approved. Linking tariffs for hydropower with tariffs for thermal power plants was aimed at reducing price gaps within regions. Nonetheless, the prices failed to reflect actual supply and demand due to the lack of functioning market mechanisms.

7.3 Pricing of Nuclear Power

Before June 2013, tariffs for nuclear power were approved by pricing authorities based on project costs and on a project-by-project basis. Project developers were usually less incentivized to control costs because higher costs translated to higher electricity prices, which usually lead to suboptimal economic efficiency. In June 2013, the NDRC (2013) identified a nationwide benchmark for on-grid tariffs at RMB0.43 RMB/kWh. For provinces where the provincial benchmark tariff for thermal power was higher than the nationwide benchmark tariff for nuclear power, the NDRC also stipulated that these provinces propose higher nuclear power tariffs to the organization for approval. Meanwhile, provinces could also propose to lower the nuclear power tariff according to the attributes of the project and seek approval from the NDRC. For instance, in July 2017, Fujian adjusted its tariffs for four nuclear power plants to a level lower than the nationwide benchmark tariff. Ningde Unit 3 and Fuqing Unit 2 on-grid tariffs were adjusted to RMB0.4055 /kWh, and Ningde Unit 4

and Fuqing Unit 3 on-grid tariffs were adjusted to RMB0.3717 /kWh (Fujian Pricing Bureau 2017).

7.4 Pricing of Wind Power

In China, different tariff-setting mechanisms were implemented at various stages of wind power industry development. Early-stage wind power projects in the 1980s and 1990s used government grants or loans as foreign aid from developed countries. Wind power projects at this stage were mostly for the purpose of research and demonstration rather than for commercial operation, and the unit capacity of wind turbines was normally small. China's wind power industry experienced a sharp learning curve over the course of development—it achieved a dismal total installed capacity of 5.7 GW in 2003, with an annual capacity growth of less than 100 MW in the 1990s and early 2000s.

Before 2003, the pricing scheme of on-grid tariffs for wind power projects was similar to that of "cost repayment" for thermal power in the 1980s. Prices were determined by taking capital investment, operation and maintenance costs, and agreed margins of profit into consideration. Wind farms negotiated with the power grid companies to propose the on-gird tariff, which was then submitted to the local governments for approval. Grid companies utilizing government subsidies had to absorb the price difference between the wind power price and average local electricity price. On-gird tariffs for wind power projects varied greatly from RMB0.38 /kWh to a high RMB1.2 /kWh.

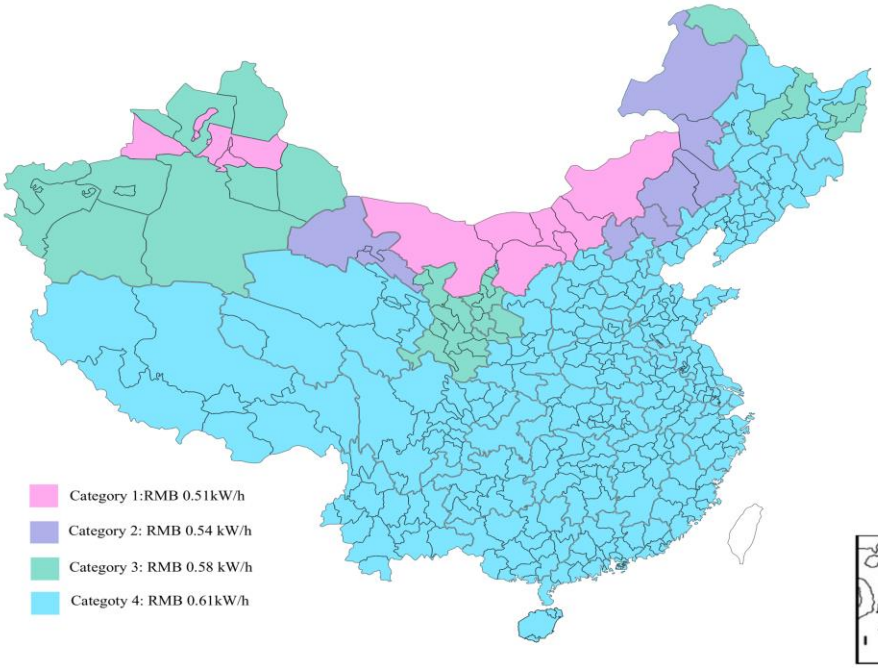
From 2003 to 2009, wind power projects adopted a dual track pricing system. While wind power projects continued to adopt the "cost repayment" pricing scheme,

in 2003, the NDRC organized the first national call for concession tenders for wind farms, inviting project developers to participate in market competition. For projects in which the provincial governments were the approval authority, provincial governments also organized local concession tenders and tendering tariffs were used as references for provincially guided tariffs for wind farm projects. For provinces which did not organize any concession tenders, on-grid tariffs for projects were determined via the traditional approach of negotiations between grid companies and wind farms.

In the early rounds of concession tenders, due to the limited number of projects available and large number of participating developers, some developers, especially state-owned enterprises, committed to ridiculously low prices so as to secure contracts. Some of the concession prices submitted were even lower than actual project costs. Prices were formulated either by overestimating wind resources and electricity generation or underestimating the costs of operation and maintenance. The number of low-bid tenders declined as more rounds of concession tenders were called, thus gradually raising the average bidding price. During the 2003–2009 period when the dual track pricing system was in place, concession tendering tariffs were lower than guided tariffs. Project approval from the national government was generally considered more difficult than obtaining approval from provincial governments. Starting from 2004, the NDRC gave provincial authorities the permission to grant approval for wind farms below 50 MW in capacity. As a result, many projects with a capacity of 49 MW were built in subsequent years, indicating that project developers preferred to deal with provincial governments for project approval.

In August 2009, the NDRC (2009) announced the implementation of four-categories of feed-in tariffs for new onshore wind power projects. The categorized feed-in tariffs represented a significant premium for wind power over thermal power. The north and some regions of northwest of China are the two regions with the most abundant wind resources in China. For these regions the tariff was set at RMB0.51 /kWh. A large partof northeast and northwest China have modest wind resources and their tariffs set were RMB0.54 /kWh and RMB0.58 /kWh, respectively. A tariff of 0.61 RMB/kWh was set for other parts of China with relatively less wind resources (Figure 7.3). These prices were set as the minimum on-grid tariffs in each region. In theory, the tariff for each individual project were still to be subject to negotiation between developers and the power grid companies. Normally, however, power grid companies do not offer higher tariffs than the feed-in tariffs.

Figure 7.3 Wind Power FITs by Category (2009)



A fixed feed-in tariff scheme for offshore wind farms was not implemented until 2014. Before 2014, on-grid tariffs for offshore wind projects were determined by tendering on a project-by-project basis and approval was required from related governmental authorities. The NDRC, in a 2014 announcement (NDRC 2014a), stipulated two categories of feed-in tariffs for offshore wind power projects and intertidal wind power projects in operation before 2017 at RMB0.85 /kWh and RMB0.75 /kWh, respectively. For projects that were in operation after 2017, the NDRC stated that tariffs should be determined based on concession tenders.

7.5 Pricing of Solar Photovoltaic (PV) Power

Prior to July 2011, China had no unified feed-in tariffs for solar photovoltaic (PV) power projects at the national level. The pricing for solar power has undergone similar stages of development as the pricing for wind power. In the early stage of development when the solar PV market was small, the government-approved feed-in tariffs remained high and differentiated, based on the diversified characteristics of individual projects. To cite an example at one end of the spectrum, the price of solar PV power projects in Inner Mongolia, Shanghai and Ningxia approved by the NDRC in 2007 was RMB4 /kWh (Zeng, Liu, Li and Xue 2013, p.265), about 10 times higher than the tariff of coal-fired power. The nationwide feed-in tariff for solar PV was implemented in 2011, two years after the implementation of feed-in tariffs for wind power.

Between 2009 and 2012, the central government launched four rounds of the Golden Sun Project (*jintaiyang gongcheng* 金太阳工程) to support the integrated application of solar PV technology in buildings and the development of off-grid solar PV power systems. For the first two years, the Golden Sun Project offered national

subsidies for distributed power plants—the ratio of subsidies for general projects was set at 50% of investment value, and that for projects in remote and least developed areas with no electricity access was set at 70%. Except for the proportional subsidy that was based on investment volume, an additional fixed subsidy was also offered based on the capacity of energy transfer of the specific project (Table 7.1).

Table 7.1 Subsidies of the Golden Sun Project

Year	Total Capacity (MW)	Types of Projects Subsidized	Subsidy Standard
2009	642	Utility-scale solar PV projects; distributed projects in remote and least developed regions.[37]	50% of investment volume for utility-scale projects, 70% of investment volume for distributed projects in least developed regions.
2010	272	1. Utility-scale solar PV projects; 2. Distributed projects in remote and least developed regions.	1. Equipment subsidy: 50% of investment volume for utility-scale projects, 70% of investment volume in least developed regions. 2. Subsidy based on capacity: RMB4/watt for utility-scale projects, RMB10/watt for distributed projects in least developed regions.
2011	692	1. Solar PV projects in economic development zones, high-tech zones, industrial parks and public welfare projects; 2. Distributed projects in remote and least developed regions.	1. RMB9/watt for demonstration projects that use silicon crystal module. 2.RMB8/watt for demonstration projects that use thin film module.
2012	4,544	1. Solar PV projects in economic development zones, high-tech zones, industrial parks and public welfare projects; 2. Distributed projects in remote and least developed regions.	The first half of 2012: RMB 7/watt (RMB5/watt in actual implementation) for solar PV projects in category 1. The second half of 2012: RMB5.5/watt for projects completed before 30 June 2012; RMB20/watt for projects in category 2.

[37] Distributed projects refer to small solar power generation facilities that are located close to consumers and connected to distribution systems. Utility-scale projects are typically located at the point of best resource availability.

It is apparent that the subsidy policy based on the criteria of project cost was not very effective in incentivizing efficiency and technological progress. For proportional subsidies based on investment volume, government departments only reviewed and approved subsidies according to the cost declared by the applicants. This implied that higher subsidies were granted to applicants with higher costs and lower subsidies for lower costs. As a result, many developers no longer made efforts to control costs in order to receive more subsidies. Some enterprises were found guilty of committing fraud when applying for government subsidies.

Contrary to the plunging prices of solar PV panels in the market, subsidies remained high during the implementation of the Golden Sun Project. Excessive local government intervention had caused market distortion and an overcapacity problem. In 2009, the feed-in tariff for the first concession project in Dunhuang, Gansu province was RMB1.09/kWh. In 2010, in the second batch of 13 concession projects with a total capacity of 280 MW, the feed-in tariff ranged between RMB0.73 /kWh and RMB0.99 /kWh (Zeng et al. 2013, p.265). Local governments had approval rights for the projects. Besides subsidies from the central government, many local governments also offered high subsidies to their local projects. The combination of incentive policies led to a boom of solar PV power plant construction in many provinces, especially in western China which is rich in solar resources. Given such explosive growth in plant construction, the power grid companies were underprepared, and many solar PV power plants constructed at an accelerated pace had to be laid idle after their completion.

In August 2011, the NDRC introduced a nationwide feed-in tariff for solar PV power projects. The national feed-in tariff was RMB1.15 /kWh for projects approved

before July 1, 2011 and completed by the end of 2011, and RMB1.0/kWh for projects approved after July 1, 2011. The latter tariff was also applicable for projects not completed before the end of 2011. In August 2013, the NDRC further categorized solar PV projects into distributed and utility-scale centralized systems. Concerning centralized systems, the whole country except Tibet, was further divided into three regions based on solar resource distribution. A feed-in tariff was set at RMB0.9 /kWh, RMB0.95 /kWh and RMB1.0 /kWh for regions I, II and III, respectively, for projects approved after September 1, 2013 or projects approved before September 1, 2013 but in operation after January 1, 2014. The NDRC particularly stated that the feed-in tariffs would be guaranteed in principle for 20 years. The feed-in tariffs were adjusted several times in the following years and have been declining consistently (Table 7.2). The issuance of the "5.31 New Policy" in May 2018 ended the national subsidy for distributional projects thereafter because the installed capacity at the time exceeded the 100 MW ceiling of the planning quota.

Table 7.2 Feed-in Tariffs for Utility-scale and Distributed Solar PV Projects

Year	Feed-in tariffs for Utility-scale Solar PV Power Projects (RMB/kW/h)			Subsidies for distributed projects
	Region I	Region II	Region III	
2013	0.9	0.95	1	0.42
2016	0.8	0.88	0.98	0.42
2017	0.65	0.75	0.85	0.42
First half of 2018	0.55	0.65	0.75	0.37
Second half of 2018	0.5	0.6	0.7	0.32

7.6 Pricing Reform in Guangdong and Xinjiang

The objective of pricing and trading reform was to introduce market mechanisms to overcome the problems associated with government pricing and planning of production and consumption. Reform measures included changing transmission and distribution tariffs, and introducing a competitive wholesale market and market-based cross-provincial trading. The reform measures related to electric power pricing will be discussed in greater detail in this chapter. The next chapter will focus on issues of transmission, distribution and cross-provincial trading. The reform process involves establishing a single buyer system that is based on a price pooling mechanism at the provincial level. The single buyer system is expected to transform China's electric power sector into a competitive wholesale electricity market in the long run.

The reform of transmission and distribution tariffs

Before the 2015 reform, transmission and distribution tariffs were not separate components of electricity prices. Transmission, distribution and sales of electricity were integrated exclusively in power grid companies, and transmission and distribution costs were kept as a trade secret by these monopolistic companies. Power grid companies' income depended primarily on sales of electricity as transmission and distribution tariffs were not discrete components. They faced little market risk due to their monopoly status, which engendered inefficiency and corruption.

In September 2015, Chinese provinces, including Guangdong and Xinjiang, implemented reforms to identify and separate transmission and distribution tariffs from electricity prices. According to the relevant reform schemes specified in

Document No. 9, transmission and distribution tariffs should be approved by government administrators based on an “allowable costs with reasonable profits” principle. Following the implementation of reform, the income of power grid companies was divided into two components, i.e., the income from sales of electricity and the income from transmission and distribution of electricity. The introduction of other players and competition in the business of electricity sales ended the power grid operators’ monopoly.

In September 2015, Shenzhen city in Guangdong province was the first to implement the reform pilot programme for the pricing mechanism of transmission and distribution. In 2017, Guangdong provincial government bodies were charged with the verification and authorization of transmission and distribution tariffs in Guangdong (excluding Shenzhen). This resulted in the publication of a list of transmission and distribution tariffs imposed from 2017 to 2019 (Appendix 3). As is evident, transmission and distribution tariffs in the Pearl River Delta region were relatively higher than in other regions of Guangdong province, indicating a disparity in developments. An updated list of new transmission and distribution tariffs was published and implemented in July 2019 (Appendix 4). A comparison of the two lists shows that transmission and distribution tariffs were lower in the updated list.

Repeated efforts to reduce the transmission and distribution tariffs and the overall electricity tariffs have helped provincial governments to promote their local economies by alleviating the costs facing local enterprises. Other provinces in China also adopted a similar approach. Different transmission and distribution tariffs (Appendix 5 and 6) were set for different types of end-users that were impacted by the market reform. Large industrial users in Guangdong and Xinjiang enjoyed much

lower electricity tariffs than ordinary commercial users, reflecting the preferential policy favoring local industrial enterprises and promoting local industry.

Introducing competitive wholesale markets

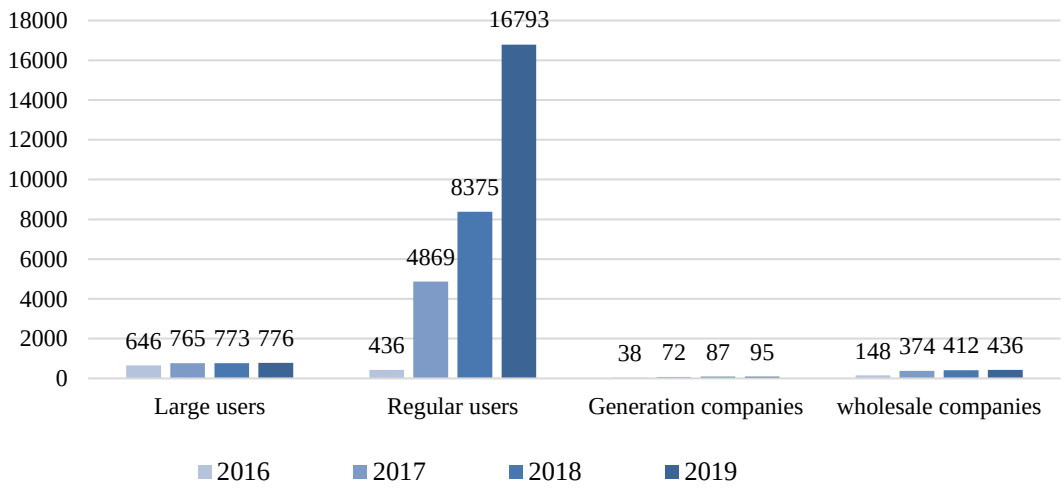
The wholesale market reform is key to the transition from planned operating hours to a more market-based approach. Wholesale market reform is mainly conducted in two fashions, i.e., bilateral trading and centralized auctions. The mechanism of bilateral contracting, which is also called power purchase agreements (PPA), was trialed in selected locations in past reforms in China, but they were of limited scale and duration.

In the new round of reform in 2015, bilateral contracts were revived and widely implemented in the provinces in order to achieve a reduction in electricity prices for end-users. In Guangdong and Xinjiang, this meant that large end-users and retailers could negotiate directly with generation companies regarding the quantity and price of electricity that they would like to purchase, and the parties could then prepare preliminary bilateral contracts, which should be reported to provincial power exchanges and authorized by relevant administrative departments.

In Guangdong, a wholesale power market officially began trading on a monthly basis in June 2016 provincewide. Market players grew rapidly initially. The number of commercial users registered an explosive increase, rising from 436 to 8,375 between 2016 and 2018. In 2019, a total of 18,100 market entities were based in Guangdong's power market. Among them, there were 95 power generating companies, 776 large end-users, and 16,793 regular end-users. They were represented by 436 retailers in Guangdong's power exchange market (Figure 7.4).

With the growth of market participants, trading volume also enjoyed a substantive expansion, from 115.7 billion kW/h in 2017 to 250 billion kW/h in 2020, and achieved an average annual growth of about 29% (“Guangdong” 2018 and 2021) (Figure 7.5). Bilateral trading constitutes the largest form of trading in Guangdong. The electricity market caught up with other forms of organized trading (Figure 7.6). Guangdong had a share of 12% of China’s total province-based electricity market scale in 2019, a drop from 17% in 2017, indicating that electricity trading in other parts of China also grew steadily.[38]

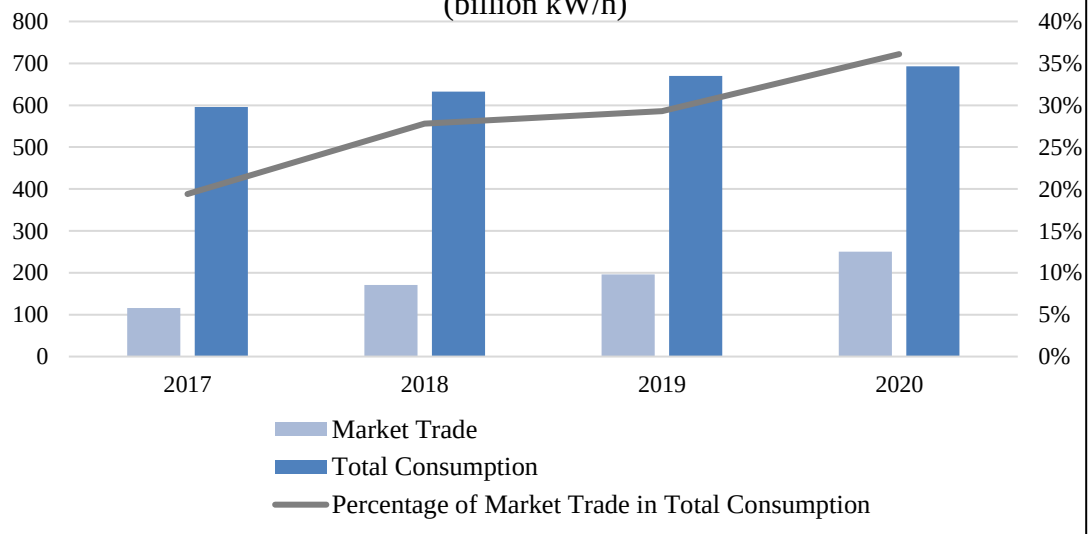
Figure 7.4. Composition of Guangdong Electricity Market (2016–2019)



Source: Author's complilation based on statistics of Guangdong Power Exchange.

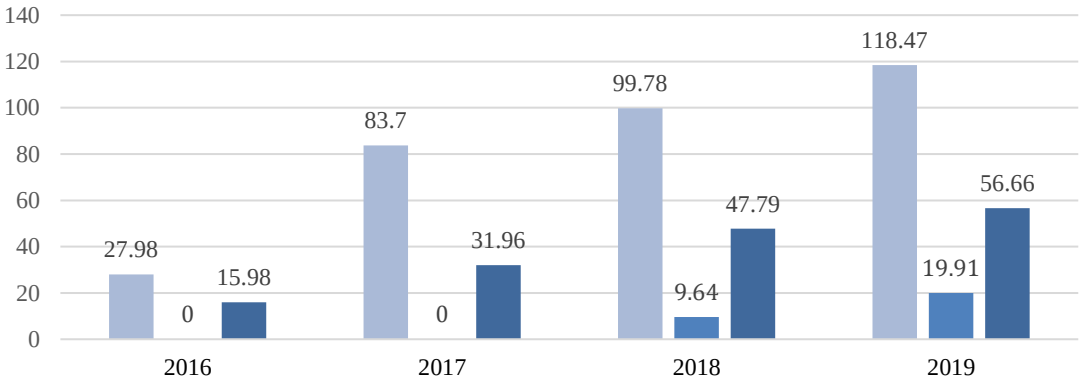
[38] Author’s calculation based on official statistics.

Figure 7.5 Market Trade Volume in Guangdong Electricity Market (billion kW/h)



Source: Author's calculation based on statistics of Guangdong Power Exchange.

Figure 7.6 Trading Volume by Type in Guangdong Electricity Market 2016–2019 (billion k/Wh)



Source: Author's complilation based on statistics of Guangdong Power Exchange.

The provincial power exchange in Xinjiang was established in March 2016. Compared to Guangdong, there is less information available on the market's operation in Xinjiang. Xinjiang does not publish an annual electricity market trade report like Guangdong does. Based on the limited published statistics, as of end of 2019, 860 generation companies and 262 retail companies were registered in the Xinjiang Power

Exchange. Among the 592 end-users, 438 were regular retail end-users and 153 were large industrial users (“Xinjiang” 2020).

Trading volume reached 73.6 billion kW/h in 2020, accounting for 24.5% of total consumption (“Xinjiang” 2021a and PGXUA 2021). Total trading volume from 2016–2020 reportedly hit 243.5 billion kW/h at an annual growth of 30% (“Xinjiang” 2021a). The 13% cap for renewables in total electricity trade was lifted in March 2021, leading to a rapid increase in renewables trading that accounted for over 25% of total market trade (Hu 2021). Similar to the situation in Guangdong, bilateral trading accounted for the majority of trading in Xinjiang. In 2019, 44.5 billion kW/h out of 59.4 billion kW/h total trading volume were made bilaterally (“Xinjiang” 2020).

Implementing direct bilateral trading was a fairly conservative reform that has helped to gradually phase out the annual output planning process. By June 2019, the number of operation hours entitled to generation companies was determined and guaranteed by bilateral contracts, replacing the annual allocation method. Large industrial consumers and generators today negotiate prices that are below the benchmark wholesale price, but higher than variable costs. In general, bilateral contracts can last for weeks, months, or even years.

The transaction price of bilateral contracts can better reflect supply and demand situation in the power market. The trading mechanism can also prevent sharp fluctuations of electricity prices and stabilize the market for both the supply and demand sides. One of the downsides is that the long-term contracting deals are often made confidentially and lack adequate transparency. As generation companies are allowed to invest and hold shares in retailing companies, they enjoy strong market power in competition with other retailers that do not have generation assets.

Therefore, it is difficult for new market players and retailers that have less market information to gain shares in the wholesale market through bilateral trading.

In centralized auctions, power producers submit their offer of supply and prices while potential buyers submit their quantities of demand and the bidding prices to provincial power exchanges in a sealed bid format. There are various bidding rules and market clearing mechanisms in different provinces.

In 2016, the clearing mechanism in Guangdong was based on price difference, which is a transformed pay-as-bid (PAD) settlement mechanism. Generators propose the price based on the gap between the generation cost and the benchmark on-grid price. Retailers and large users bid the price of the gap between the preferred electricity price and the benchmark on-grid price. The price difference is the gap between the price that generators submitted and the price that retailers or large users submitted. A deal would be deemed to fail if the price difference is positive, while a deal could be made if the price difference is negative or zero. Retailers and users that bid the lower absolute value of the price difference win the bid ("Guangdong" 2016).

In early 2017, the settlement mechanism was changed to one that is based on a uniform clearing price. After bidding, an aggregated supplier curve and an aggregated customer curve are produced and analyzed. The market clearing price is determined by the intersection of the two aggregated curves. All buyers that secure the auction pay the clearing price for power, while all sellers winning the auction are paid the same clearing price. Auctions can be used for both long-term and short-term trading. Currently in Guangdong and Xinjiang, double-sided auctions are implemented for the yearly and monthly power exchange, as well as spot market power exchange trials.

Pricing reform for renewable energies

Since the current new round of market reform, a small proportion of nuclear power has entered the electricity market and is traded under market mechanisms. The provinces where the plants are located have the authority to determine the proportion of the traded nuclear power in the supply. In Guangdong, nuclear power entered the market in 2018, accounting for only around 6% of the total electricity traded.[39] By comparison, Xinjiang does not have any nuclear power plants.

In May 2018, the NDRC issued a new feed-in-tariff policy for wind energy. The government renamed the description of the feed-in tariff from "benchmark" wind energy tariff to "guiding" wind energy tariff, emphasizing that wind energy feed-in tariffs will serve as price caps instead of fixed on-grid tariffs as of July 2019. The policy also requires all tariffs for new wind energy projects to be set via tendering as of 2019. The policy includes an explicit timeline for phasing out subsidies for onshore wind energy projects. China ended subsidies for new onshore wind power projects from the start of 2021 and all projects are set to compete on an equal footing with coal- and gas-fired electricity. The 2019 onshore/intertidal guidance rate for wind energy was set at RMB 0.34 /kWh–RMB0.52 /kWh, while projects in 2020 were subject to a rate of RMB0.29 /kWh–RMB0.47 /kWh, suggesting a continual decrease in government subsidies.

The NDRC also reduced the feed-in tariff for offshore wind power, although the reduction was rather small. The policy adjustments demonstrate that the Chinese government continues to support offshore wind energy and is willing to enhance the

[39] Author's calculation based on statistics by Guangdong Power Exchange.

competitiveness of the industry. With new policies in force, offshore projects that were authorized by end-2018 can apply for the fixed rate at RMB0.85 /kWh, provided they connect to the grid before the end of 2021. If they are connected to the grid after 2021, they will be subject to the bidding rate of the year.

Compared to 2018, the price decreases by RMB0.05 /kWh in 2019 and by RMB0.1 yuan/kWh in 2020, characterizing a "guidance" tariff, i.e., a cap price of RMB0.8 yuan /kWh for 2019 and RMB0.75 yuan /kWh for 2020. As wind speed conditions in coastal areas display large regional differences, the levelized cost for offshore wind energy ranged between RMB0.65 yuan/kWh and RMB0.8 yuan/kWh in 2019. Intertidal offshore wind projects, however, are subject to onshore bidding guidance rather than feed-in tariff for offshore wind energy.

Based on central policies, Guangdong published its tendering policies for new wind energy projects in December 2018—the first province in China to do so. Guangdong province is not typically rich in wind energy; therefore, curtailment in wind energy is not a prominent issue there. By contrast, Xinjiang has had serious overcapacity problems in past years. A similar "traffic light system" has been in place nationally to monitor investments in renewable energies as in coal-powered plants. Xinjiang was labeled as a "red" area in 2018 and 2019, meaning that it will not approve new wind projects. Old projects that were approved before 2018 as well as those that have already been in operation can still enjoy national subsidies/feed-in tariffs.

Solar photovoltaic (PV) energy experienced even stricter restrictions than wind energy. On May 31, 2018 (hence the "531 policy"), the NDRC issued a notification that halted the construction of utility-scale solar PV projects nationwide and forbade

local governments from approving such projects that require government subsidies. Distributed solar PV projects were limited up to 10 GW in total capacity in 2018, which means that only a very small expansion of capacity was possible given the fact that 7.69 GW of distributed solar PV capacity had already been built in the first quarter in 2018.

The central government also renamed the description of feed-in tariff for solar PV energy from “benchmark” tariff to “guiding” tariff. Most PV projects are subject to the tendering process. Except for PV projects assigned for poverty alleviation purposes in rural areas, subsidies for regular utility-scale projects across China have declined consistently year by year. After May 31, 2018, the feed-in tariffs for utility-scale projects were lowered by RMB 0.15 /kWh in all regions from the 2017 level and were further cut by RMB 0.25/kWh in 2019 (Table 7.3).

Meanwhile, feed-in tariffs for distributed solar PV projects also dropped, to just RMB 0.1 yuan/kWh for commercial-use projects and RMB 0.18 yuan/kWh for domestic-use projects. Grid-parity renewable energy projects that do not require government subsidies are highly encouraged by the central government. The first batch of approved projects for 2019 was released by the NDRC in May that year with a combined capacity of 20 GW for both wind and solar PV energy.

Table 7.3 Feed-in Tariff for Utility-scale Solar PV Projects in China (RMB)

Year	Type I Region	Type II Region	Type III Region
2013	RMB 0.9 /kWh	RMB 0.95 /kWh	RMB 1/kWh
2017	RMB 0.65 /kWh	RMB 0.75 /kWh	RMB 0.85 /kWh
2018 (Post 5.31)	RMB 0.5 /kWh	RMB 0.6 /kWh	RMB 0.7 /kWh
2019	RMB 0.4 /kWh	RMB 0.45 /kWh	RMB 0.55 /kWh

7.7 Conclusion

This chapter discusses the process of market reform in electricity pricing and studies the specific cases of Guangdong and Xinjiang. China's electricity market is largely province-specific and territorially defined within provincial borders. Before the implementation of market reform, electricity price was mainly determined by central planning and prices in individual provinces needed to be approved by the NDRC. The reform transformed the pricing mechanism into a mixture of planning and market-based pricing as a transition period to achieve full marketization. Power generation planning in industrial and commercial sectors was subsequently abolished. Transmission and distribution tariffs were identified for the purpose of shaping market-based electricity prices in the wholesale market.

There is a shift in provincial authorities' role from planning electricity production and consumption of the provinces under central coordination and authorization of the NDRC to setting pricing and trading rules within their territories to boost electricity market growth. Indeed, the market reform presents provinces with a good opportunity to achieve further decentralization and expand their economic decision-making power. Market reforms in both Guangdong and Xinjiang have shown

steady progress. Significant first steps to marketization are the abolition of both the benchmark tariffs for coal-powered plants and the mechanism of coal and electricity price covariation. Many provinces introduced market trading mechanisms and the share of electricity in market-based trading increased year by year across China.

Both Guangdong and Xinjiang have made prominent progress in market reform, achieving growth, especially, in mid- and long-term trading. Both regions have executed bilateral direct trading and double-sided auctions, although their specific trading rules and clearing mechanisms vary in detail. Spot market trials for short-term trading have been in place in both regions as well. Electricity generated by coal-fired power plants accounts for the majority of market trading. Other types of renewable energies such as nuclear, hydroelectric, wind and solar PV power also started to participate in market trading on a small scale.

Despite similarities in policy outcome, Guangdong is more advanced than Xinjiang in market reform in terms of market scale and degree of marketization. Guangdong has not only more market participants, but also more forms and higher frequencies of trading in that market. Market vibrancy is correlated with such factors as higher levels of general economic development and more amenities in overall market environment which are clearly more representative of Guangdong than Xinjiang.

Chapter 8 Reform of Power Transmission and Distribution

This chapter discusses China's reform efforts in relation to electric power transmission and distribution. The first 40 years of power sector reform focused mainly on power generation, which accomplished the diversification of power generation entities and effectively solved the power shortage problem in China. Reforms in power transmission and distribution were the next significant steps to follow the reforms in the area of power generation; their aim was to further diversify power supply sources. Besides the new policy of establishing an independent accounting of transmission and distribution tariffs discussed in the previous chapter, major reforms in this policy area involve market trials in distribution (*zengliang peidian* 增量配电) and market measures in trans-regional power transmission.

Provincial and local governments were identified as the main bodies responsible for these reforms. In terms of electricity distribution, provincial and local governments are responsible for distribution network planning, setting boundaries of power supply business areas, and selection of project owners through bidding process and pricing mechanism. In terms of cross-regional transmission reform, they are responsible for negotiating on-grid tariffs and organizing electricity market trading. Reforms on both fronts have shown mixed outcomes, reflecting the complexity and tensions existent in central–provincial as well as provincial–provincial relations. The power grid companies, as important stakeholders, played particularly important roles in implementing reforms on these fronts. This chapter explains the triangular relationships between the stakeholders at the central and provincial levels.

8.1 Reform in Power Distribution

While investments in the past mainly focused on transmission infrastructure, China's investment in distribution grids was lower than the developed countries' average of over 60% of total power grid investment (Zhu 2018). In order to catch-up to this level, the National Energy Administration (NEA) made plans to invest over RMB2 trillion in distribution grids from 2015 to 2020, accounting for 65% of total investment on power grids yearly on average (NEA 2016c). Prior to the new round of reforms, the State Grid Corporation of China (hereafter "State Grid") and China Southern Power Grid (hereafter "Southern Grid"), both centrally owned power grid companies, were solely responsible for the construction and operation of the distribution grids. The objective of distribution reform was to introduce new players into the sector in order to break-up the State 's monopolies.

In October 2016, the NDRC and the NEA jointly issued the "Regulations for the Orderly Opening of the Distribution Network Market" (NDRC and NEA 2016a), followed by a series of more than 20 relevant official policy documents on implementation guidelines for issues such as reform pilots, cost monitoring and price regulations. The document clearly pointed out that distribution networks in principle refer to power grids below 110 kV voltage and power grids below 220 (330) kV in industrial parks/economic development zones, and that they do not denote transmission power grids above 220 kV.

Provincial authorities have the autonomy to elaborate on and carry out detailed implementation plans according to the central government guidelines. Policy experimentation through pilot projects in burgeoning industrial zones have been the typical approach for implementing reforms. In 2016, there were 347 national

industrial parks and 1,167 provincial industrial parks in China. As local governments essentially have to complete basic infrastructure construction before proceeding to attracting investment in these areas, newly developed industrial zones are perfect locations for reform pilots for liberalizing the construction and operation of distribution grids.

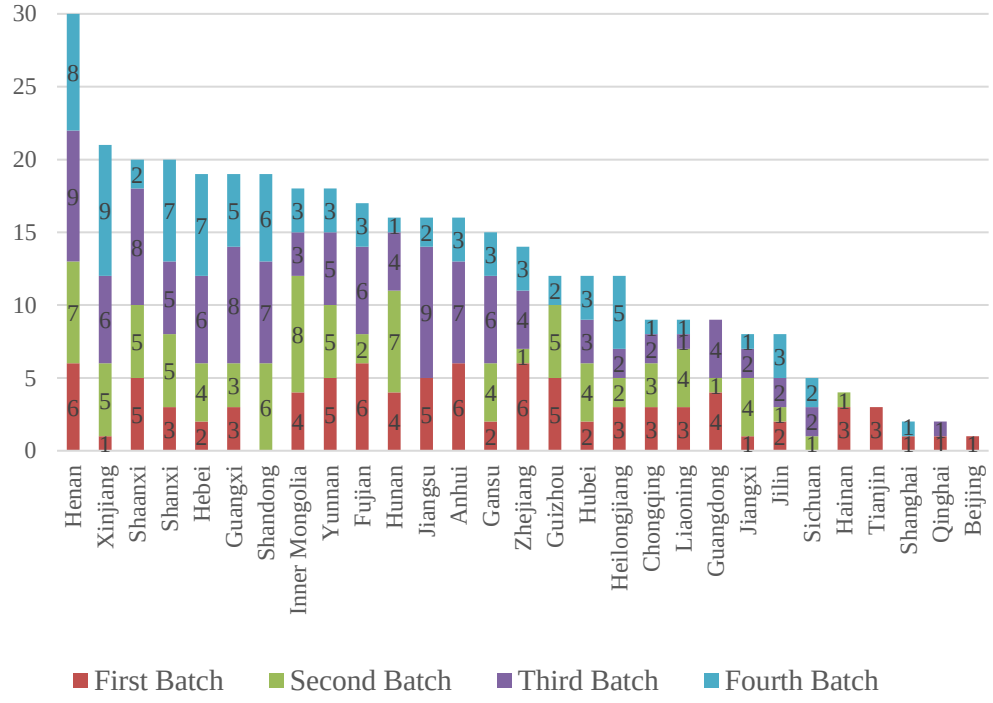
In Guangdong province, Shenzhen Qianhai Shekou Free Trade Zone Power Supply Corporation, which was established in November 2015, was the first enterprise (excluding power grid companies) in China to obtain the power supply business license issued by the Southern Energy Regulatory Bureau of the NEA and also the first to gain rights of management and access to transmission and distribution networks. On November 1, 2016, the company officially took over the power distribution business (electricity supply of 20 kV and lower voltage) and customer service of Qianhai and Guiwan areas in Shenzhen city.

As of June 2019, four batches of 404 reform pilots (106 in the first batch, 89 in the second, 125 in the third and 84 in the fourth) (Figure 8.1) had been established nationwide; most were located in industrial zones and mining areas. Industrial users in these areas have high energy demand and electricity consumption, given that they are the major contributors to local economic growth. In addition, the call for applications for the fifth batch of pilot projects was announced in October 2019.

As of August 2019, of the first batch of 94 projects (excluding 12 canceled projects), project owners were identified for 92 projects (accounting for 98%), 25 projects were completed and operational (26%), and 29 projects had begun with construction (30.8%). As of January 2019, of the 202 projects in the second and third batch of pilot projects (excluding 12 cancelations), project owners were identified for

62 projects (accounting for 30.7%), eight projects had begun construction (3.9%), and 13 projects had obtained power business licenses (6.4%).

Figure 8.1 Distribution Network Pilot Projects (as of 2019)



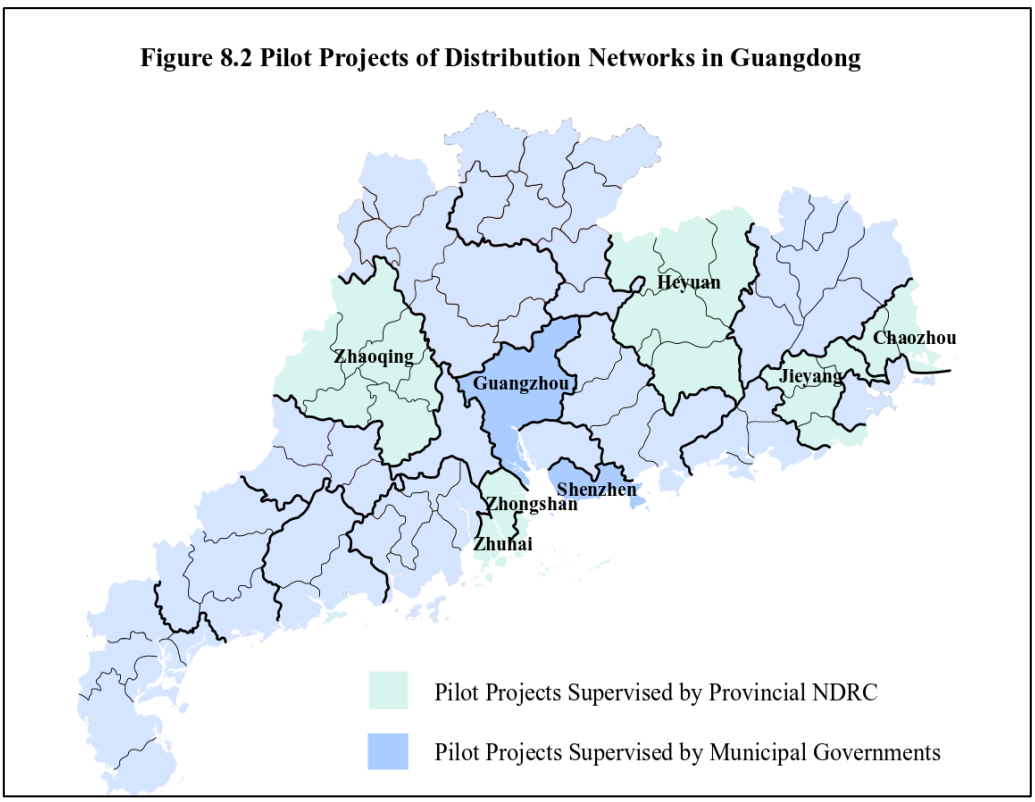
Source: NDRC and NEA.

Note: 24 canceled projects are not included in this chart.

Due to their monopolistic nature, investments in public utilities such as power grids, require large-scale initial capital investment and have long payback periods. These factors mean that the investment cannot yield high returns in the short term. Due to this industrial attribute, investors of pilot projects are mainly state-owned enterprises (SOEs) that enjoy better financing conditions and can afford large capital investments. These enterprises are mainly enterprises controlled by provincial and local governments as well as power grid companies. Private enterprises only account for a small share in these projects.

In Guangdong, there are nine reform pilots from the four batches of pilot programs, with locations in Guangzhou, Zhuhai, Shenzhen (two pilots), Zhongshan, Chaozhou, Heyuan and Jieyang (Figure 8.2). Most projects feature stakeholders with SOE and local government connections. The Jinwan East power distribution reform pilot project was an exemplary project selected in Zhuhai's first batch of reform pilots in November 2018. The project was implemented by the Jinwan East Power Supply Corporation which was jointly established by Guangdong Power Grid Corporation (a subsidiary of the South Grid), Zhuhai Huajin Development and Construction Corporation, and Zhuhai Jinhang Industry Investment Corporation. The latter two corporations are state-owned enterprises owned by the Zhuhai municipal government. The pilot project located at Jinwan district, Zhuhai city in Guangdong occupies a total area of 18.5 square kilometers. The industrial zone has developed two major industries, namely biopharmaceutical and medical devices, as well as aircraft manufacturing and maintenance.

Figure 8.2 Pilot Projects of Distribution Networks in Guangdong



In Xinjiang, 23 pilot projects were identified in four batches (Figure 8.3, excluding two projects that were canceled). Notably, a private enterprise -- Dongxu Lantian, a subsidiary of Tunghsu Group headquartered in Beijing, won the bid for the pilot project in Xinjiang Hefeng Industrial Park. It was selected out of the second batch of pilot projects announced by the NDRC and the NEA, and was the first pilot project in Xinjiang. According to sources from the Tunghsu Group, the company has obtained licenses for the sale of electricity from seven provinces, including Xinjiang, and has also deployed multiple energy projects in other regions of China. Hefeng Industrial Park occupies a planned area of about 67 square kilometers at the location where Tacheng, Altay and Karamay intersect. The area surrounding the park is rich in mineral resources, with over 100 billion tons in coal reserves, an estimated two billion tons of oil reserves, 30 billion cubic meters of natural gas, 1.84 billion tons of proven salt reserves, 2.3 billion tons of proven bentonite reserves, and 40,000 tons of beryllium oxide reserves. In addition, the area is abundant in copper, gold, iron, limestone and quartz sand resources. Thanks to its rich natural resource endowment, the industrial park is centered on industries such as the coal-powered chemical industry, coal-fueled metallurgy, the salt chemical industry, and petrochemical industry.

Power transmission and distribution are considered natural monopolies, i.e., only one power supply network is needed in a given business area; however, this does not mean that every area has to have the same provider. Multiple service providers can coexist in different areas. One of the objectives of distribution reform was to break the market monopoly on power transmission and distribution across China held by the two power grid companies. Understandably and importantly, the two industrial

monopolies have taken a rather passive approach to conforming with the new policies and collaborating with other stakeholders.

Several pilot project implementers even reported that the power grid companies had blocked access to key technical data and information in order to deliberately procrastinate the progress of these reforms ("guowang" 2020). The person in charge of a pilot project in Ankang city of Shanxi province reproached the State Grid for its reluctance for nearly two years to negotiate demarcation lines for power supply areas. "We recently had to complain to the relevant provincial authority and the issue is still not yet solved", according to an interview the pilot project lead gave to the state media (Su 2020). In terms of the division of distribution areas, in other projects, the grid companies reduced the geographical scope that was to be covered giving convenient excuses for these decisions, such as to avoid the need for more construction and to avoid there being multiple power supply providers (Wubuli 2019).

The dominance of SOEs and power grids runs contrary to the reform objective to liberalize the market and encourage effective competition. In October 2018, the NDRC and the NEA (2018b) disclosed in the official document "Announcement on the Progress of the First Batch of Pilot Projects for the Reform of Distribution Market" that the progress of the first batch of pilot projects was generally slow. The document points out that practices of local governments and power grid companies in key reform issues deviated from the objectives of the central government. The document also criticized grid companies for holding back some pilot projects in aspects such as the division of power supply areas and access to the transmission system.

To address the deviation in reform, the NDRC and the NEA (2019a) issued further instructions in January 2019 forbidding local governments and power grid companies from holding a dominant share in pilot projects. The central authorities stipulated that all pilot projects should be subject to an open bidding process to stimulate market competition in order to prevent local governments from intervening on decisions about project developers.

In response to the NDRC's criticism, the State Grid changed its attitudes towards reform, at least on the surface. It issued "Opinions on Further Supporting and Promoting the Reform of Distribution Market" in March 2020. The usage of words such as "support" and "promote" in this document contrasts with previous documents which clearly lacked enthusiasm for reform.

8.2 Power Distribution Pricing Policies

The most crucial policy with regard to distribution market reform is the pricing of distribution services. In 2017, the NDRC issued price-setting guidelines for distribution networks. In this publication, the user price is defined as the combined sum of the on-grid tariff, provincial transmission tariff, distribution tariff (of pilot projects) and fund and cross-subsidies. The guidelines also specify that end-user electricity prices in reform pilots should not be higher than the normal electricity prices directly accessed from power grids at the same voltage level.

There are, however, no detailed implementation methods specified in the guidelines. According to the guidelines, the relevant provincial authorities should determine their own pricing mechanisms upon consultation with enterprises in the electric power industry and industrial end users. Some provinces have carried out

open bidding as a pricing mechanism and have imposed a cap on the price for projects that are not selected in open bidding. Before the reforms, large industrial users in China needed to pay power grid companies a two-part tariff, which includes the actual electricity consumption and the user capacity, also known as “basic rate of electricity” (*jiben dianfei* 基本电费). One controversial issue was whether large industrial users should pay a flat rate based on user capacityto the distribution networks.

Provincial pricing authorities have given different solutions to this predicament. For example, Henan province proposed that distribution networks should pay power grid companies (transmission) a share of the basic tariffs charged to users according to the transmission vs. distribution investment proportion. Sichuan province has the strongest policy in that it stipulates clearly in an official document that the State Grid should not charge industrial users of the distribution pilot projects basic tariff rates (NDRC Sichuan 2018). Yunnan province instructs its provincial power grid not to charge industrial users of distribution networks basic tariffs exceeding 1.1 times the tariff rates paid by these users in the preceding year.

Based on the experience of some developed countries, the ratio of distribution investment to transmission investment is typically around 3:7 or 4:6, and the end-user tariff should also reflect this ratio. At present, the price ratio of power distribution and transmission of the State Grid and the Southern Grid of China is about 1:9, meaning the distribution price is limited to about 10%. The pricing structure greatly limits the profitability and development of new upcoming companies that participate in the reform pilots. Companies involved in the pilot projects also need to seek overall improvement in revenue by applying diversified business models such as distributed energy, energy conservation services, and charging and replacing facilities.

In Guangdong, the distribution price in pilot projects is set by the provincial pricing authority, except in the cases of Guangzhou and Shenzhen pilot projects, which are set by the authorized municipal governments. In November 2019, the Guangdong Provincial Development and Reform Commission issued the "Administrative Measures of the Guangdong Provincial Development and Reform Commission on Prices of Distribution Networks (Trial)." The policy document prescribes that the distribution tariff should be based on the rule of the "permitted income" method, and be subject to a price cap if the tariff is not established via a bidding process. Permitted income equals permitted costs plus permitted profit and tax.

Permitted costs include costs of depreciation and costs of operation and maintenance. The policy document also explains in detail the pricing method and settlement mechanism. It stipulates that enterprises running distribution networks (pilot projects) can independently choose between two settlement mechanisms, i.e., "category settlement" and "comprehensive settlement", for transactions with provincial power grid companies. In the "category settlement" mechanism, enterprises collect electricity charges from end users according to the categories that these users are in, based on the voltage level and user capacity, and then settle the transmission costs with provincial power grids. The type of users that adopt the "category settlement" mechanism are large industrial users, general industrial and commercial users, residential users and agricultural users. In the "comprehensive settlement" mechanism, enterprises shall pay transmission fees to provincial power grid companies based on the grid connection capacity and voltage level of the distribution network connected to the provincial power grid.

In Xinjiang, the autonomous region authority does not issue any specific policy document on the regulation of tariffs for distribution pilot projects, instead it included pricing rules in a general policy statement in April 2020 (Hu 2020). The document sets out that users of distribution networks shall be charged the transmission and distribution tariffs (including a one-time charge for costs of line loss) only once, thus avoiding the possibility of duplicate charges by both power grids and distribution networks. The document also states that the distribution networks are public utilities and the practice of making networks exclusively available to only certain users is strictly prohibited.

As is evident from both the NDRC guideline and the practice of provinces, transmission and distribution tariffs are two significant factors in the profitability of pilot projects. After the first regulatory cycle from January 1, 2018 to December 31, 2019 (Appendix 5), in January 2019, the NDRC began supervision work and review of transmission and distribution costs of power grid companies for the second regulatory cycle (2020–2022). It completed this work within the same year. Based on the published data covering the second regulatory cycle (Appendix 6), the regional differences in tariffs for transmission and distribution in China are still relatively large. On the whole, the price level of the Southern Grid is generally higher than that of the State Grid.

Electricity tariffs for electricity transmitted to the next voltage level includes the price of the preceding voltage level. This means the electricity price difference at different voltage levels in a region will directly determine the profitability of distribution pilot projects in a region. The greater the difference in the price of electricity at each voltage level, the more favorable the investment and the better the

profitability of pilot distribution projects will be. The NDRC guidance requires that tariffs set for distribution pilot projects cannot exceed the price difference between the voltage levels of transmission and regular distribution networks run by power grid companies. This requirement significantly limits the profitability of pilot projects because the price difference between the voltage levels of transmission and distribution networks for provincial grids is generally very low due to cross-subsidies.

There are generally three types of cross-subsidies in China: subsidies from users in more developed areas to users in less developed areas; subsidies from high-voltage users to low-voltage users; and subsidies from large industrial and commercial users to residential and agricultural users. The prevalence of extensive cross-subsidies means that the price difference between the voltage levels of power grids often do not reflect the actual investment costs. Hence, using the price difference between voltage levels of power grids as the price cap for distribution pilot projects often renders it difficult for the projects to generate sufficient profits. There are also electricity price differences at different voltage levels in different regions of China. In Guangdong and Xinjiang, the average price difference is around RMB0.02–0.03 per kWh, meaning the provinces are of lower investment value than other provinces such as Guangxi and Yunnan, which observe higher average price differences.

8.3 Reform of Inter-regional/provincial Transmission

While important load centers in more economically developed regions such as Jing-Jin-Ji Region (Beijing, Tianjin, and Hebei), the Yangtze River Delta and the Pearl River Delta are located in the south and east of China, resource- and energy-rich regions are mainly located in the central and western parts of the country. As

resource-rich regions are normally not able to consume all the power generated locally and economically more advanced regions are often short of power supply, inter-regional and inter-provincial transmission of electricity is considered by policy makers as one of the means to solve the economy–resource imbalance between the east and the west of China.

The West-to-East Electricity Transfer (WEET) Project, initiated during the 10th Five-Year Plan (2000–2005), was the first attempt at inter-regional transmission. The project is designed to bring investment and development to China's lagging western regions while satisfying the growing needs for electricity in the country's eastern provinces. In August 2000, then Guangdong governor Li Changchun required the central government to approve his proposal for Guangdong province to develop new power facilities with 10 million kW in generation capacity. Premier Zhu Rongji offered an alternative plan to build power capacity in Yunnan and Guizhou and then transfer power to Guangdong. When confronted with concerns from Guangdong local officials, Zhu allegedly said that he would resign if the task in Yunnan and Guizhou failed (Zhang 2016).

Over the years, the WEET project has continued to expand the electricity-generating capacity of western provinces, primarily through the construction of new coal-based generation and hydroelectric dams. In addition, China has developed a significant capacity in inter-regional and inter-provincial transmission. Power transmission has been expanded to form three major electricity transmission corridors that connect newly built generation capacity in the north, central, and south of inland regions to coastal regions of China.

With the subsequent expansion of renewable energies, trans-regional electricity transmission also facilitates effective large-scale integration of renewable sourced electricity into the grid. Some of the transmission projects were primarily built for the purposes of renewable energy integration, such as the 800 kV Hami–Zhengzhou ultra-high voltage direct current (UHVDC) project completed in 2014 to transmit power from Xinjiang to central China. During the 13th Five-Year Plan (2016–2020) period, the NDRC and the NEA (2018a) planned 19 new inter-provincial and inter-regional channels and 130 million kW of new transmission capacity, 70 million kW of which are from renewable energy.

Due to the expansion of transmission, inter-regional and inter-provincial power transmission is no longer primarily constrained by the physics of the transmission system, but rather by the political and economic interests of the importing and exporting provinces. In 2015, inter-regional/provincial power exchange reached 884.2 TWh, 15.9% of total electricity consumption nationally (NEA 2016a). The low level of inter-regional transmission is attributed to multiple factors such as local protectionism, incompatible system operation and distorted transmission prices.

Local protectionism is often seen as a result of the fiscal squeeze experienced by subnational governments in the course of economic reforms (Lee 2002). Following the 1994 tax reform, the tax sources of local governments shrunk significantly. Sales tax and customs duty are channeled to the central government. Corporate income tax goes to either the central or the local governments, depending on the corporation's affiliation. For example, income tax from centrally owned enterprises such as the State Grid and the Southern Grid is paid to the central government, and income tax from provincial-level state-owned enterprises such as the generation assets in

provinces is paid to the provincial government. Value-added tax was split between the central and local governments along a 3:1 ratio.[40] A large proportion of the resource tax goes to local governments, except that from oceanic resources and oil, which are collected by the central government. Due to the tax structure, the provincial governments have a strong incentive to ensure the profitability of local generation as well as of coal companies in order to retain local government revenue and local employment (Hurlbut, Zhou, Bird, and Wang 2017, p.8). In situations of economic slowdown, provinces are likely to have difficulty in paying for imported power from other provinces.

The system operation of China's power grids has also prevented large-scale inter-regional/provincial transmission. Although China has seven regional grids (six of which are synchronous grids, namely the Northeast Grid, Northwest Grid, North China Grid, Central China Grid, East China Grid, South China Grid, and Tibet Grid), grid operation and balancing is primarily done at the provincial level rather than at the regional level. The grid operators can only access baseload reserves within provincial boundaries and dispatch electricity accordingly (Qi, Liu, and Zhu 2018, p.18). Planned arrangements and provincial government negotiations are still the primary methods of determining the amount and prices of inter-regional/inter-provincial power exchange on an annual basis.

The administrative plans are relatively stable on a yearly basis with few short-term mechanisms for adjustment. Short-term inter-provincial trading is very limited, often used for emergency purposes only. Short-term inter-regional trading is almost

[40] The ratio has been adjusted to 1:1 since May 1^{t}, 2016 in the new round of tax reform.

non-existent. As a result, the inefficiencies in the annual administrative scheduling plan often cannot be adjusted in a timely manner (Hurlbut et al. 2017, p.6).

As the inter-provincial and inter-regional power exchange prices are set through central administrative planning and provincial government negotiation, the prices are very likely to be distorted and do not realistically reflect the supply and demand situations of the power market. The administratively set price is often higher than what the market price would be. In addition to the government-set portion of the inter-regional/provincial power exchange, some provincial governments negotiate partial market or market trading prices as well. In 2015, Guangdong and Yunnan agreed to offer their excess electricity in Yunnan, which is beyond the government-set plan for inter-regional transmission, for trading by public listing (*guapai jiayi* 挂牌交易), but the generators did not participate in the price negotiations. Instead, the provincial governments settled the price for them (NEA 2016b).

Some provincial governments extensively intervene in inter-regional and inter-provincial trading. According to the NEA's 2016 report, the energy administration of Jiangxi province set a quota for the Jiangxi Provincial Grid to import no more than 10 TWh of electricity, including the scheduled transfer from the Three Gorges Dam and Gezhou Dam that the central government had arranged. The provincial authority also requires Jiangxi Provincial Grid to seek its approval when the provincial power grid needs to import power. It even ordered the provincial grid to cancel the transfer of 733 GWh of electricity after a trading agreement had already been completed on the market (NEA 2016a).

The NEA report also highlighted the recurring difficulties of reaching an agreement on the annual contracts of inter-provincial transmission between provinces. For example, as of June 30, 2015, the relevant provincial governments still had not signed contracts for 2015 inter-provincial power transmission from Yunnan and Guizhou to Guangdong, and from Yunnan to Guangxi; a large portion of the inter-provincial power exchange went through without any contractual basis (NEA 2016a).

Being fully aware of the problem of market fragmentation and local protectionism in the power sector, the NDRC made reforming the inter-regional/provincial transmission a key task in its 2015 reform plan. As a supplement to Document No. 9, the NDRC (2015) issued a "Notice on Improving Price-Formation Mechanism of Inter-Regional/Provincial Electricity Trading and Related Issues" in order to break the bottlenecks of inter-regional/provincial power transmission. Similar to intra-provincial trading, the NDRC instructs power trading participants to utilize the market for inter-regional/provincial trading. It further directs that new generation projects for inter-regional/provincial trading should be selected through competitive bidding (NDRC 2015).

China established Beijing Electric Power Trading Center and Guangzhou Electric Power Trading Center in 2016. As national-level trading centers, they are designed to mainly realize inter-provincial power trading within the State Grid and the Southern Grid. In 2017, the Beijing trading center successfully achieved an inter-provincial power trading volume of 873.5 billion kWh, an increase of 10.6% over 2016. Market-based trading hit 272.3 billion kWh, accounting for 31.2% of total inter-provincial power trading within the State Grid. The same year, the Guangzhou trading center achieved 202.8 billion kWh in inter-provincial power transactions (WEET

project). 26.77 billion kWh of this were market transactions accounting for 13.2% of the inter-provincial power trading within the Southern Grid.[41]

Direct power purchase presents a channel for liberalizing inter-regional and inter-provincial power exchange. In the past, most direct power purchasing has been limited to intra-provincial trading, but thanks to the power sector reform since 2015 it became the preferred method for expanding inter-regional and inter-provincial power exchange (Bai, Liu, Ye, and Wang 2016). In 2016, the NDRC opened up regional transmission scheduling to direct power purchase for the first time, including the Yindong HVDC transmission line. There were 824 generation companies in four Northwest provinces and 30 industrial end-users in Shandong province that participated in market trading utilizing this transmission line, resulting in a 10% reduction of electricity prices for end consumers in Shandong (Caixin Energy2016).

Furthermore, the NDRC and NEA have led the work to re-evaluate the transmission and distribution tariffs for specified projects for power transmission across provinces and regions (kuasheng kuaqu zhuanxiang shudian gongcheng 跨省跨区专项输电工程), and published the revised tariffs for 31 specified projects. It is stipulated that the allocation ratio of benefits for tariff reduction will be 1:1 between the power-sending province and the power-receiving province. Benefits are allocated solely to power-receiving provinces for point-to-network transmission projects. Among the 31 specified power transmission projects, five reported a tariff drop of more than 8%. The Jinnan Jing project recorded the biggest decline, with a decrease of 24.31% (Appendix 7).

[41] Author's calculation based on data sources from Beijing Electric Power Trading Center and Guangzhou Electric Power Trading Center.

Cross-provincial Transmission from Yunnan to Guangdong

Guangdong is the main receiver of power from Yunnan province, and both Guangdong and Yunnan are managed by the Southern Grid. Thermal power and nuclear power dominate the power generation in Guangdong, while Yunnan is abundant in hydropower. Given that thermal power and nuclear power generation costs are relatively higher than hydropower costs, Yunnan's hydropower has the obvious advantage in price. In reality, electricity prices in Yunnan are among the cheapest in China, while those of Guangdong are among the most expensive. Power transmission from Yunnan to Guangdong thus makes economic sense.

In 2015, Yunnan's interconnection with Guangdong and Guangxi provinces consisted of 20.3 GW high-voltage transmission capacity and 10 GW of ultra-high voltage (UHV) transmission capacity. An additional 5 GW UHV was completed in November 2017 and 46 GW in total transmission capacity was targeted by the end of 2020 (Cheng et al. 2018, p.688). Despite growth in capacity in inter-provincial transmission, the quantity of electricity transferred has not been able to keep up with demand. In 2014, 87.7 TWh of electricity were transferred to Guangdong from Yunnan, accounting for nearly 40% of total generation in Yunnan and approximately 16% of Guangdong's consumption, meaning a 75% utilization rate of transmission line at the time (Cheng et al. 2018, p.688).

Yunnan provincial government signs a framework agreement with Guangdong government every five years to specify the annual quantity and price of electricity for the next five-year period. Before the market reform, the purchase prices stated in the WEET agreements between Guangdong and Yunnan were not always below the average of Guangdong prices. As Yunnan exports a fixed quantity of electricity to

Guangdong based on the yearly agreement, the exported power does not have to face competition from local power in the market. Therefore, there is no incentive for Yunnan to keep prices low. Moreover, due to the attributes of hydropower and varying climate conditions, Yunnan suffers from insufficient hydropower generation and faces power supply crunches in dry seasons, and is sometimes unable to fulfill the targets set in the bilateral agreement with Guangdong. Guangdong, on the other hand, needs to financially compensate idle capacity within the province which serves as backup power sources for dry seasons.

Following the market reform, additional quantities of power generation are allowed to be traded in the inter-provincial market so long as there is demand outside of the transmission agreement, although the transmission agreement still constitutes the largest share of inter-provincial trade. Market-oriented transactions have gradually experienced limited increases since 2015. As of 2018, Yunnan's installed capacity was approximately 88 GW, of which hydropower accounted for 71%. In 2018, the proportion of cross-provincial power transmission from Yunnan to Guangdong and Guangxi under the WEET project reached 52% of total generation. The generation was mainly concentrated in the summer months from May to October; electricity transmission during peak periods reached 72% of the total power transmission for the year (Xu, Ding, Liang, and Chen 2020). WEET project power transmission from Yunnan rose to 138 billion kWh in 2018, a yearly increase of 11%. In the same year, the cross-provincial and cross-regional market-oriented transaction volume was 15 billion kWh, of which 10.7 billion kWh was directed to Guangdong (Information Office of Yunnan Provincial Government 2018).

Several trading mechanisms have been used in market transactions. First, Yunnan generation companies are listed on the Guangzhou Power Exchange Market; they trade at a specific price that is deemed competitive in the market. Second, there is "thermal power replacement" between Guizhou province and Yunnan province, whereby thermal power scheduled for transmission from Guizhou to Guangdong is replaced with hydropower scheduled for transmission from Yunnan to Guangdong; this is done through market transactions. Guizhou generation companies can transfer their allocated power transmission volume under the WEET Project to Yunnan generation companies for a market-based compensation. Another form of market trading is for Yunnan generation companies to sell their generation contracts under the WEET Project to Guangdong generation companies. These trading mechanisms display a mixture of market and planned economy features. They can be understood as transitional forms of market development.

Despite progress, the electricity transmission from Yunnan to Guangdong is still dominated by negotiated deals, and the proportion of market-based electricity is small. Power transmission from Yunnan to Guangdong is mainly "point-to-grid" transmission, which means transmission is from power plants in Yunnan to Guangdong power grids. The Guangdong Power Grid Corporation, which is a wholly owned subsidiary of the Southern Grid, is the only purchaser of Yunnan electricity. Under the current market transaction mechanism, the power transaction price in the inter-provincial market is the arithmetic average of the monthly market-based transaction prices within the two provinces.

The power price in Guangdong during Yunnan's dry season is slightly lower than that in Yunnan, and that in Yunnan during the flood season is much lower than

that in Guangdong. Taking this fact into consideration, power traded from Yunnan to Guangdong is cheaper than power produced in Guangdong but only during Yunnan's flood season, which is normally from May to October. In dry reasons, Yunnan electricity enterprises lack competitiveness in cross-provincial market transactions. In addition, market-oriented trading between the two provinces was only organized for deals with relatively longer terms. The frequency of transaction is unable to match the prediction accuracy for clean energy power generation capacity, resulting in lags to actual clean energy demand.

Cross-regional Transmission from Xinjiang to Other Provinces

Due to the remoteness of its location and the relatively early-stage of economic development, the power grid in Xinjiang operated for many years as an isolated grid. Yet, as Xinjiang is a large energy resource base for China, the central and Xinjiang governments explored the possibility of starting cross-regional power transmission. In 2010, Xinjiang was finally connected to the Northwest power grid through a 750 kV channel, ending the history of its isolated grid operation. In subsequent years, three more transmission channels were completed, connecting Xinjiang to central, eastern and southern China. Similar to the WEET project, cross-regional power transmission was regarded as an important measure to help balance regional inequality in economic development.

Another motivation to promote cross-regional transmission from Xinjiang to the inland is that Xinjiang has experienced serious overcapacity in power production in recent years. The imbalance between power supply and demand has been prominent in Xinjiang. By the end of 2016, Xinjiang's power grid had an installed capacity of 81 million kW, while the power grid maximum load ability was only

28.05 million kW. As of mid-2016, wind power and solar PV power in Xinjiang reached 17 million kW and 8.77 million kW in cumulative installed capacity, respectively, accounting for 30% of Xinjiang's total installed power capacity. At the same time, the wind curtailment rate reached 43.9%, and the solar power curtailment rate was 31.8%, both of which hit a record high (Liu 2016).

In order to overcome the overcapacity problem, the authority of Xinjiang autonomous region proposed two cross-regional transmission plans known as "transmitting power from Xinjiang" (*Jiangdian waisong* 疆电外送) and "supporting Xinjiang by buying electricity" (*dianli yuan jiang* 电力援疆, "supporting Xinjiang" thereafter). Both plans were implemented based on bilateral negotiations with counterpart provinces. The former plan is part of the national five-year plan and is coordinated by the State Grid, and the latter is an initiative of the Xinjiang authority in collaboration with other provincial authorities.

Xinjiang has long been a major target region of the "counterpart support" scheme (*duikou zhiyuan* 对口支援), a policy initiative of the central government whereby the economically developed or stronger provinces provide assistance to the economically underdeveloped or weaker provinces. Many provinces decided to import electricity from Xinjiang and signed bilateral agreements with the Xinjiang government. Some of these provinces are in genuine need of additional power supply, while others that are far away from Xinjiang symbolically purchased electricity as a gesture of support. In a workplan published by the Xinjiang authorities, the "supporting Xinjiang" scheme set a target to negotiate 20 billion kW/h of electricity sales toother provinces (Appendix 8). Yet the actual completed transmission was only 7.78 billion kW/h in 2017 (Du 2018).

Similar to the case for Yunnan – Guangdong power transmission, government negotiations were the main method of determining prices and quantity of cross-regional power transmission from Xinjiang. Market-based transmission accounts for only a fraction of all power transmitted. The Beijing Power Exchange documented only 10 listing transactions and 2.8 billion kW/h of market-based transmission from Xinjiang as of the end of 2016 (Lv and Zhang 2016).

The scale of cross-regional transmission showed steady, albeit slow, progress in subsequent years. In 2019, power generation totaled 71.24 billion kWh and exchanges occurred with 19 provinces. Power transmission under the "supporting Xinjiang" scheme hit 16.79 billion kW/h the same year (Chen 2020). The target surpassed 100 billion kW/h for overall cross-regional transmission in 2020. Market-based transmission also expanded with the overall growth of cross-regional transmission. Currently, 19% of total power produced in Xinjiang is transmitted to other provinces.[42] With the completion of four major cross-regional transmission power grids, Xinjiang now has the capacity to generate large surpluses of electricity, meaning theoretically, there is still a large potential for further expansion of cross-regional transmission.

In comparison to Yunnan – Guangdong transmission, both regional and provincial marketization in the power sector is still generally less developed in Xinjiang. This demonstrates that the overall level of economic development may affect the degree of marketization. The degree of marketization is also largely associated with the degree of fragmentation in management responsibilities of governmental bureaucracies. Xinjiang's power sector is far more fragmented than

[42] Author's calculation based on statistics from China Electricity Council.

most other Chinese regions; this is evident in its large number of captive power plants that are run independently by sub-regional governments.

8.4 Conclusion

Reforms in both power distribution and transmission have displayed mixed results, indicating that conflicts of interest among different stakeholders impeded the pace of reforms. Provincial and local governments largely aim to lower electricity prices through power distribution reform in order to promote local economic growth, contrary to the objective of pilot distribution networks to achieve higher profitability. Conflicts of interest are evident in the tensions between project investors and power grid companies with monopolies in the sector.

Prices for pilot distribution networks are calculated by the price difference of transmission between different voltage levels. This price difference does not reflect the real cost of power transmission due to factors such as cross-subsidies. In the wake of the continuous reduction of electricity prices for industrial and commercial users, the price difference, which is also the source of profit for distribution networks, is often not able to cover the cost of the pilot distribution networks. Power grid companies in many places still treat investors in pilot distribution networks as end-users.

Low levels of profitability, and at times the losses incurred, have made new projects less attractive to investors and slowed the reform momentum. Moving forward, the progress in reform will be contingent on how the general pricing mechanism for power transmission can be rationalized, and on how major stakeholders, that is, project investors, local interests represented by local

governments, and power grid owners, can find a common ground to balance their interests.

Conflicts of interest are also apparent in the reform of cross-regional power transmission. Provinces that are involved tend to give priority to local enterprises in order to secure the most favorable conditions. A large part of cross-regional power transmission is initiated centrally as administrative directives. More often than not, the provinces prefer to negotiate to reach a compromise instead of seeking market solutions. In the current dual-track system, electricity prices are not fully determined by market trading, which results in distorted prices and a lack of incentive for investors.

China's cross-regional and cross-provincial power transmission is mainly based on mid- to long-term transactions. At present, spot trading is piloted as a very small part of cross-regional power transmission. Market barriers between provinces and the lack of a market mechanism in price formation are key issues. There has been no obvious breakthrough in the province-based scheduling mechanism. In medium and long-term trading, power generators list the predetermined volume of electricity to be transmitted, while end-users are mainly represented by provincial power grid companies acting as single purchasers. As market information is non-transparent, power generation companies and end-users are in a weaker position than single purchasers. In other words, a planned economy still persists in cross-regional transmission.

The new round of power system reform is mainly implemented by provincial entities, reinforcing the management functions of the provincial government in the power sector and policy fragmentation So long as provincial governments negotiate

major transactions between provinces, government intervention is inevitable. Both case studies demonstrate that provincial governments play prominent roles in cross-regional power transmission deals. As producers and consumers in regional markets are isolated by institutional market barriers, most of the current cross-provincial and cross-regional transactions are not real market transactions.

Chapter 9 Conclusion

9.1 The Puzzle of Provincial Power in the Era of Recentralization

Many observers of Chinese politics believe that the political importance of local actors, including Chinese provinces, have been fading under President Xi Jinping's recentralization of political authority after he took power in 2013 (Li 2016, Fewsmith 2018, Economy 2018). Some even claimed that "…we can say goodbye, for now, to the era of decentralization" (Ahlers 2018, p.263). However, this dissertation on the study of China's electric power sector demonstrates a relatively different and nuanced picture.

In the electric power sector, provinces have gained greater autonomy over investment and planning as well as pricing and trading. Provincial control within their borders is the main barrier that impede cross-regional power transmission. The case of China's electric power sector proves that provincial authorities have not necessarily weakened while the central Party-state apparatus has strengthened in specific political and even economic terms. Policy outcomes display more similarities than differences in the two provinces studied, i.e., Guangdong and Xinjiang, in spite of their huge difference in many other aspects economically. It is argued that the central–provincial relations are the common denominator in the two cases that explains the similar policy outcomes.

Indeed, amid the wave of the seemingly political recentralization, Chinese provinces continue to retain their capacity of governance and influence in economic and industrial policymaking in a fundamental way. Scholars of China studies generally agree that China's decision-making model is based on consensus,

particularly when it involves creating significant national economic blueprints (He 2018, p.11). The question is how and why a consensus could be built if central and local actors have different policy preferences in a specific institutional setting. This chapter discusses the dynamic of Chinese central–provincial politics from a theoretical perspective.

Actor-centered institutionalism (ACI) provides a descriptive language for identification of factors that influence policy outcomes and explain similarities and variances in policy outcomes in different cases. Institutions are treated as a set of factors affecting the interactions among policy actors. ACI integrates action-theoretical and structural paradigms. Combining rational-choice and sociological insights, ACI regards actors' preferences as having a broad existence formed by both their subjectively defined (material) interests and by their normative and cognitive orientations (Scharpf 1997, pp. 19–22). The framework thus parts ways with reductionist understanding of actors as self-interested utility-maximizers, and seeks to lend an enhanced theoretical and analytical corporeity to actors.

Actors are intentional and they respond differently to external situations as they differ in their capabilities, intrinsic perceptions and preferences, which are also, to a large extent, shaped by the specific institutional settings. It thus entails the need to differentiate distinct dimensions of analysis. By analyzing the perceptions and policy preferences, capabilities of central and provincial actors, as well as their modes of interactions, the policy process of market reform in China's electric power sector and drivers of policy change can be dissected.

9.2 The Effects of Institutions

The ACI framework defines institutions as "systems of rules that structure the courses of action that a set of actors may choose" (Scharpf 1997, p.38). Similarly, rationalists regard institutions as "shared concepts used by humans in repetitive situations organized by rules, norms, and strategies" (Ostrom 1999, p.37). According to the sociological point of view, institutions are "formal and informal rules and procedures, routines, norms and conventions, embedded in the organizational structure of the polity or political economy" (Hall and Taylor 1996, p.938).

By rejecting the assumption that institutions determine actors' preferences and behavior, it does not imply that the ACI framework disregards the various ways in which institutions influence the actors. This section discusses the three dimensions of institutional effects: the actors' constraints on permissible policy options, defining the actors' constellations and modes of interaction, and provision of structure to actors' incentives (Scharpf 2000).

First, formal rules tend to constrain actors on permissible policy options and discourage them to pursue policy objectives that are clearly conflicting to institutional rules. Central–provincial relations constitute a major institutional factor that affects the policymaking process in the electric power sector. Due to China's authoritarian political system, the central government has the authority to define the direction, the scope and the objective of the electric power sector market reform. In other words, the central government formulates the general rules and method of implementation of the market reform. While provincial governments possess some bargaining power in policymaking and have the maneuvering space in policy implementation to make

adjustments that work to their advantage, they cannot openly disobey the central directive and resist the market reform.

Second, institutions tend to place the constellation of actors participating in policy processes into structure, and this facilitates the identification of relevant players and their permissible modes of interaction. A collective/composite actor is a relevant unit of analysis in ACI framework (Scharpf 1997, pp.53–5). Composite actors refer to those organized groups and administrative bodies that are capable of intentional action to achieve a common purpose through collectivized resources and normative orientations. Although individual members within a composite actor may have differing preferences, the composite actor regularly reached common policy goals upon consensus-building within the organization. In the context of Chinese politics, it is a normality and political fact, rather than a rarity, that composite actors have common policy goals to achieve. Therefore, composite actors such as the National Development and Reform Commission (NDRC), the provincial governments and the centrally controlled state-owned enterprises (SOEs) are the starting point of analysis instead of individuals within these organizations.

Scharpf points out the scenario of some institutional settings in which actors with formal "veto positions" form a multiple-actor constellation (Scharpf 1997). Although provincial actors in the Chinese political system do not possess formal "veto power", the power sharing, especially in economic governance, is institutionalized and their bargaining power can be understood as an informal "veto power" in policymaking. Hence, provinces are indispensable strategic actors in a multiple-actor constellation.

Third, institutions constitute the "structure of incentives" that increases or

decreases the payoffs associated with the given strategies, and thus affecting self-interested actors' probability of adopting the strategies (Scharpf 1997, p.39). Promotion opportunities provide the most attractive political incentive for provincial cadres to carry out market reform. Appointments, promotions, and demotions of subnational officials in China are ultimately determined by the central government, and their career paths are tied to the performance of their jurisdiction (Xu 2011, p.1093). In order to climb the bureaucratic ladder, lower-level cadres compete with each other in some sort of "promotion tournament" (Zhou 2007) to achieve better performance in terms of economic development and social stability, upon which the evaluation are mainly based.

9.3 Actor Preferences, Capabilities and Modes of Actor Interactions

Actor Preferences

One attribute of the ACI framework is that it treats actors' preferences as a theoretically distinct category from the institutional conditions in which they are embedded (Scharpf 2000, p.771). An actor's preferences are the way it orders the possible outcomes of an interaction. Scharpf categorizes actor preferences into two dimensions: organizational self-interest and internalized normative obligations and aspirations. The organizational interests in "survival" are to ensure adequate organizational resources, defend organizational autonomy and achieve competitive success.

By and large, provinces prefer to implement policy options that generate more local revenue as key organizational resources. The 1994 tax-sharing reform raised the central share of total revenues and correspondingly lowered the local share, leaving

most local governments in fiscal shortages. Meanwhile, local governments are expected to be the main providers of public service such as education, health care and infrastructure construction. Therefore, securing more local revenue to sustain local development becomes the top priority and major concern of local governments.

In the electric power sector, promoting local enterprises' generation capabilities would help generate more local revenue than importing electricity from other provinces. Maintaining low electricity prices would also help local industrial enterprises to remain competitive and consequently generate more local revenue. Provinces' propensity for higher local revenue thus serves as a strong explanatory variable for the differentiated policy outcomes in different policy areas. Actor preferences also serve to explain how localism in capacity expansion in individual provinces would have an accumulative effect on the overall nationwide overcapacity problem.

Provinces also prefer to adopt policy options that allow them to obtain greater organizational autonomy, compared to the central government's propensity for a more balanced and coordinated regional development. A strengthened local capability in planning and investment projects, and a sustainable provincial electricity market could contribute positively to local economic autonomy. By contrast, cross-provincial transmission and regional market-building would more likely weaken local economic decision-making power, thus are thus less favorable as policy options.

Actors have preferences to achieving self-interests, but they are intertwined in many situations with other preferences and norms concerning appropriate actions and outcomes. Besides rational organizational self-interests, institutional and cultural norms have strong effects on the preferences and cognitive orientations of actors.

From a sociological perspective, institutions encompass not only formal rules but also informal, common, and taken-for-granted cultural frameworks, scripts, and cognitive schemes (Jepperson, 1991). Institutions, in this sociological sense of social norms, shape the value orientation and preferences of actors.

The dominant Confucianism in Chinese traditional culture embraces the ideology of *tianxia* (天下, all under heaven), an abstract notion embodying the idea of a superior authority that guided behavior in a civilized world (Wang 2013). The notion is regarded as a moral, cultural and political establishment deeply rooted in Chinese history. It provides a philosophical foundation for Chinese cultural identity and national unity. Based on this notion, centralism had always been upheld as a strategy to strengthen the imperial authority throughout ancient Chinese history. In the modern era, the century of humiliation by foreign invasion and occupation further deepened China's national awareness of cherishing national unity and integration.

With such a cultural value, local officials are required to think with the "big picture" in mind (*daju guan* 大局观). Institutionalized expectations have created "common knowledge" of which actors take action. The coordinated national development (*quanguo yipan qi* 全国一盘棋) norm becomes a political doctrine and standard under central advocacy. Accordingly, despite Xinjiang's remote geographic location and high cost of long-distance transmission, other provinces have little difficulty in accepting the central measures of exporting Xinjiang's electricity which is aimed at balancing regional development. Depending on the transmission and on-grid-tariffs, these provinces may receive few economic benefits from the cross-provincial transmission projects than with local production, but their perceptions of the "big picture" dictate their policy choice.

Actor Capabilities

Although institutions constitute a certain decision environment for actors and often indicate the actors' preferences and perceptions, they are by no means able to determine the outcome of a decision. There is little use to gain an understanding of actors' perceptions and preferences if actors have no influence in the policy process (Scharpf, 1997, p.10). Capabilities of actors are what enable them to "play the real game."

The discussion on actor capabilities of central and provincial players covers four dimensions, namely administrative authority, authority of personnel control, financial capabilities and access to information. The center displays strong capabilities in controlling and allocating administrative authority. Administrative authority refers to the government's power to manage public affairs and provide public services. Except for foreign affairs and national defense which the central government has exclusive authority over, the Chinese Constitutional Law does not clearly define the administrative responsibilities of governments at different levels.

Administrative power is commonly shared by both the horizontal and vertical line of bureaucracies (the "tiao-kuai" arrangement), i.e., departments of lower-level governments are responsible to both the central ministries in the vertical line and provincial governments in the horizontal line. Although there is no clear division of administrative authority, the Constitution bestows the central government the ultimate power to delegate power to provinces and also to rescind this power. In other words, the State Council has the authority to alter the specific division of administrative jurisdiction and government functions between the center and the provinces according to specific circumstances.

While the center did indeed initiate the decentralization process to incentivize the sector reform, provincial and lower-level authorities may not use their new powers in the manner that central leaders envisaged. Sometimes, local authorities distorted the objectives of central reforms for their own end. (Breslin 1996, p.696). Such cases always lead to central intervention. In the electric power sector, the retrieval of some administrative authority from the provinces has occurred multiple times. The "traffic light system" of monitoring and restricting coal power capacity expansion is exemplary of how the central government reclaimed its administrative authority from provinces.

In terms of the authority in personnel control, the retention of central control over important personnel decisions through the nomenklatura system is contended to be the most significant instrument of Party rule in China (Burns 1989). In practice, the central government makes decisions on appointment and removal of provincial leaders (Xu 2011). Moreover, reshuffling and cross-region rotation of regional leaders is another common practice to maintain central control (Xu 2011).

Despite the central capability and dominance in administrative authority and personnel control, provincial actors still have maneuverable space in some crucial and high-priority issues. In economic governance, the power of provincial actors largely comes from their financial capabilities. Before the monumental 1994 tax-sharing reform, the central government was mired in serious fiscal crisis. The lack of funding and investment in infrastructure that includes the electric power industry had given provincial authorities opportunities to gain a solid foothold in the industry, thus guaranteeing their status as the basic structural units of the industry. Since then, provinces as functional entities (*sheng wei shiti* 省为实体) remained as the

fundamental organizational structure of the industry.

The 1994 reform reclassified taxes into the central tax, the local tax and the shared tax to increase source of tax revenues for the central government. However, central fiscal expenditure did not expand as rapidly as the increase of central fiscal revenue (Zhang 2010), and provinces remain the major investors of infrastructure projects. Based on the "whoever invests will benefit" (*shui touzi shui shouyi* 谁投资，谁受益) principle specified by the central authority, provinces naturally wield significant influence over the electric power industry within their territory.

As provinces account for an ever-increasing share of investment in generation capacity since the mid-1980s, the break-up of generation from the previously centrally controlled and vertically integrated industry became possible in 2002. On the other hand, provinces' dominance in generation vis-à-vis transmission and distribution by the central SOEs had created an imbalance in the industry and led to serious coordination problems. The central initiative in its previous reforms to build regional markets in order to overcome the imbalance had failed miserably due to the segregation of markets based on provincial borders. Learning from past mistakes, the 2015 reform reinstated the central status of provinces and they have been delegated policy choices related to implementation and resource allocation.

Actors' access to information is another aspect of actor capability that requires attention. The ACI framework is grounded on the assumption of bounded rationality of actors, i.e., actors are intendedly, but only limitedly, rational because information search is costly and the information-processing capabilities of human beings are limited (Ostrom 2011). The information that actors collect is dependent, to a certain degree, on the "specific knowledge and ignorance shared among actors in

institutionalized interactions" (Scharpf, 1997, p.62). By and large, central authorities have less access to information in regard to local situations, compared to provincial authorities. Information asymmetry between the higher and lower levels of governments often means that actors at the subnational level may behave opportunistically.

Opportunism—deceitful behavior intended to improve one's own welfare at the expense of others—may take many forms, from inconsequential, perhaps unconscious, shirking to a carefully calculated effort to defraud others with whom one is engaged in ongoing relationships (Ostrom 2011). The common Chinese saying "the center has policies and the local has counter policies" (*shangyou zhengce xiayou duice* 上有政策，下有对策) perfectly summarizes such opportunistic behavior. Collusion among local governments is also identified in response to less favorable orders and policies from higher authorities (Zhou 2010). As illustrated in the previous empirical chapters, the case of the 49 MW wind power projects to circumvent central regulations serves as an exemplary of the opportunism and collusion by subnational governments.

With incomplete information and imperfect information-processing capabilities, actors may make mistakes in choosing strategies designed to realize a set of goals (Ostrom, 2010). The failure of past reform in the electric power sector to build regional market was mainly attributed to the wrong strategies that central policymakers employed to wrestle provincial authority in policymaking. However, actors may, over time, learn more complete and reliable information, especially in situations that happen repeatedly and those that generate reliable feedback. Actors can then adopt strategies that result in higher returns. Information asymmetry may also

cause delay in policy reactions from the higher level in many issues. For instance, the center was alerted to the coal power generation problem only after the situation exacerbated in severity.

Modes of Actor Interactions

Chinese central–provincial relations are interdependent relationships characterized by interlocking goals—both parties rely on each other to accomplish their goals. Their interdependence in achieving goals forms the basis of the social interaction between them (Lewicki, Saunders and Barry 2003, p.7). Of the four modes of actor interactions that Scharpf categorizes, hierarchical direction and negotiated agreement most frequently occur in Chinese bureaucratic politics. While the center takes unilateral action in foreign affairs and national defense, such approach does not apply to economic decision-making as it relies on the provinces for policy implementation. Nevertheless, the provinces have no political power to openly disobey central directives.

In democratic societies, negotiation plays a critical role in policymaking. Even in an authoritarian system, negotiation is a main component of national policymaking processes from agenda setting to determining the issues to address, exploring options, and finding solutions. Distinguished American statesman and negotiator Henry Kissinger defines negotiation as "a process of combining conflicting positions into a common position, under a decision rule of unanimity" (Kissinger 1969). In fact, behind-door negotiations are so prevalent in Chinese policy processes at all levels that David Lampton (1987) dubbed the system a "bargaining treadmill."

It is therefore important to understand under what conditions the actors choose

certain modes of interactions and what their strategic tactics are in negotiations. In the three policy areas studied, a mixture of hierarchical direction and negotiated agreements is observed. Negotiation is the prevalent mode of interactions in central–provincial relations. However, if subnational actors manifest deviant behaviors and if unexpected policy outcomes such as overcapacity problem happen, the center will demand the provinces to adhere to the central orders as a defense mechanism to maintain the relations it prefers with no room allowed for bargaining.

Negotiation is often regarded a learning process in which parties react to each other's concession behavior (Zartman 1978). Parties use their bids both to respond to the previous counteroffer and to influence the next one; thus, the offers themselves become an exercise in power (Zartman 1978). In the process of interactions, institutions are not only periodically contested, but are also subject to ongoing skirmishes as actors attempt to achieve an advantage by interpreting or redirecting institutions in pursuit of their goals, or by subverting or circumventing rules that clash with their interests (Maggi 2016, p.21). Walton and Mckersie (1965) created a theoretical framework to study approaches to negotiation, in which negotiations are conceptualized as either distributive or integrative in nature.

Integrative bargaining is the interaction in which both sides know they could be better off if they both cooperate. In such situation, the interests or objectives of the actors are related and not mutually exclusive; hence, values claimed by one party are not necessarily at the expense of the other. The parties negotiate to create or generate values and make a joint effort directed at finding a solution that will be perceived as beneficial to both parties. Both sides believe in a potential win-win scenario in which they can achieve mutual gains beyond what they could achieve independently.

In integrative negotiations, “if one side achieves its goals, the other is not necessarily precluded from achieving its goals” (Lewicki, Saunders and Barry 2003, p.113). Neither of the actors can unilaterally pursue their goals without considering the interests and concerns of the other. As integrative approaches use objective criteria, and seek to create conditions of joint decision-making and mutual gains, they involve finding mutual interests and commonalities, emphasizing the importance of information exchange between parties, and problem-solving,

Distributive approaches to bargaining, in sharp contrast to integrative approaches, frame negotiations as interactions of a zero-sum game. Integrative theories and strategies, instead, look for ways of creating values, or “expanding the pie”, which differ from a zero-sum game that sees the goal of negotiations as an effort to claim one's share over a “fixed amount of pie.” Distributive negotiation is regarded as a competitive/win-lose situation in which the interests or objectives of the parties are mutually exclusive. Therefore, any gain by one party in the negotiation is at the expense of the other. As such, negotiations require agreements as to how shares of scarce resources should be allocated.

Integrative bargaining is highly likely to happen in conditions of a continuing, open-ended relationship than a fixed short-term relationship. According to Axelrod (1984), in a short-term relationship, each interaction is effectively a single-shot prisoner's dilemma game, whereby one party may as well defect in all cases, because even if one cooperates, there is no way to prevent the other player from exploiting the gains. But in iterated interactions, the value of repeated cooperative interactions can overwhelm the benefit/risk of a single exploitation. Curiously, rationality and deliberate choice are not essential in reciprocal cooperation, nor trust nor even

consciousness (Axelrod 1984, p.18).

Integrative and distributive approaches are ideal types for analytical purposes. “In short, the bargaining process is too complex, and too fluid to be contained within a rationalistic game-theoretic framework” (Martin 1992, p.20). In reality, mixed bargaining is the common mode of actor interaction which contains both integrative and distributive elements. When the center and provinces engage in open-ended relationships and repeated games, the gain or loss sustained in one round of the game at the time does not necessarily equate to the ultimate “win or lose.” In essence, there need not be winners and losers in Chinese central–provincial relations. In many circumstances, all parties could gain and one cannot be better off if the other loses.

While actors that have identical interests rarely exist, it is however possible that they expand their areas of interdependency and identify integrative tendencies in mixed bargaining. In the Chinese electric power sector, central and provincial policymakers interact via typical integrative bargaining in industrial planning —i.e., the center and provincial NDRC undergo intensive rounds of dialogues based on the principle “two-ups and two-downs.” In regard to investment approval, both the central and provincial sides reached a consensus to taking the decentralization path, and provinces are able to broaden their authority in supervising most infrastructure projects in power grid and power generation. More importantly, enhanced local autonomy is not at the expense of weakening central authority.

For electricity trading and pricing policy, both central and provincial authorities commit to enlarging the “pie” of the electricity market, hence creating integrative situations for common actions and problem-solving. By contrast, cross-provincial transmission and distribution market reform progressed very slowly and the

market “pie” was “not well baked.” Although provinces accept the administratively negotiated prices for cross-regional transmission, they regard such arrangement as some sort of “sacrifice” in order to contribute to national development.[43]

When the task is to secure the biggest slice possible of a proverbial market “pie”, “salami tactics” are often deployed in distributive bargaining. Such actions include prolonging a policy process to a painstakingly slow pace, thus only giving a very small concession to the other side when it can no longer be avoided in order to placate the other side for a little while longer (Saner 2005). As discussed earlier, some provinces displayed procrastinating behavior in the market reform of distribution market although the central authority demands that at least one pilot project must be established in every Chinese prefecture-level city. The failure in building a regional market in the 2002 reform was also due to similar reasons such as provincial resistance.

Both integrative and distributive bargaining tactics entail manipulating utility parameters to influence the other party’s perceptions of the utilities associated with different policy options. A distributive scenario can also be turned into an integrative scenario depending on the changes made in the policy preferences of the relevant parties, a process which is defined as “attitudinal structuring” (Walton and Mckersie 1965). In the 2002 market reform, provinces perceived the share distribution of total utility negatively because the goal of the reform was to build a regional market and the provinces were unwilling to give up local interests. Compared to the 2015 reform, both central and provincial authorities recognize an integrative potential when they agree that there should be a refocus of the reform priority to designing and building

[43] Personal interviews in Xinjiang, May 2017.

the provincial market instead of regional market.

9.4 Explaining Policy Changes

In the erstwhile management system before market reforms, investment, production and distribution of electric power were controlled and led exclusively by multilevel administrations, and most of the sector-related decisions were established and implemented by provincial governments. Following the two rounds of market-oriented reforms that the central government initiated in the sector in 2002 and 2015, the sector has been under the dual influence of administrative planning and market forces. So far, the market-based pricing mechanism still has limited impact on the sector. It is foreseeable that the dual-track system will continue for some time; however, the market's role will become increasingly salient over time with the expansion of market-oriented transactions in the electric power sector. This study takes a gradualist perspective of institutional change for an enhanced understanding of how small changes could lead to big shifts, in order to explain how the sector has evolved into a dual-track system. As Thelen (2004, p.293) forcefully argues,

> Formal institutions do not survive long stretches of time by standing still. The language of stasis and inertia is particularly unhappy because as the world around institutions is changing their survival will not necessarily rest on the faithful reproduction of those institutions as originally constituted, but rather on their ongoing active adaptation to changes in the political and economic environment in which they are embedded.

Actor centered-institutionalism recognizes that different actors are central to the policy process as they negotiate to produce acceptable outcomes. Institutional change could be due to a complex process of actor-centered bargaining activities and not solely because of the logic of either appropriateness or consequences. Changes

may originate from a redistribution of power and resources between key actors and/or the change of actor preferences and perceptions. From an actor-centered perspective, institutional change depends on the capability of the involved actors, and more importantly, whether they are willing to promote changes.

In the Chinese policy process, central and provincial policymakers adopt strategies characterized by incrementalism—what Lindblom refers to as "successive limited comparisons." According to Lindblom (1959 and 1979), as actors have limited capacities to gather and process information and they recognize that there are uncertain consequences associated with their choices, they need to "muddle through" the policy process by serial search and repeated attacks on the same problems. Policy goals are constantly readjusted in response to changing conditions and new information in the interactive process dealing with other actors. Actors' adaptive capacity contradict the proposition that decision-makers take consistent, anticipatory and goal-directed actions to meet well-articulated objectives based on complete information (Zhou et al. 2013).

As is observed, the reform process of the electric power sector often involves repetitive adjusting of policy objectives and implementation methods. As aforementioned, policy goals had shifted from establishing regional markets to setting up provincial markets; policies on investment and price control also changed constantly alongside the imbalanced demand and supply cycles of the electric power sector. The purposeful trial-and-error approach of policy experimentation (Heilman 2008) simulated institutional change in major domains of the sectoral reform to transform existing and sometimes deficient institutions.

Moreover, actors' decision-making could have other effects than those

originally intended and that would sometimes lead to institutional change. In some cases, institutions designed for a sole purpose may have different or even opposite effects. For example, decentralization, which was designed to overcome investment shortage in the sector, had created a situation of unequal dispatch and competition among generation companies of different ownership since the1980s. Tension among the power producers intensified and eventually led to the separation of generation from transmission and distribution in 2002.

At first sight, policy measures of the sectoral reform may seem drastic and transformative, and according to Peter Hall (1993)'s definition of third-order policy change, they resemble a paradigm shift from planning economy to market economy. Thus, the "punctuated equilibrium" concept (Baumgartner and Jones 1991, 1993, 2002) may fittingly explain the landmark emergence of "Document No. 5" and "Document No. 9" that induced the market mechanism. There also appeared to be a strong link between the reform and the exogenous factors and external shocks such as macroeconomic growth cycle and international financial crisis.

Nonetheless, upon closer examination of how China's electric power sector evolved from a vertically integrated planning system into a semi-fragmented dual-track system instead of a purely market-oriented system, China's policy approach can be more accurately described as marginal adaptation or disjointed incrementalism. In short, institutional change is gradual and piecemeal, with most component parts remaining intact, even during a "critical juncture." As is argued by Thelen (2004, p.31), "elements of stability and change are in fact inextricably intertwined."

9.5 The Implications of the Chinese Case for Energy Transition Literature

Energy transition has become one of the most influential aspects in studying socio-technical changes (Moss and Galling 2016) and also a popular topic in many fields of studies. O'Connor (2010) defines energy transition as "a particularly significant set of changes to the patterns of energy use in a society, potentially affecting resources, carriers, converters, and services." The politics of energy transitions has been studied in multiple theoretical paradigms including critical theory and post-structuralism. This dissertation aims to contribute to the institutionalist perspective of energy transition research, and adopts a relational approach to emphasize the role of strategic agencies.

The transformation of China's electric power sector reaffirms the significance of agency in the creation, stabilization and reproduction of institutions that shape energy transitions. Energy transitions are also characterized by alternating periods of fast and slow changes, forming a distinctly non-linear process (Rotmans and Loorbach 2010). Similar to energy transitions of other economies, China's energy transition is also "path dependent rather than revolutionary, cumulative rather than fully substitutive" (Sovacool 2017).

Some literature on the politics of socio-technical transitions contend that transitions involve contestation between and within coalitions of incumbents and challengers, which result in policies that benefit particular actors (Betsill and Stevis 2016). The multilevel perspective (Rip and Kemp1998; Geels 2002; Geels and Schot 2007) seeks to understand niche innovations of challenging actors that deviate substantially from existing socio-technical regimes, which are influenced by socio-

technical landscapes. The multilevel perspective tends to show a bias towards "bottom-up" innovations and emphasize the public–private linkage in market terms in shaping social actors' behavior.

The reform in one of the most important facets of its energy system, i.e., the electric power sector, demonstrates that China's energy transition process is largely driven by the state, rather than by the market and that both central and provincial political actors played crucial parts in initiating and sustaining the transition process. Besides, the concepts of challengers and incumbents do not accurately portray the Chinese actors in the electric power sector reform. New actors are incorporated into the system with exiting actors in order to "stir up the still water" and create new interests, but they are not necessarily challengers.

Despite their contestations from time to time, the newcomers and exiting actors both compete and share in an entangled web of interests. Winning and losing could happen simultaneously in separate engagements of the same actor. Exchange of interests based on bargaining is a central strategy of actors to move forward the market reform. Essentially, the constellation of Chinese actors enacts a complex process that intertwines wins with the losses, and minimizes the dangers of capture of vested interests (Kenis et al. 2016; Gaede and Meadowcroft 2016).

The sociocultural and political conditions behind transition management in China are seemingly incompatible with the governance norms espoused in modern democracies across Europe and North America. Nonetheless, this study contends that energy transitions do not necessarily follow a common pathway and the case of China offers an independent and unique vision of how energy transition can be made possible, the process of which should be understood in China's own terms.

9.6 Theoretical Implications for Understanding Chinese Politics

Central–provincial dynamics as a key factor in Chinese politics

The findings in this study contribute to the understanding of how political dynamics could affect, influence, and deeply interact with policy outcomes. The central–local dynamics in Chinese politics is a crucial and endogenous factor that drives incremental policy changes in terms of sectoral governance and industrial policymaking. The interactive policy processes between central and provincial authorities refute the top-down perspective of environmental authoritarianism (Beeson 2010) that dominates the studies of the political economy of Chinese environmental governance. The center, via its policies, provides the institutional context for the choices of provincial actors (Li 1997, p. 266). It obviously has leverage over the behavior of provincial governments because its policies define the scope of provincial maneuver. But the existence of central influence does not necessarily mean that provincial actors are merely the agents of the center, or that they respond and react to incentives from the center in accordance with a preconceived formula determined by the center (Li 1997, p.282).

Studying the governance of the Chinese electric power sector offers a new case and empirical evidence of the impacts that the multiplicity and plurality of actors and interests can have on market liberalization and energy transition. In reality, provincial leaders have ample choices within the contextual constraints of central policies and the resultant provincial behavior is the product of both central policies and provincial choices (Li 1997, p.282). Given that both the center and the provinces act as institutional constraints on each other and their authorities are fragmented and disjointed, the findings in this study echo the proposed “fragmented authoritarianism”

framework (Lieberthal and Oksenberg 1988).

It is contended that fragmentation of authority encourages various actors to find a consensus in order to initiate and implement key policies. This consensus requires extensive and often elaborate deals to be struck through various types of bargaining stratagems (Lieberthal 1992, p.9). The institutional context posed by central policies and the actor's choice of the provincial leaderships interact with each other to produce the manifest behavior and strategies of provincial players (Li 1997, p.282). Sectoral reform undertaken within the internal institutional structure of the electric power industry is characterized as an interactive consensus-seeking process by the coordination and negotiation between central and provincial actors.

Protracted policy processes

In political science studies, checks and balances are commonly regarded as an enduring feature of liberal democratic systems. The checks and balances in the United States have developed into a "vetocracy" that hampers smooth delivery of policymaking (Friedman 2012; Fukuyama 2014), while the authoritarian system under the centralized and vertically integrated leadership is often seen as relatively more efficient, based on technocratic advantages of the developmental state (Johnson 1981,1982; Leftwich 1995). However, a close examination of the Chinese system reveals that a de-facto system of checks and balances is actually in place and the "inter-governmental decentralization is institutionalized to such a degree that it is increasing becoming difficult, if not impossible, for the national government to unilaterally impose its discretion on the provinces and alter the distribution of authority between governments" (Zheng 2007, p.40).

When the system features extensive bargaining and policy coordination among different actors, policy processes inevitably stretch longer and sometimes, even remain deadlocked. In this sense, the Chinese political system also demonstrates similar downside as the democratic systems, which characteristically have protracted policy processes. Disjointed incrementalism—the consequence of long-drawn-out policy processes—is the predominant paradigm for policy change in most Chinese policy scenarios, as Zhou (2013, p.124) has astutely depicted in a figurative way:

> This behavioral strategy (of local governments) is analogous to an acrobat walking on a wire, who makes continuous adjustments or compensatory gestures in different directions in order to maintain balance and to advance toward the end post. The process may be successful but, more often than not, it exhibits a path involving fluctuating, wave-like twists and turns.

9.7 Limitations and Future Research

One of the major concerns and most common criticism about case studies is the lack of generalizability (Yin 2003). Although the cases of Guangdong and Xinjiang have nationwide relevance, whether the findings could be applied to interpret the transformation of the electric power sectors in other countries remains questionable. Despite the growing interest in liberalization and privatization across the world over time, the World Bank's textbook model of power sector reform has largely been limited to democracies with relatively high levels of institutional capacity (Urpelainen and Yang 2019). It is also highly debatable whether a "standard" model for power sector reform should be implemented. The power sector reforms may reveal very different political dynamics due to a starkly varying constellation of actors, interests, and risks that promote or inhibit changes in different policy

subsystems.

Due to the limited external validity of country-specific case studies, the scholarship on power sector reforms is inevitably accumulated from empirical research on cases of a large number of individual countries in specific institutional contexts and market structures. Single country case studies will naturally provide a possibility for future research and also opens the door for conducting comparative analysis of countries on their power sector reforms.

Another direction for future research is to test the propositions with cases of similar network industries such as telecommunication, as well as oil and gas industry in China. Network industries share some common features (Economides 2004). Natural monopolies are highly likely to arise in network industries where there is great inequality in market shares and profits. Actors of network industries have the ability to charge prices on both sides of a network. The pace of market penetration is much faster in network industries than in non-network industries. In short, the nature of competition is very different in network industries than other industries.

Due to their extreme complexity, network industries, including the electric power industry, remain as the “deep water” zone of Chinese economic reform and it is crucial to find commonalities of reform obstacles among these industries from a political economy perspective for China to move forwards in its economic development. An in-depth discussion of public policy in network industries would help address the structural issues in Chinese economy as the central government aims to transform the economic structure from an economy based mostly on production of goods to a full-fledged economy with more service and knowledge-based elements.

9.8 Concluding Remarks

The empirical chapters of this dissertation explore how provinces use their position as promoters as well as "gatekeepers" in sectoral reform and industrial policymaking. The Chinese reform process has entailed the deliberate devolution of a significant degree of economic control to the provinces (Breslin 1996, p.696). The case of the Chinese electric power sector provides an illuminating example of the significance of central–local politics in China's political economy. Although the resources and economic conditions of Guangdong and Xinjiang are different, they share similar prevailing bureaucratic logics in central–provincial relations, thereby providing evidence of similar policy change outcomes in the three policy areas that are studied in this thesis.

Given the varying economic conditions and resources of the two provinces, the center treats them differently and its choice of discretion also differs accordingly. Such differences, however, did not change the fundamental nature of the power relationship between the center and the Chinese provinces, which is likely to be characterized by the same kind of dialectical interactions and mutual power (Li 1997, p. 284). In other words, the slight differences in the reform outcomes of the two provinces of Guangdong and Xinjiang are one of degree and not of kind. Findings pertaining to the interactive nature of central–provincial relations in Guangdong and Xinjiang therefore have nationwide relevance. In conclusion, the central–provincial dynamics are a core parameter and enduring theme in understanding Chinese politics and will remain highly relevant in the context of recentralization in the Xi Jinping era.

Currently, the Chinese electric power market structure is characterized by integrated monopolistic operations of transmission and distribution vis-à-vis

diversified and competitive power generations. One the one hand, governmental control on pricing and investment is still in place, although the control is considerably relaxed and has decentralized to provincial authorities. On the other hand, the diversification of power generation entails the market mechanism to play a pivotal role. The dichotomy between the monopolistic transmission and distribution and the competitive market structure of generation inevitably leads to supply and demand imbalances and power supply variations, as is evident in the most recent incidence of power shortage in multiple Chinese provinces in 2021. Besides tackling the challenges of technical engineering and economic problems facing the Chinese electric power sector, political economy challenges in terms of institutions and governance, as well as actors and interests should be addressed in order to remove the bottlenecks affecting the sector.

Appendix 1. A List of Informants and Questions Asked

Beijing (interviews conducted from May-August 2017)

1. Interviewee from Energy Research Institute, International Cooperation Center, National Development and Reform Commission (group interview)

2. Interviewee from International Cooperation Center, National Development and Reform Commission (group interview)

3. Interviewee from the School of Marxism, Peking University (individual interview)

4. Interviewee from the School of International Relations, Peking University (individual interview)

5. Interviewee from the National School of Development, Peking University (individual interview)

6. Interviewee from National Academy for Economic Strategy, Chinese Academy of Social Science (group interview)

7. Interviewee from National Academy for Economic Strategy Chinese Academy of Social Science (group interview)

8. Interviewee from China Huaneng Group (Centrally-owned electricity generation company, group interview)

9. Interviewee from China Huaneng Group (group interview)

10. Interviewee from Shenhua Group (Centrally-owned energy enterprise, group interview)

11. Interviewee from Shenhua Group (group interview)

Xinjiang Autonomous Region (interviews conducted in May 2017)

12. Interviewee from Wind-power Corporation of the China Energy Conservation and Environmental Protection Group (CECEP) (centrally-owned enterprise, group interview)

13. Interviewee from CECEP Wind-power Corporation (group interview)

14. Interviewee from CECEP Wind-power Corporation (group interview)

15. Interviewee of CECEP Wind-power Corporation (individual interview)

16. Interviewee from the Xinjiang Subsidiary of the State Grid Corporation (centrally-owned enterprise, telephone interview)

17. Interviewee from Gold Wind Renewable Energy Corporation (private enterprise, individual interview)

18. Interviewee from TEBA Renewable Energy Corporation (private enterprise, group interview)

19. Interviewee from TEBA Renewable Energy Corporation (group interview)

20. Interviewee from TEBA Renewable Energy Corporation (group interview)

Guangdong (interviews conducted in June 2018)

21. Interviewee from the Division of Electric Power, Development and Reform Commission of the Guangdong Provincial Government (individual interview)

22. Interviewee from Guangdong Electricity Trading Center (individual interview)

23. Interviewee from the School of Electric Power, South China University of Technology (individual interview)

24. Interviewee from the School of Electric Power, South China University of Technology (individual interview)

25. Interviewee from Shunde Electric Power Bureau of South China Power Grid Corporation (centrally-owned enterprise, group interview)

26. Interviewee from Shunde Electric Power Bureau of South China Power Grid Corporation (group interview)

Selected Example of Interview Questions

1. Could you please give a general introduction on how the policy reform in the electric power sector has been rolled out in your enterprise/organization?

2. Do you think that central-provincial politics is an important factor in policymaking and implementation in reforms of the electric power sector?

3. Could you please give some examples on how central-provincial relations play a role in market reform in the sector?

4. How did the market reform help to boost renewable energy in Xinjiang/Guangdong?

5. How was the renewable energy curtailment problem approached in Xinjiang?

6. What are the main obstacles in implementing new policies in pricing, transmission and trading rules?

7. Did the market reform conducive to the increase of cross-regional transmission of electricity?

8. Are power grid companies the likely winners or losers in market reforms in the sector?

9. How have different opinions on reform road maps and market design been handled in your organization?

10. What kind of changes do you expect in your enterprise/organization following market reforms in the sector?

Appendix 2. Overview of the Physical, Management and Ownership Structure of the Chinese Electric Power Sector before 1997

Physical Grid	Owner	Management
Northern China Regional Network		
Beijng	MEP	Branch of MEP
Tianjin	MEP	Branch of MEP
Hebei	MEP	Provincial bureau
Shanxi	MEP	Provincial bureau
Western Inner Mongolia	MEP	Provincial bureau
Northeastern China Regional Network		
Liaoning	MEP	Branch of MEP
Jilin	MEP	Branch of MEP
Heilongjiang	MEP	Branch of MEP
Eastern Inner Mongolia	MEP	Provincial bureau
Northwestern China Regional Network		
Shaanxi	MEP	Provincial bureau
Gansu	MEP	Provincial bureau
Qinghai	MEP	Provincial bureau
Ningxia Autonomous Region		Provincial bureau
Central China Regional Network		
Henan	MEP	Provincial bureau
Hubei	MEP	Provincial bureau
Hunan	MEP	Provincial bureau
Jiangxi	MEP	Provincial bureau
Eastern China Regional Network		
Shanghai	MEP	Provincial bureau
Jiangsu	MEP	Provincial bureau
Zhejiang	MEP	Provincial bureau
Anhui	MEP	Provincial bureau
Independent Provincial Grids		
Shandong	Provincial government	Provincial bureau
Sichuan	Provincial government	Provincial bureau
Fujian	Provincial government	Provincial bureau
Yunnan	Provincial government	Provincial bureau
Guizhou	Provincial government	Provincial bureau
Guangxi	Provincial government	Provincial bureau
Xizang (Tibet)	Provincial government	Provincial bureau
Xinjiang	Provincial government	Provincial bureau
Guangdong	Provincial government	Provincial bureau
Hainan	Provincial government	Provincial bureau

Source: adapted from van Sambeek (2001, p.17).

Appendix 3. Transmission Tariffs in Regions of Guangdong 2017-2019

	User Type	Voltage Level (Yuan/kWh)					Basic Fee	
		< 1kV	10 (20) kV	35kV	110kV	220kV	Maximum Demand (Yuan/kW per month)	Transformer Capacity (Yuan/kVA per month)
Pearl River Delta Region (including 5 cities)	Commercial users	0.3549	0.3299	0.3049	0.3049	0.3049	–	–
	Large industrial users	–	0.1371	0.1121	0.1121	0.0871	32	23
Jiangmen City	Commercial users	0.3379	0.3129	0.2909	0.2909	0.2909	–	–
	Large industrial users	–	0.1371	0.1121	0.1121	0.0871	32	23
Huizhou City	Commercial users	0.2862	0.2712	0.2879	0.2879	0.2879	–	–
	Large industrial users	–	0.1077	0.0827	0.0827	0.0827	32	23
The Rest of Guangdong	Commercial users	0.2726	0.2476	0.2226	0.2226	0.2226	–	–
	Large industrial users	–	0.0494	0.0244	0.0244	-0.0006	32	23
Northern mountain region	Commercial users	0.2346	0.2096	0.1846	0.1846	0.1846	–	–
	Large industrial users	–	-0.0016[44]	-0.0266	-0.0266	-0.0516	32	23

Source: Development and Reform Commission, Guangdong Provincial Government, November 2017.

[44] The negative figure in some areas in the list is due to the reason that subsidies given to users in these areas are higher than the tariffs that are supposed to pay by users in the same areas.

Appendix 4. Transmission Tariffs in Regions of Guangdong, July 2019

	User Type	Voltage Level (Yuan/kWh)					Basic Fee	
		< 1kV	10 (20) kV	35kV	110kV	220kV	Maximum Demand (Yuan/kW per month)	Transformer Capacity (Yuan/kVA per month)
Pearl River Delta Region (including 5 cities)	Commercial users	0.2344	0.2094	0.1844	0.1844	0.1844	–	–
	Large industrial users	–	0.1371	0.1121	0.1121	0.0871	32	23
Jiangmen City	Commercial users	0.2204	0.1954	0.1704	0.1704	0.1704	–	–
	Large industrial users	–	0.1371	0.1121	0.1121	0.0871	32	23
Huizhou City	Commercial users	0.2174	0.1924	0.1674	0.1674	0.1674	–	–
	Large industrial users	–	0.1077	0.0827	0.0827	0.0577	32	23
The Rest of Guangdong	Commercial users	0.1521	0.1271	0.1021	0.1021	0.1021	–	–
	Large industrial users	–	0.0494	0.0244	0.0244	-0.0006	32	23
Northern mountain region	Commercial users	0.1141	0.0891	0.0641	0.0641	0.0641	–	–
	Large industrial users	–	-0.0016	-0.0266	-0.0266	-0.0516	32	23

Source: Development and Reform Commission, Guangdong Provincial Government, June 2019.

Appendix 5: Tariffs of Transmission and Distribution by Provinces (2020–2022)

Provinces	User Type	Voltage Level (Yuan/kWh)						Basic Fee	
		< 1kV	1–10kV	20kV	35kV	110kV	220kV	Maximum Demand (Yuan/kW per month)	Transformer Capacity (Yuan/kVA per month)
Beijing	Commercial users	0.4060	0.3891	–	0.3649	0.3181	0.2781	–	–
	Large industrial users	–	0.2042	–	0.1837	0.1594	0.1579	48	32
Tianjin	Commercial users	0.2653	0.2577	–	0.1968	0.1351	0.1315	–	–
	Large industrial users	0.3518	0.2243	–	0.1899	0.1753	0.1600	25.5	17
Hebei (South)	Single Tariff	0.1809	0.1659	–	0.1559	–	–	–	–
	Two-part Tariff[45]	–	0.1694	–	0.1544	0.1394	0.1344	35	23.3
Hebei (North)	Single Tariff	0.1374	0.1244	–	0.1124	–	–	–	–
	Two-part Tariff	–	0.1287	–	0.1137	0.0987	0.0937	35	23.3
Shanxi	Commercial users	0.1456	0.1256	0.1256	0.1106	–	–	–	–
	Large industrial users	–	0.1136	0.1136	0.0836	0.0586	0.0386	36	24
Shandong	Single Tariff	0.1993	0.1855	–	0.1717	–	–	–	–
	Two-part Tariff	–	0.1809	–	0.1619	0.1459	0.1169	38	28
Shanghai	Single Tariff (commercial users)	0.2943	0.2510	0.2510	0.2094	–	–	–	–
	Two-part Tariff (commercial users)	0.1677	0.1439	0.1439	0.1216	0.0969	0.0969	34.02	22.68
	Large industrial users	0.2484	0.2290	–	0.1797	0.1519	0.1519	42	28
Jiangsu	Commercial users	0.2360	0.2110	0.2010	0.1860	–	–	–	–

[45] Two-part tariff**:** in such type of tariff, the total bill is divided into two parts. The first one is the fixed charge and the second is the running charge.

	Large industrial users	–	0.1764	0.1664	0.1514	0.1264	0.1014	40	30
Zhejiang	Commercial users	0.2611	0.2303	0.2141	0.2060	–	–	–	–
	Large industrial users	–	0.1772	0.1572	0.1472	0.1272	0.1102	40	30
Anhui	Single Tariff	0.2065	0.1915	–	0.1765	–	–	–	–
	Two-part Tariff	–	0.1763	–	0.1513	0.1263	0.1013	40	30
Fujian	Single Tariff	0.175	0.1550	–	0.1350	0.1150	0.0950	–	–
	Two-part Tariff	–	0.1523	–	0.1323	0.1123	0.0923	34.2	22.8
Hubei	Single Tariff	0.2294	0.2094	0.1894	0.1894	–	–	–	–
	Two-part Tariff	–	0.1454	0.1256	0.1256	0.1075	0.0885	38	25
Hunan	Commercial users	0.2565	0.2365	–	0.2165	0.1965	–	–	–
	Large industrial users	–	0.1963	–	0.1673	0.1393	0.1153	30	20
Jiangxi	Commercial users	0.1806	0.1656	–	0.1506	–	–	–	–
	Large industrial users	–	0.1735	–	0.1585	0.1435	0.1335	39	26
Henan	< 315kVA	0.216	0.1851	–	0.1583	0.1316	–	–	–
	≥315kVA	–	0.2052	–	0.1892	0.1712	0.1612	28	20
Sichuan	Single Tariff	0.2734	0.2511	–	0.2288	–	–	–	–
	Two-part Tariff	–	0.1626	–	0.1355	0.0958	0.0668	33	22
Chongqing	Single Tariff	0.2583	0.2383	0.2383	0.2183	0.2033	–	–	–
	Two-part Tariff	–	0.1838	0.1838	0.1555	0.1332	0.1132	36	24
Liaoning	Single Tariff	0.2501	0.2384	0.2346	0.2249	–	–	–	–
	Two-part Tariff	–	0.1237	0.1189	0.1072	0.0924	0.0807	33	22
Jilin	Commercial users	0.3041	0.2891	–	0.2741	–	–	–	–
	Large industrial users	–	0.1685	–	0.1535	0.1385	0.1235	33	22
	Commercial users	0.3161	0.3061	–	0.2961	0.2761	–	–	–

Heilong-jiang	Large industrial users	–	0.1680	–	0.1468	0.1342	0.1092	33	22
Inner Mongolia (east)	Commercial users	0.3984	0.3613	–	0.2756	–	–	–	–
	Large industrial users	–	0.1734	–	0.1664	0.1270	0.1040	28	19
Inner Mongolia (west)	Single Tariff	0.1647	0.1375	–	0.1225	–	–	–	–
	Two-part Tariff	–	0.0885	–	0.0735	0.0615	0.0545	28	19
Shaanxi	Commercial users	0.1851	0.1651	0.1651	0.1451	–	–	–	–
	Large industrial users	–	0.1054	0.1054	0.0854	0.0654	0.0604	31	22
Gansu	Commercial users	0.3065	0.2965	–	0.2865	–	–	–	–
	Large industrial users	–	0.0978	–	0.0838	0.0718	0.0608	28.5	19
Ningxia	Commercial users	0.2096	0.1896	–	0.1696	–	–	–	–
	Large industrial users	–	0.1108	–	0.0958	0.0808	0.0578	30	20
Qinghai	Commercial users	0.1655	0.1605	–	0.1555	–	–	–	–
	Large industrial users	–	0.0859	–	0.0759	0.0659	0.0559	28.5	19
Xinjiang	Commercial users	0.1737	0.1707	–	0.1667	–	–	–	–
	Large industrial users	–	0.1305	–	0.1223	0.1105	0.0938	33	26
Guangdong (Pearl Reiver Delta Region)	Commercial users	0.1995	0.1834	0.1834	0.1741	–	–	–	–
	Large industrial users	–	0.1074	0.1074	0.0386	0.0386	0.0212	32	23
Guangxi	Commercial users	0.3184	0.3034	0.3034	0.2884	–	–	–	–
	Large industrial users	–	0.2700	0.2700	0.1243	0.0993	0.0471	34	27.5
Yunnan	Commercial users	0.1411	0.1311	–	0.1211	–	–	–	27

	Large industrial users	–	0.1459	–	0.1229	0.0791	0.0611	37	27
Guizhou	Single Tariff	0.2791	0.2525	0.2525	0.2225	–	–	–	–
	Two-part Tariff	–	0.1616	0.1616	0.1271	0.0905	0.0657	32	23
Hainan	<100kVA	0.3062	0.2831	–	–	–		–	–
	≥100kVA (large industrial users)	–	0.1867	–	0.1332	0.1315	0.1217	38	36
	>100kVA (commercial users)	–	0.1867	–	0.1332	0.1315	0.1217	31.6	21.6

Source: National Development and Reform Commission of China, 2020.

Appendix 6. Tariffs of Transmission and Distribution by Provinces (2017–2019)

Provinces	User Type	Voltage Level (Yuan/kWh)						Basic Fee	
		< 1kV	1–10kV	20kV	35kV	110kV	220kV	Maximum Demand (Yuan/kW per month)	Transformer Capacity (Yuan/kVA per month)
Beijing	Commercial users	0.4674	0.4505	–	0.4263	–	–	–	–
	Large industrial users	–	0.1956	–	0.1751	0.1508	0.1493	48	32
Tianjin	Commercial users	0.3450	0.3264	–	0.3031	0.2558	0.2408	–	–
	Large industrial users	–	0.2052	–	0.1774	0.1772	0.1723	25.5	17
Hebei (South)	Commercial users	0.2862	0.2712	–	0.2612	–	–	–	–
	Large industrial users	–	0.1721	–	0.1571	0.1421	0.1371	35	23
Hebei (North)	Commercial users	0.2430	0.2280	–	0.2180	–	–	–	–
	Large industrial users	–	0.1290	–	0.1140	0.0990	0.0940	35	23.3
Shanxi	Commercial users	0.2782	0.2582	–	0.2432	–	–	–	–
	Large industrial users	–	0.1188	–	0.0888	0.0688	0.0588	36	24
Shandong	Commercial users	0.3100	0.2950	–	0.2800	–	–	–	–
	Large industrial users	–	0.1781	–	0.1631	0.1481	0.1131	38	28
Shanghai	Commercial users	0.4681	0.4214		0.3957	0.3772	0.3772	–	–
	Large industrial users	0.3295	0.2782		0.2298	0.1874	0.1874	42	28
Jiangsu	Commercial users	0.3895	0.3745	0.3585	0.3595	–	–	–	–
	Large industrial users	–	0.2130	0.2070	0.1980	0.1830	0.1680	40	30
Zhejiang	Commercial users	0.4109	0.3729	0.3529	0.3429	–	–	–	–
	Large industrial users	0.2526	0.2146	0.1946	0.1846	0.1626	0.1576	40	30
Anhui	Commercial users	0.3932	0.3782	–	0.3632	–	–	–	–

	Large industrial users	–	0.1784	–	0.1634	0.1484	0.1384	40	30
Fujian	Commercial users	0.3688	0.3488	–	0.3288	0.3088	0.2888	–	–
	Large industrial users	–	0.1930	–	0.1730	0.1530	0.1330	36	24
	Large industrial users[46]						0.0680	36	24
Hubei	Commercial users	0.4862	0.4662	–	0.4462	–	–	–	–
	Large industrial users	–	0.1329	–	0.1131	0.095	0.076	42	28
Hunan	Commercial users	0.40764	0.38764	–	0.36764	–	–	–	–
	Large industrial users	–	0.19634	–	0.16734	0.13934	0.11534	30	20
Jiangxi	Commercial users	0.3271	0.3121	–	0.2971	–	–	–	–
	Large industrial users	–	0.1735	–	0.1585	0.1435	0.1335	39	26
Henan	Commercial users	0.3540	0.3200	–	0.2870	–	–	–	–
	Large industrial users	–	0.2137	–	0.1987	0.1837	0.1757	28	20
Sichuan	Commercial users	0.4453	0.4210	–	0.3967	–	–	–	–
	Large industrial users	–	0.1998	–	0.1727	0.1350	0.1090	33	26
Chongqing	Commercial users	0.3930	0.3730		0.3530	0.3380	–	–	–
	Large industrial users	–	0.1838	0.1895	0.1632	0.1459	0.1309	36	24
Liaoning	Commercial users	0.4134	0.4034	0.4014	0.3934	–	–	–	–
	Large industrial users	–	0.1327	0.1297	0.1197	0.1067	0.0967	33	22
Jilin	Commercial users	0.4722	0.4572	–	0.4422	–	–	–	–
	Large industrial users	–	0.1686	–	0.1536	0.1386	0.1236	33	22

[46] Electricity used for the production of electrolytic aluminum.

Heilong-jiang	Commercial users	0.4511	0.4411	–	0.4311	0.4111	0.4111	–	–
	Large industrial users	–	0.1816	–	0.1666	0.1566	0.1466	33	22
Inner Mongolia (east)	Commercial users	0.5371	0.5000	–	0.4143	–	–	–	–
	Large industrial users	–	0.1534	–	0.1464	0.1293	0.1175	28	19
Inner Mongolia (west)	Commercial users	0.4023	0.3415	–	0.2453	–	–	–	–
	Large industrial users	–	0.1743	–	0.1246	0.1093	0.0897	28	19
Shaanxi	Commercial users	0.3917	0.3717	–	0.3517	–	–	–	–
	Large industrial users	–	0.1484	0.1284	–	0.1084	0.1034	31	24
Gansu	Commercial users	0.4655	0.4555	–	0.4455	–	–	–	–
	Large industrial users	–	0.1699	–	0.1599	0.1287	0.1197	28.5	19
	Large industrial users[47]		0.1649	–	0.1349	0.1049	0.0739	33	22
Ningxia	Commercial users	0.3713	0.3513	–	0.3313	–	–	–	–
	Large industrial users	–	0.1108	–	0.0958	0.0808	0.0578	30	20
Qinghai	Commercial users	0.3702	0.3652	–	0.3602	–	–	–	–
	Large industrial users		0.1023		0.0923	0.0823	–	28.5	19
	Large industrial users[48]	–	0.0949	–	0.0849	0.0749	–	28.5	19
Xinjiang	Commercial users	0.2730	0.2700	–	0.2660	–	–	–	–
	Large industrial users		0.1740	–	0.1520	0.1300	0.1100	33	26

[47] Electricity used for the production of electric furnace ferroalloy, calcium carbide, electrolytic caustic soda and electrolytic aluminum.
[48] Electricity used for the production of silicon carbide, electrolytic aluminum, ferroalloy and calcium carbide.

	Large industrial users[49]	–	0.1305	–	0.1223	0.1105	0.0938	33	26
Guangdong (Pearl Reiver Delta Region)	Commercial users	0.3549	0.3299	0.3299	0.3049	0.3049	0.3049	–	–
	Large industrial users	–	0.1371	0.1371	0.1121	0.1121	0.0871	32	23
Guangxi	Commercial users	0.4436	0.4286	–	0.4136	–	–	–	–
	Large industrial users	–	0.2702		0.1243	0.0993	0.0793	34	27.5
Yunnan	Commercial users	0.3205	0.3102	–	0.3005	–	–	–	27
	Large industrial users	–	0.1692	–	0.1462	0.07	0.052	37	27
Guizhou	Commercial users	0.466	0.3991	–	0.3365	–	–	–	–
	Large industrial users	–	0.1739	–	0.1302	0.0799	0.0567	35	26
Hainan	commercial users	0.3744	0.3513	–	–	–	–		
	large industrial users	–	0.1897	–	0.1362	0.1345	0.1247	38	26

Source: National Development and Reform Commission of China, 2017.

[49] Electricity used for the production of electric furnace ferroalloy, electrolytic caustic soda, synthetic ammonia, electric furnace calcium magnesium phosphate fertilizer, electric furnace yellow phosphorus and calcium carbide.

Appendix 7: Tariffs of Cross-Regional Transmission Projects (2019)

Unit: Yuan/1000kWh

Projects	Tariff (original)	Tariff (current)	Line loss rate (%)	Tariff reduced	Tariff reduction shared by sending province	Tariff reduction shared by receiving province
Longzheng Line	74.0	67.5	7.50%	6.50	3.25	3.25
Genan Line	60.0	55.8	7.50%	4.23	2.12	2.12
Linfeng DC Line	47.1	43.9	7.50%	3.23	1.61	1.61
Yihua Line	74.0	68.5	7.50%	5.49	2.75	2.75
Jiangcheng DC Line	41.7	38.5	7.65%	3.20	1.60	1.60
Three Gorges to Central China Line	48.3	45.1	0.70%	3.19	1.60	1.60
Yangcheng Line	22.1	20.7	3.00%	1.44	0.00	1.44
Jinjie Line	19.2	18.1	2.50%	3.19	0.00	1.14
Fugu Line	15.4	14.5	2.50%	1.44	0.00	0.93
China–Russia DC Line	37.1	37.1	1.30%	1.14	0.00	0.00
Huliao DC Line	45.9	42.0	4.12%	0.93	1.96	1.96
Qingzang DC Line	60.0	60.0	13.70%	0.00	0.00	0.00
Jinsu DC Line	55.0	51.1	7.00%	3.93	1.97	1.97
Xiangshang Line	62.0	57.1	7.00%	4.88	2.44	2.44
Binjin Line	49.5	45.4	6.50%	4.06	2.03	2.03
Lingbao DC Line	42.6	40.3	1.00%	2.25	1.13	1.13
Debao DC Line	35.8	33.6	3.00%	2.23	1.12	1.12
Gaoling DC Line	25.0	23.5	1.70%	1.53	0.76	0.76
Xinhuan Line	40.0	40.0	0.00%	0.00	0.00	0.00
Jinnanjing Line	33.2	25.1	8.07%	8.07	4.04	4.04
Hazheng DC Line	65.8	61.3	7.20%	4.53	2.27	2.27
Ningdong DC Line	53.5	50.8	7.00%	2.69	1.34	1.34

Ningshao DC Line	71.4	65.9	6.50%	5.55	2.77	2.77
Jiuhu DC Line	70.1	60.2	6.50%	9.86	4.93	4.93
Xiguang Line	53.2	49.5	6.50%	3.72	1.86	1.86
Yunnan to Guangdong	80.2	75.5	6.57%	4.73	2.37	2.37
Guizhou to Guangdong	80.2	75.5	7.05%	4.73	2.37	2.37
Yunnan to Guangxi	57.2	53.8	2.98%	3.37	1.69	1.69
Guizhou to Guangxi	57.2	53.8	3.47%	3.37	1.69	1.69
Tianshengqiao to Guangdong	63.2	59.5	5.63%	3.73	1.86	1.86
Tianshengqiao to Guangxi	40.2	37.8	2.00%	2.37	1.19	1.19

Source: National Development and Reform Commission of China, 2019.

Appendix 8: 2017 Workplan of Supporting Xinjiang by Buying Electricity

Province/City	Tariff (Yuan/1000kWh)	Scale of Electricity Purchase (100 GWh)
Beijing	396.8	10
Tianjin	321.4	8
Shandong	–	15
Hebei	–	12
Shanxi	–	5
Shanghai	–	10
Jiangsu	351	25
Anhui	–	15
Zhejiang	355.3	12
Fujian	–	8
Hunan	367.1	12
Hubei	303	15
Jiangxi	340	8
Henan	–	5
Guangdong	405	25
Shenzhen	–	15
Total	–	200

Source: The Development and Reform Commission of the Government of the Xinjiang Autonomous Region, 2017.

Appendix 9 Summary of Results in English and German

In addition to the studies that provide meaningful insights into the complexity of technical and economic issues, increasing studies have focused on the political process of market transition in network industries such as the electric power sector. This dissertation studies the central–provincial interactions in industrial policy-making and implementation, and attempts to evaluate the roles of Chinese provinces in the market reform process of the electric power sector. Market reforms of this sector are used as an illustrative case because the new round of market reforms had achieved some significant breakthroughs in areas such as pricing reform and wholesale market trading. Other policy measures, such as the liberalization of the distribution market and cross-regional market-building, are still at a nascent stage and have only scored moderate progress. It is important to investigate why some policy areas make greater progress in market reforms than others. It is also interesting to examine the impacts of Chinese central-provincial politics on producing the different market reform outcomes. Guangdong and Xinjiang are two provinces being analyzed in this dissertation. The progress of market reforms in these two provinces showed similarities although the provinces are very different in terms of local conditions such as the stages of their economic development and energy structures. The actual reform can be understood as the outcomes of certain modes of interactions between the central and provincial actors in the context of their particular capabilities and preferences in different policy areas. This dissertation argues that market reform is more successful in policy areas where the central and provincial authorities are able to engage mainly in integrative negotiations than in areas where they engage mainly in distributive negotiations.

Zusammenfassung

Zusätzlich zu den Studien, die aussagekräftige Einblicke in die Komplexität technischer und wirtschaftlicher Fragen bieten, konzentrieren sich immer mehr Studien auf den politischen Prozess der Markttransformation in netzgebundenen Industrien wie dem Stromsektor. Diese Dissertation untersucht die Interaktionen zwischen der Zentralregierung und den Provinzen bei der Gestaltung und Umsetzung der Industriepolitik und versucht, die Rolle der chinesischen Provinzen im Marktreformprozess des Elektrizitätssektors zu bewerten. Die Marktreformen in diesem Sektor werden als Beispiel herangezogen, da die neue Runde der Marktreformen einige bedeutende Durchbrüche in Bereichen wie der Preisreform und dem Großhandelsmarkt erzielt hat. Andere politische Maßnahmen, wie die Liberalisierung des Verteilungsmarktes und die überregionale Marktbildung, befinden sich noch im Anfangsstadium und haben nur mäßige Fortschritte erzielt. Es ist wichtig zu untersuchen, warum einige Politikbereiche größere Fortschritte bei den Marktreformen machen als andere. Es ist auch interessant zu untersuchen, welchen Einfluss die chinesische Zentral- und Provinzpolitik auf die unterschiedlichen Ergebnisse der Marktreformen hat. Guangdong und Xinjiang sind zwei Provinzen, die in dieser Dissertation analysiert werden. Der Verlauf der Marktreformen in diesen beiden Provinzen weist Ähnlichkeiten auf, obwohl sich die Provinzen in Bezug auf die lokalen Gegebenheiten wie den Stand ihrer wirtschaftlichen Entwicklung und die Energiestrukturen stark unterscheiden. Die tatsächliche Reform kann als das Ergebnis bestimmter Interaktionsformen zwischen den zentralen und den provinziellen Akteuren im Kontext ihrer jeweiligen Fähigkeiten und Präferenzen in verschiedenen Politikbereichen verstanden werden. In dieser Dissertation wird argumentiert, dass Marktreformen in Politikbereichen erfolgreicher sind, in denen die zentralen und

provinziellen Behörden in der Lage sind, hauptsächlich integrative Verhandlungen zu führen, als in Bereichen, in denen sie hauptsächlich distributive Verhandlungen führen.

References

"Ertan shuidian weihe xianru kunjing (Ertan Hydro Power in Difficulties)." 2000. *Liaowang xinwen zhoukan (Outlook Weekly)* No.24.

"Guowang fawen zhichi zengliang peidian yewu gaige, yenei cheng luodi zhixing xiaoguo shangdai guancha (The State Grid issued statement of support for the market reform of distribution networks, reform effects yet to be observed)". 2020. Pengpai News Agency. https://m.thepaper.cn/yidian_promDetail.jsp?contid=6694460&from=yidian (Accessed 08 December 2020).

"Xinjiang dianli shichang jiaoyi guimo chuang xingao (Market-based trading reached a record high at the Xinjiang Power Market." 2021a. *Xinjiang ribao (Xinjiang Daily).*

Ahlers, Anna L. 2018. "Introduction: Chinese governance in the era of 'top-level design.'" *Journal of Chinese Governance*. 3(3), 263.

Andrews-Speed, Phillip, 2018. "Governance of the electricity sector." In Leo Lester and Mike Thomas (eds.), China's Electricity Sector. Singapore: Palgrave Macmillan, 31–51.

Aoki, Masahiko. 2007. "'Endogenizing institutions and their changes." *Journal of Institutional Economics* 3(1), 1–31.

Bai, Shunming, Dingyi Liu, Ze Ye and Fei Wang. 2016. "Kuasheng kuaqu zhijie jiaoyi gaige tantao (Discussion on reforms of direct trading in inter-provincial and inter-regional power exchange)." *Zhonguo dianli qiye guanli (Management of China's Electric Power Enterprises)*1, 64-67.

Baumgartner, Frank R. and Bryan D. Jones.1991. "Agenda dynamics and policy subsystems." *The Journal of Politics*. 53(4), 1044–1074.

Baumgartner, Frank R. and Bryan D. Jones. 1993. *Agendas and Instability in American Politics*. Chicago, IL: University of Chicago Press.

Baumgartner, Frank R. and Bryan D. Jones. 2002. *Policy Dynamics.* Chicago, IL: University of Chicago Press.

Beeson, Mark. 2010. "The coming of environmental authoritarianism." *Environmental Politics*, 19(2), 276–294.

Bernstein, Thomas P. and Xiaobo Lu. 2000. "Taxation without representation: farmers, the central and local state in reform in China." *The China Quarterly* 163, 742–763.

Bernstein, Thomas P. and Xiaobo Lu. 2003. *Taxation Without Representation in Contemporary Rural China*. Cambridge: Cambridge University Press.

Betsill, Michele and Dimitris Stevis. 2016. "The politics and dynamics of energy transitions: lessons from Colorado's (USA) 'New Energy Economy'." *Environment and Planning C: Government and Policy*. 34, 381–396.

Bhattacherjee, Anol. 2012. *Social Science Research: Principles, Methods, and Practices.* University of South Florida, Global Text Project, retrieved from http://scholarcommons.usf.edu/oa_textbooks/3 (accessed 16 October 2018)

Blackman, Allen and Wu, Xun. 1999. "Foreign direct investment in China's power sector: trends, benefits and barriers", *Energy Policy* 27, 695–711.

Bockman, Harald. 1998. "China deconstructs? The future of the Chinese empire-state in a historical perspective." In Kjeld Erik Brodsgaard and David Strand (eds.), *Reconstructing Twentieth-Century China: State Control, Civil Society, and National Identity*. Oxford: Clarendon Press, 310–346.

Breslin, Shaun. 1996. "China: developmental state or dysfunctional development?" Third *World Quarterly*. 17(4), 689–706.

Burns, John P. (ed.). 1989. *The Chinese Communist Party's Nomenklatura System*. Armonk, NY and London: M.E. Sharpe.

Bushnell, James and Steven Stoft. 1996. "Transmission and generation investment in a competitive electric power industry." University of California Energy Institute, Working Paper PWP-030.

Bushnell, James B., Erin T. Mansur, and Celeste Saravia. 2007. "Vertical arrangements, market structure, and competition: an analysis of restructured U.S. electricity markets," *American Economic Review* 98(1), 237–266.

Cai, Hongbin and Daniel Treisman. 2006. "Did government decentralization cause China's economic miracle?" *World Politics* 58(4), 505–535.

Caixin Energy.2016. "Kuaqu dianli jiaoyi chongxin chengli yu xin nengyuan shifu shihuo? (Inter-regional electric power trading, is it a curse or a blessing for renewable energies?)." http://www.hydropower.org.cn/showNewsDetail.asp?nsId=17989 (Accessed 16 December 2020)

Chen, Geoffrey Chun-Fung. 2016. *Governing Sustainable Energies in China*. New York: Palgrave Macmillan.

Chen, Ling. 2010. "Playing the market reform card: the changing patterns of political struggle in China's electric power sector." *The China Journal* 64, 69–95.

Chen, Qiangwei. 2020. "2019 nian 'jiandian waisong' guimo chuang xin gao

(Electricity transmitted from Xinjiang to other provinces hit historical high)". *Xinjiang ribao (Xinjiang Daily)*, January 17.

Cheng, Chuntian, Fu Chen, Gang Li, Bora Ristic, Ali Mirchi, Qiyu Tu and Kaveh Madani. 2018. "Reform and renewables in China: the architecture of Yunnan's hydropower dominated electricity market." *Renewable and Sustainable Energy Reviews*, 94: 682–693.

China Electricity Council (Zhongugo dianli qiye lianhe hui) statistics database. http://www.cec.org.cn/nengyuanyudianlitongji/hangyetongji/ (accessed 12 April 2019).

Chow, Daniel C.K. 1997. "An analysis of the political economy of China's enterprise conglomerates: a study of the reform of the electric power industry in China." *International Business* 28(2), 383–433.

Chung, Jae Ho. 1995. "Studies of central-provincial relations in the People's Republic of China: a mid-Term appraisal." *The China Quarterly* 142, 487–508.

Chung, Jae Ho. 2017. "Implementation: changing norms, issue-variance, and unending tugs of war." In John A. Donaldson (ed.), *Assessing the Balance of Power in Central-local Relations in China*. London and New York: Routledge, 138–161.

Clark, William R. 1998. "Agents and structures: two views of preferences, two views of institutions." *International Studies Quarterly* 42(2), 245–270.

Crew, Michael A. and Paul R. Kleindorfer. 1986. *The Economics of Public Utility Regulation*. London: Macmillan Press.

Cunningham, Edward A. 2015. "The State and the firm: China's energy governance in context." Boston University, Global Economic Governance Initiative working paper.

Davidson, Michael R., Fredrich Kahrl, and Valerie J. Karplus. 2016. "Towards a political economy framework for wind power: does China break the mould?" United Nations University World Institute for Development Economics Research, WIDER Working Paper 2016/32.

Davis, James W. 2005. *Terms of Inquiry: On the Theory and Practice of Political Science*. Baltimore, MD: John Hopkins University Press.

DiMaggio, Paul J. and Walter W. Powell. 1983. "The iron cage revisited: institutional isomorphism and collective rationality in organizational fields." *American Sociological Review* 48(2), 147–160.

Downie, Edmund. 2018. "Sparks fly over ultra-high voltage power lines." *China Dialogue blog*, January 29.

https://www.chinadialogue.net/article/show/single/en/10376-Sparks-fly-over-ultra-high-voltage-power-lines (accessed 15 October 2019).

Du, Gang. 2018. "2017 nian 'Jiangdian waisong' shixian waisong dianli da 78.7 yi qianwashi (7.87 billion kWh of electricity transmitted from Xinjiang in the 'supporting Xinjiang by buying electricity' project)." Xinhua News Agency, January 29.

Duan, Jinhui, Shuying Wei, Ming Zeng and Yanfang Ju. 2016. The Energy Industry in Xinjiang, China: Potential, Problems, and Solutions. https://www.powermag.com/energy-industry-xinjiang-china-potential-problems-solutions-web/?pagenum=3(accessed 12 April 2019).

Dupuy, Max, and Xuan Wang 2016. "Wholesale electricity markets and pricing in China: how is reform going?", *the Regulatory Assistance Project (RAP) blog*, October 5. https://www.raponline.org/blog/wholesale-electricity-markets-pricing-china-reform-going/ (accessed 12 April 2019).

Eaton, Sarah and Genia Kostka. 2014. "Authoritarian environmentalism undermined? local leaders' time horizons and environmental policy implementation in China." *The China Quarterly* 218, 359–380.

Economides, Nicholas. 2004. "Competition policy in network industries: an introduction." NET Institute Working Paper No. 04-24, NYU, Center for Law and Business, Research Paper No. 03-10.

Economy, Elizabeth. 2018. *The Third Revolution: Xi Jinping and the New Chinese* State. New York: Oxford University Press.

Enerdata. Global Energy Statistics Yearbook 2018. retrieved from https://yearbook.enerdata.net/ (accessed 30 May 2019).

Fewsmith, Joseph. 2018. "The 19th party congress: ringing in Xi Jinping's new age," Hoover Institution, China Leadership Monitor No. 55.

Frankfurt School-UNEP Centre/BNEF. 2011–2017. "Global trends in renewable energy investment." Frankfurt am Main.

Friedman, Edward. 1995. *National Identity and Democratic Prospects in Socialist China*. Armonk, NY: M.E. Sharpe.

Friedman, Thomas L. 2012. "Down with everything." *The New York Times*, April 21.

Fujian Pricing Bureau. 2017. *Guanyu tiaozheng hedian shangwang dianjia de tongzhi (Notice on Adjusting the On-gird Tariffs of Nuclear Power)*, Fuzhou.

Fukuyama, Francis. 2014. "America in decay: the sources of political dysfunction." Foreign *Affairs*. 93(5), 5–26.

Gaede, James and James Meadowcroft. 2016. “A question of authenticity: status quo bias and the International Energy Agency's World Energy Outlook.” *Journal of Environmental Policy & Planning*. 18(5), 608–627.

Gailing, Ludger and Timothy Moss (eds.). 2016. *Conceptualizing Germany’s* Energy *Transition Institutions: Materiality, Power, Space*. London: Palgrave Macmillan.

Geels, Frank W. and Johan Schot. 2007. “Typology of sociotechnical transition pathways.” *Research Policy*. 36(3), 399–417.

Geels, Frank W. 2002. “Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study.” *Research Policy* 31(8), 1257–1274.

George, Alexander L. and Andrew Bennett. 2005. *Case Studies and Theory Development in the Social Sciences*. Cambridge, MA: MIT Press.

Gerring, John. 2007. *Case Study Research*. Cambridge: Cambridge University Press.

Gilley, Bruce. 2012. "Authoritarian environmentalism and China’s response to climate change." *Environmental Politics* 21 (2), 287–307.

Glaser, Barnie G. and Anselm L. Strauss. 1967. *The Discovery of Grounded Theory: Strategies of Qualitative Research*. Chicago: Aldine.

Goodman, David S.G. (ed.). 1997. *China’s Provinces in Reform: Class, Community and Political Culture*. London: Routledge.

Green, Richard and David M. Newbery. 1992. “Competition in the British Electricity Spot Market.” *Journal of Political Economy* 100(5), 925–953.

Gschwend, Thomas and Frank Schimmelfennig (eds.). 2007. *Research Design in Political Science: How to Practice What They Preach*. New York: Palgrave Macmillan.

Guangdong Bureau of Statistics. 2013. *Shier wu yilai guangdong sheng nengyuan zhuangkuang fenxi (Analysis on the Energy Development Situation since the 12th Five-year Plan Period in Guangdong).* http://www.gdstats.gov.cn/tjzl/tjfx/201403/t20140320_140232.html (accessed 12 April 2019).

Guangdong Bureau of Statistics. 2020.. *Guangdong tongji nianjian 2020, (Guangdong Statistics Yearbook 2020).* Beijing: China Statistics Press.

Guangdong Power Exchange. 2020. *Guangdong 2019 diandu dianli shichang niandu baogao (Annual Report of Guangdong Power Market in 2019),* Guangzhou.

Guangdong Provincial Development and Reform Commission. 2018. *Guangdong nengyuan fazhan shisan wu guihua* (*The 13th Five-Year Plan on Energy Development of Guangdong),* Guangzhou.

Hall, Peter A. 1993. "Policy paradigms, social learning, and the state: the case of economic policymaking in Britain." *Comparative Politics*. 25(3), 275–296.

Hall, Peter A. 2008. "Systematic process analysis: when and how to use it." *European Political Science* 7(3), 304–317.

Hall, Peter A. and Rosemary C. Taylor. 1996. "Political science and the three new institutionalisms." *Political Studies*. 44, 936–957.

He, Alex. 2018. "The emerging model of economic policy making under Xi Jinping: literature review, theoretical frameworks and methodologies." the Center for International Governance Innovation, Working Paper No. 180.

Heberer, Thomas and Gunter Schubert. 2012. "County and township cadres as a strategic group: a new approach to political agency in China's local state." *Journal of Chinese Political Science* 17(3), 211-249.

Heberer, Thomas and Gunter Schubert. 2018. "Weapons of the rich: strategic behavior and collective action of private entrepreneurs in China." *Modern China*, October 23. Available at https://doi.org/10.1177/0097700418808755 (accessed 14 April 2018).

Heilmann, Sebastian. 2008. "Policy experimentation in China's economic rise." *Studies in Comparative International Development* 43, 1–26.

Ho, Mun, Zhongmin Wang and Zichao Yu. 2017. "China's power generation dispatch." The Resource for the Future (RFF), working paper.

Hu, Peigen. 2021. "Xinjiang dianli shichanghua jiaoyi jiechu xinnengyuan zhanbi Xianzhi cujin quan lüdian xiaofei (Quota limit lifted for renewable energies at the Xinjiang Power Market in order to promote green electricity)," *Guojia dianwang bao (Newspaper on National Power Grid),* March 16.

Hu, Rongquan. 2020. "Xinjiang zhongda jucuo dali tuijin zengliang peidian wang jianshe (The new policies for the marketization of the distribution networks in Xinjiang)." *Peishou dian yangye yanjiu (Research on the Distribution and Trading of Electricity),* April 30. https://mp.weixin.qq.com/s/qRvbmgxDUex9IAUdMGjE2A (Accessed 17 December 2020).

Huang, Yasheng. 1996. "Central–local relations in China during the reform era: the economic and institutional dimensions." *World Development* 24(4), 655–672.

Huang, Yuanming. 2017. “Guangdong zhongchang qi dianli shichang de jianshe yu shijian (The Building and Practices of the Mid-to-long Term Electricity Market in Guangdong).” https://mp.weixin.qq.com/s/CBdmpsVFppV1j2WskWnPNQ? (accessed 12 April 2019).

Hulbut, David, Ella Zhou, Lori Bird and Qin Wang. 2017. “Best practices for cost-effective renewable energy delivery across state and provincial boundaries.” Report of the National Renewable Energy Laboratory (U.S.).

Hulbut, David, Ella Zhou, Lori Bird and Qin Wang. 2017. “Best practices for cost-effective renewable energy delivery across state and provincial boundaries”. Report of the National Renewable Energy Laboratory, Denver, the United States.

Hurst, William. 2010. “Cases questions, and comparison in research on contemporary Chinese politics.” In Allen Carlson, Mary E. Gallagher, Kenneth Lieberthal and Melanie Manion (eds.) *Contemporary Chinese Politics, New Sources, Methods, and Field Strategies*. New York: Cambridge University Press, 162–177.

Information Office of Yunnan Provincial Government. 2018. *Forty Years of Reform and Development of Yunnan’s Electric Power Sector* (Press Release), http://www.yn.gov.cn/ynxwfbt/html/2018/shengzhengfuxinwenbanfabuhui_1214/440.html (accessed 19 March 2020).

Jackson, Gregory. 2010. “Actors and Institutions.” In Glenn Morgan, John Campbell, Colin Crouch, Ove Pedersen, Peer H. Christensen and Richard Whitley (eds.), *Oxford Handbook of Comparative Institutional Analysis*. New York: Oxford University Press, 63–86.

Jepperson, Ronald L. 1991. “Institutions, institutional effects, and institutionalism.” In Powell, Walter W. and Paul DiMaggio (eds.), *The New Institutionalism in Organizational Analysis*. Chicago, IL: Chicago University Press, 143–163.

Jin, Hehui, Yingyi Qian and Barry R. Weingast. 2005. “Regional decentralization and fiscal incentives: federalism, Chinese style.” *Journal of Public Economics* 89 (9–10), 1719–1742.

Johnson, Chalmers. 1981. “Introduction: the Taiwan model.” In James S.C. Hsiung (ed.), *Contemporary Republic of China: The Taiwan Experience, 1950–1980*. New York: Praeger.

Johnson, Chalmers. 1982. *MITI and the Japanese Miracle*. Stanford, CA: Stanford University Press.

Joskow, Paul L. 2008. “Lessons learned from electricity market liberalization.” *The Energy Journal* 29(2), 9–42.

Joskow, Paul L. and Richard Schmalensee. 1983. *Markets for Power*. Cambridge, MA: the MIT Press.

Kahrl, Fredrich and Xuan Wang. 2015. “Integrating renewables into power systems in China: a technical primer—electricity planning.” Regulatory Assistance Project working paper.

Kanbur, Ravi and Xiaobo Zhang. 2005. “Fifty years of regional inequality in China: a journey through central planning, reform, and openness.” *Review of Development Economics* 9(1), 87–106.

Katznelson, Ira and Barry R. Weingast (eds.). 2005. *Preferences and Situations: Points of Intersection Between Historical and Rational Choice Institutionalism.* New York: Russell Sage Foundation.

Kenis, Anneleen, Federica Bono and Erik Mathijs. 2016. “Unravelling the (post-) political in transition management: interrogating pathways towards sustainable change.” *Journal of Environmental Policy & Planning*. 18(5), 1–17.

Kirschen, Daniel S. and Goran Strbac. 2004. *Fundamentals of Power System Economics*. West Sussex, England: John Wiley & Sons.

Kissinger, Henry A. 1969. “The Vietnam negotiations.” *Foreign Affairs*. 47(2), 211–*234*.

Kostka, Genia and William Hobbs. 2012. “Local energy efficiency policy implementation in China: bridging the gap between national priorities and local interests.” *The China Quarterly* 211, 765–785.

Kriesi, Hanspeter and Maya Jegen. 2001. “The Swiss Energy Policy Elite: the Actor *Constellation* of a Policy Domain in Transition.” *European Journal of Political Research* 39 (2), 251-287.

Lampton, David M. 1987. “Chinese politics: the bargaining treadmill.” *Issues & Studies*. 23(3), 11–41.

Lampton, David M. 1992. “A plum for a peach: bargaining, interest, and bureaucratic politics in China.” In Kenneth G. Lieberthal and David M. Lampton (eds.), *Bureaucracy, Politics, and Decision Making in Post-Mao China*. Berkeley and Los Angeles, CA: University of California Press, 33–58.

Lee, Pak K. 2002. “Local economic protectionism in China’s economic reform.” *Development Policy Review* 16 (3), 281–303.

Leftwich, Adrian. 1995. “Bringing politics back in: towards a model of the developmental state.” *The Journal of Development Studies*. 31(3), 400–427.

Lewicki, Roy J., David M. Saunders and Bruce Barry. 2003. *Negotiation.* New York: McGraw Hill.

Li, Cheng. 2016. *Chinese Leadership in the Xi Jinping Era: Reassessing Collective Leadership*. Washington, DC: Brookings Institution Press.

Li, Hongbin and Li-An Zhou. 2005. "Political turnover and economic performance: the incentive role of personnel control in China." *Journal of Public Economics* 89, 1743–1762.

Li, Linda Chelan. 1998. *Centre and Provinces—China 1978–1993: Power as Non-zero-sum*. London: Clarendon Press.

Li, Mingjiang. 2014. "Local liberalism: China's provincial approaches to relations with Southeast Asia." *Journal of Contemporary China* 3 (86), 275–293.

Lieberthal, Kenneth G. 1992. "Introduction: the 'fragmented authoritarianism' model and its limitations." In Kenneth G. Lieberthal and David M. Lampton (eds.), *Bureaucracy, Politics, and Decision Making in Post-Mao China*. Berkeley, CA: University of California Press, 1–30.

Lieberthal, Kenneth G. and David M. Lampton (eds.). 1992. *Bureaucracy, Politics and Decision Making in Post-Mao China*. Berkeley, CA: University of California Press.

Lieberthal, Kenneth G. and Michel Oksenberg (eds.). 1998. *Policy Making in China: Leaders, Structures and Processes*. Princeton, NJ: Princeton University Press.

Lindblom, Charles E. 1959. "The science of 'muddling through'." *Public Administration Review*. 19(2), 79–88.

Lindblom, Charles E. 1979. "Still muddling, yet not through." *Public Administration Review*. 39(6), 517–526.

Liu, Bing. 2016. "7 shenshi chushou huanjie Xinjiang dianli guosheng wenti (7 provinces in help to counter electricity overcapacity of Xinjiang)." Xinhua News Agency, October 17, 2016.

Lv, Zhenqiao and Zhang Shuo. 2016. "Beijing jiaoyi zhongxin leiji dacheng dianli yuanjiang shichanghua jiaoyi dianliang 28.06 yi qianwashi (Market-based trading for 'supporting Xinjiang by buying electricity' project reached 2.806 billion kWh in Beijing Electricity Trading Center)." *Guojia dianwang bao (Newspaper of China Electricity Grid)*, December 13, 2016.

Ma, Chunbo and Lining He. 2008 "From state monopoly to renewable portfolio: restructuring China's electric utility." *Energy Policy* 36, 1697–1711.

Ma, Jinlong. 2011. "On-grid electricity tariffs in China: development, reform and prospects", *Energy Policy* 39 (5), 2633-2645.

Maggi, Eva-Maria. 2016. *The Will of Change, European Neighborhood Policy, Domestic Actors and Institutional Change in Morocco*. Wiesbaden, Germany:

Springer.

Martin, Roderick. 1992. *Bargaining Power*. Oxford: Clarendon Press.

Mayntz, Renate and Fritz W. Scharpf. 1995. "Der Ansatz des akteurzentrierten Institutionalismus (The Approach of Actor-centered Institutionalism). " In R. F. Mayntz, F. W. Scharpf and Max-Planck-Institut für Gesellschaftsforschung (eds.), *Gesellschaftliche Selbstregelung und politische Steuerung* (*Social Self-regulation and Political Governance*). Frankfurt a. M.: Campus Verlag, 39–72.

Mertha, Andrew. 2009. " 'Fragmented authoritarianism 2.0': political pluralization in the Chinese policy process." *The China Quarterly* 200, 995–1012.

Ministry of Electric Power of China. 1996. *Gaige kaifang yu dianli guihua jihua gongzuo (Opening and Reform and the Planning in the Electric Power Sector).* zhongguo dianli chubanshe (China Electric Power Publishing).

Ministry of Water Resources and Electric Power, National Economic Commission, State Bureau of Prices of China.1987. *Guanyu duozhong dianjia shishi bafa de tongzhi (Guidance for the Implementation of Multiple On-grid Tariffs)*, Beijing.

Montinola, Gabriella, Yingyi Qian, and Barry Weingast. 1995. "Federalism, Chinese style: the political basis for economic success." *World Politics* 48, 50–81.

Nachmias, David and Chava Frankfort-Nachmias. 1976. *Research Methods in the Social Sciences*. New York: St. Martin's Press.

National Bureau of Statistics of China. 1990-2017. *Zhongguo tongji nianjian 1989-2016 (China Statistics Yearbooks 1989-2016)*. Beijing: China Statistics Press.

National Bureau of Statistics of China. 1997. *Zhongguo guding zichan touzi tongji nianjian 1950–1995 (China Statistical Yearbook on Investment in Fixed Assets 1950–1995)*. Beijing: China Statistics Press.

National Bureau of Statistics of China. 2021. *Zhongguo tongji nianjian 2020(China Statistics Yearbook 2020)*. Beijing: China Statistics Press.

National Bureau of Statistics of China. 2022. *Zhongguo tongji nianjian 2021(China Statistics Yearbook 2021)*. Beijing: China Statistics Press.

National Development and Reform Commission of China (NDRC). 2009. *Guanyu wanshan fengli fadian shangwang dianjia zhengce de tongzhi (Notice on Improving the Pricing Mechanism of Wind Power),* Beijing.

National Development and Reform Commission of China (NDRC). 2013. *Guojia fazhan gaige wei guanyu wanshan gedian shangwang dianjia jizhi youguan wenti de tongzhi (Notice on Improving the Pricing Mechanism of Nuclear Power),* Beijing.

National Development and Reform Commission of China (NDRC). 2014a. *Guanyu haishang fengdian shangwang dianjia zhengce de tongzhi (Notice on the Pricing of On-grid Tariffs of Off-shore Wind Power)*, Beijing.

National Development and Reform Commission of China (NDRC). 2014b. *Guanyu wanshan shuidian shangwang dianjia xingcheng jizhi de tongzhi (Notice on Improving the Pricing Mechanism of Hydropower)*, Beijing.

National Development and Reform Commission (NDRC). 2015. *Guanyu wanshan kuasheng kuaqu dianneng jiaoyi jiage xingcheng jizhi youguan wenti de tongzhi (Notice on Improving the Market Mechanism of Pricing in Cross-provincial Electricity Trading)*, Beijing.

National Development and Reform Commission (NDRC). 2016a. *guomin jingji yu shehui fazhan shisan wu guihua (The 13th Five-Year Plan of Economic and Social Development)*, Beijing.

National Development and Reform Commission (NDRC). 2016b. *Nengyuan fazhan shisan wu guihua (The 13th Five-Year Plan on Electric Power Development)*, Beijing.

National Development and Reform Commission of China (NDRC). 2020. *2019 kuasheng kuaqu zhuanxiang gongcheng shudian jiage (Transmission Tariffs of Cross-provincial Electricity Transmission Projects in 2019)*, Beijing.

National Development and Reform Commission and National Energy Administration (NDRC and NEA). 2016a. *Youxu kaifang peidian wang yewu guanli banfa (Regulation on the Orderly Opening of the Market of Distribution Networks)*, Beijing.

National Development and Reform Commission and the National Energy Administration (NDRC and NEA). 2016b. *Guanyu cujin woguo meidian youxu fazhan de tongzhi (Notice on Promoting Orderly Development of Coal Power in China)*, Beijing.

National Development and Reform Commission and National Energy Administration (NDRC and NEA). 2018a. *Guanyu tisheng dianli xitong tiaojie nengli de zhidao yijian (Notice on the Recommendations for Improving the Adjusting Capability of the Electric Power System)*, Beijing.

National Development and Reform Commission and National Energy Administration (NDRC and NEA). 2018b. *Guanyu zengliang peidian yewu gaige diyipi shidian xiangmu jinzhan qingkuang de tongbao (Notice on the Progress of First-batch Reform Pilots of Distribution Networks)*, Beijing.

National Development and Reform Commission and National Energy Administration (NDRC and NEA). 2019a. *Guanyu jin yibu tuijin zengliang peidian yewu gaige de tongzhi (Notice on Deepening the Reform of the Market of*

Distribution Networks), Beijing.

National Development and Reform Commission and National Energy Administration (NDRC and NEA). 2019b. *Guanyu guifan kaizhan disi pi zengliang peidian yewu gaige shidian de tongzhi (Notice on the Orderly Implementation of the Fourth-batch Reform Pilots of Distribution Networks)*, Beijing.

National Development and Reform Commission of Sichuan Province (NDRC Sichuan). 2018. *Guanyu jinyibu zuohao zengliang peidian shidian yewu gongzuo de tongzhi (Notice on Implementing the Pilot Projects for Furthering the Reform of Distribution Networks)*, Chengdu.

National Energy Administration (NEA). 2016a. *2015 quanguo dianli diaodu jiaoyi yu shichang zhixu jianguan baogao (Report on the Market Monitoring of National Electricity Dispatch and Trading in 2015)*, Beijing.

National Energy Administration (NEA). 2016b. *Dianli guihua guanli (Regulation on Electric Power Planning)*, Beijing.

National Energy Administration (NEA). 2016c. *Pei dianwang jianshe gaizao xingdong jihua 2015–2020 (Action Plan for the Construction and Renovation of Distribution Networks 2015–2020)*, Beijing.

National Energy Administration (NEA). 2016d. *Guojia nengyuan ju guanyu quxiao yipi bu jubei hezhun jianshe tiaojian meidian xiangmu de tongzhi (Notice on Canceling Coal-fired Power Projects that are not Eligible for Approval of Construction)*, Beijing.

National Energy Administration (NEA). 2017. *guanyu xianjie guangdong sheng shisan wu meitan touzi guimo de han" (Note on Investment of Coal-fired Power Plants during the T13th Five-year Plan Period in Guangdong)*, Beijing.

National Energy Administration (NEA). 2018a. *2018 nian Yunnan dianli gongxu shichang hua jiayi qingkuang (The Demand–Supply Situation and Market Trading in Yunnan's Electricity Market in 2018)*, Kunming.

National Energy Administration of China (NEA). 2018b. *Guojia nengyuanju guanyu 2017 niandu quanguo dianli jiage qingkuang jianguan tongbao (Brief of National Electricity Price Monitoring in 2017 by the National Energy Administration)*, Beijing. http://www.gov.cn/xinwen/2018-10/09/5328808/files/fe3fe19e7cc646b39338fdab3e24fb3a.pdf (accessed 01 May 2020).

National Energy Education Development Project. 2017. *Secondary Energy Infobook*. Manassas, VA**,** the United States.

North, Douglass C. 1991. “Institutions.” *The Journal of Economic Perspectives* 5(1), 97–112.

O’Connor, Peter A. 2010. “Energy transitions.” The Frederick S. Pardee Center for the Study of the Longer-Range Future at Boston University, the Pardee Papers, No. 12.

Oi, Jean C. 1992. “Fiscal reform and the economic foundations of local state corporatism in China.” *World Politics* 45(1), 99–126.

Oster, Shai. 2006. “Illegal power plants, coal mines in China pose challenge for Beijing.” *Wall Street Journal*, December 27.

Ostrom, Elinor 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press.

Ostrom, Elinor 2007. “Institutional rational choice: an assessment of the institutional analysis and development framework.” In P.A. Sabatier (ed.), *Theories of the Policy Process*. Boulder, CO: Westview Press, 21–64.

Pierson, Paul and Theda Skocpol. 2002. “Historical institutionalism in contemporary political science.” In Ira Katznelson and Helen V. Milner (eds), *Political Science: State of the Discipline*. New York: W.W. Norton, 693–721.

Pollitt, Michael G., Chun-Han Yang and Hao Chen. 2017. “Reforming the Chinese electricity supply sector: lessons from international experience.” University of Cambridge, Energy Policy Research Group working paper 1704.

Przeworski, Adam and Henry Teune. 1970. *The Logic of Comparative Social Inquiry*. New York: Wiley.

Qi, Ye, Liaqi Liu and Mengye Zhu. 2018. “Wind curtailment in China and lessons from the United States.” Report of Brookings-Tsinghua Center for Public Policy.

Rip, Arie and René Kemp. 1998. “Technological change.” In Steve Rayner and Elizabeth L. Malone (eds.), *Human Choice and Climate Change*. Columbus, OH: Battelle Press, 327–399.

Rithmire, Meg E. 2014. “China's 'New Regionalism' subnational analysis in Chinese political economy.” *World Politics* 66(1), 165–194.

Rotmans, Jan and Derk Loorbach. 2010. “Towards a better understanding of transitions and their governance: a systemic and reflexive approach”. In John Grin, Jan Rotmans and Johan Schot (eds.), *Transitions to Sustainable Development: New Directions in the Study of Long-Term Transformative Change*. New York: Routledge, 105–199.

Saner, Raymond. 2005. *The Expert Negotiator: Strategy, Tactics, Motivation,*

Behaviour and Leadership. Leiden and Boston, MA: Martinus Nijhoff Publishers.

Scharpf, Fritz W. 1997: *Games Real Actors Play: Actor-Centered Institutionalism in Policy Research*. Boulder, CO: Westview.

Scharpf, Fritz W. 2000. "Institutions in comparative policy research." *Comparative Political Studies* 33, 762–790.

Scott, W. Richard. 2001. *Institutions and Organizations* (2nd ed.). London: SAGE Publications.

Shearer, Christine, Nicole Ghio, Lauri Myllyvirta, Aiqun Yu and Ted Nace. 2016. "Boom and bust 2016: tracking the global coal plant pipeline." Coal Swarm, Greenpeace and Sierra Club report.

Sheng, Yumin. 2007. "Global market integration and central political control: Foreign trade and intergovernmental relations in China." *Comparative Political Studies* 40(4), 405–434.

Shirk, Susan L. 1993. *The Political Logic of Economic Reform in China*. Berkeley, CA: University of California Press.

Sioshansi, Fereidoon P. and Wolfgang Pfaffenberger (eds.). 2006. *Electricity Market Reform: An International Perspective.* Amsterdam: Elsevier.

Skocpol, Theda and Paul Pierson. 2002. "Historical Institutionalism in Contemporary Political Science." In Ira Katznelson and Helen V. Milner (eds.), *Political Science: State of the Discipline*. New York: W.W. Norton, 693-721.

Smith, Vernon L. 1996. "Regulatory reform in the electric power industry."*Regulation* 1, 33–46.

Snyder, Richard. 2001. "The subnational comparative method." *Studies in Studies in Comparative International Development* 36(1), 93–110.

Sovacool, Benjamin K. 2017. "The history and politics of energy transitions, comparing contested views and finding common ground." In Douglas Arent, Channing Arndt, Mackay Miller, Finn Tarp and Owen Zinaman (eds.), *the Political Economy of Clean Energy Transitions*. Oxford: Oxford University Press, 16–35.

Steinmo, Sven and Kathleen A. Thelen. 1992. "Historical institutionalism in comparative politics." In Sven Steinmo, Kathleen A. Thelen, and Frank Longstreth (eds.), *Structuring Politics: Historical Institutionalism in Comparative Analysis.* Cambridge, UK: Cambridge University Press, 1–32.

Su, Nan. 2020. "Zengliang peidian tuichu chao yixian (Trend of exiting appeared in distribution network market)." *Zhongguo Nengyuan Bao (Newspaper of China*

Energy), April 08.

Suck, André. 2002. "Renewable energy policy in the United Kingdom and in Germany." MPI Collective Goods Preprint No. 2002/15. Available at https://ssrn.com/abstract=349900 or http://dx.doi.org/10.2139/ssrn.349900 (accessed 15 October 2018).

Sun, Shouguang, Zhe Li and Ning Wang. 2016. "Zhongguo dianli guihua PK meiguo dianli guihua (Comparison between Electric Power Planning in China and the United States)." *Zhongguo dianli bao (Newspaper of China Electric Power)*, August 10.

The People's Government of Xinjiang Uyghur Autonomous Region (PGXUA). 2021. 2020 nian Xinjiang Weiwuer zizhiqu guomin jingji yunxing qingkuang xinwen fabugao (News Release on the Economic Development Status of Xinjiang Uyghur Autonomous Region in 2020), Beijing.

The State Council of China. 2012. *Guowuyuan bangongting guanyu shenhua dianmei* shichanghua *gaige de zhidao yijian (Guidelines on Implementing the Mechanism of Coal and Electricity Prices Covariation)*, Beijing.

Tsai, Chung-min. 2014. "Regulating China's power sector: creating an independent regulator without autonomy." *The China Quarterly* 218, 452–473.

Tsui, Kai-yuen. 2005. "Local tax system intergovernmental transfers and China's local fiscal disparities." *Journal of Comparative Economics* 33 (1), 173–196.

Urpelainen, Johannes and Joonseok Yang. 2019. "Global patterns of power sector reform, 1982–2013." *Energy Strategy Reviews* 23, 152–162.

van Sambeek, E.J.W. 2001. "Institutional framework of the Chinese power sector." The Energy Research Center of the Netherlands, working paper.

Walton, Richard E. and Richard B. McKersie. 1965. *A Behavioral Theory of Labor* Negotiations*: An Analysis of a Social Interaction System.* New York: McGraw-Hill.

Wang, Gungwu. 2013. *Renewal: The Chinese State and the New Global History*. Hong Kong: The Chinese University of Hong Kong Press.

Wang, Hua and Lan Wang. 2018. "2018 nian Guangdong shichanghua jiaoyi dianliang yuezhan quan shehui yongdianliang 25% (Market-based trading accounts for 25% of total electricity consumption in Guangdong in 2018)", China News Agency, November 06.

Wedeman, Andrew H. 2003. *From Mao to Market: Rent Seeking, Local Protectionism, and Marketization in China*. Cambridge: Cambridge University Press.

Wengraf, Tom. 2001. *Qualitative Research Interview*. Los Angeles, CA: SAGE publications.

White, Lynn T., III and Cheng Li. 1993. “China coast identities: regional, national, and global.” In Lowell Dittmer and Samuel S. Kim (eds.), *China’s Quest for National Identity*. Ithaca, NY: Cornell University Press, 154–193.

Wong, Christine, Christopher Heady and Wing T. Woo. 1995. *Fiscal Management and Economic Reform in the People's Republic of China*, Hong Kong: Oxford University Press.

Wong, Christine. 1992. “Fiscal reform and local industrialization: the problematic sequencing of reform in post-Mao China.” *Modern China* 18,197–227.

Wubuli, Naibijiang. 2019. “Xinjiang Weiwuer zizhiqu zengliang beidianwang gaige cunzai de wenti ji duice jianyi (Problems and suggestions on reforming the distribution networks in Xinjiang).” The Institute of Economic Research of Xinjiang Development and Reform Commission.

Xu, Chenggang. 2011. “The fundamental institutions of China’s reforms and development.” *Journal of Economic Literature* 49, 1076–1151.

Xu, Yi-chong. 2002. *Powering China: Reform the Electric Power Industry in China*, Dartmouth, NH: Ashgate.

Xu, Zhe, Junce Ding, Zhifei Liang, Wei Chen. 2020. “kua shengqu zhongchang qi lianxu jiaoyi jizhi de shixian moshi yanjiu (Realization Mode of Medium-and Long-term Inter-provincial Continuous Transaction Mechanism).” *Dianwang Jishu (Technology of Power Grids)* 6,2071-2077.

Yang, Dali. 1997. *Beyond Beijing: Liberalization and the Regions in China*. New York: Routledge.

Yang, Dali. 2006. “Economic transformation and its political discontents in China: authoritarianism, unequal growth, and the dilemmas of political development.” *Annual Review of Political Science* 9, 143–164.

Yeh, Emily T. and Joanna I. Lewis. 2004. “State power and the logic of reform in China's electricity sector.” *Pacific Affairs* 77(3), 437–465.

Yin, Robert K. 2003. *Case Study Research: Design and Methods* (3rd ed.). Los Angeles, CA: SAGE publications.

Yu, Chongde (ed.). 2018. Z*hongguo dianli nianjian 2017 (China Electric Power Yearbook 2017)*. Beijing: China Electric Power Press.

Yu, Yilei. 2008. “Xinjiang quyu ranmei zibei dianchang hegui xing wenti chengyin fenxi ji dui nengyuan fazhan silu de qishi (Causal Analysis on the Legitimacy

of Captive Power Plants in Xinjiang and the Implications on Energy Development Pathways).” *Zhongguo dianye (China Electric Power)*7, 42-43.

Zartman, I. William (ed.).1978. *The Negotiation Process: Theories and Applications*. London: Sage Publications.

Zeng, Ming, Ximei Liu, Na Li, Song Xue. 2013. “Overall review of renewable energy tariff policy in China: Evolution, implementation, problems and countermeasures,” *Renewable and Sustainable Energy Reviews* 25:260-271.

Zhang, Chi and Thomas C. Heller. 2007. “Reform of the Chinese electric power market: economics and institutions.” In David G. Victor and Thomas C. Heller (eds.), *The Political Economy of Power Sector Reform: the Experiences of Five Major Developing Countries*. Cambridge and New York: Cambridge University Press, 76-108.

Zhang, Guobao. 2016. “Xidian dongsong de juece he shishi (The Decision-making and Implementation of the West-to-East Electricity Transfer Project).” *Zhongguo nengyuan bao (Newspaper of China Energy)*, February 24, 2016.

Zhang, Xiaochun and John E. Parsons. 2008. “Market power and electricity market reform in northeast China.” Center for Energy and Environmental Policy Research, MIT, working paper 08-001.

Zhang, Yongsheng. 2010. “How will China’s central–local governmental relationships evolve? An analytical framework and its implications.” In Ross Garnaut, Jane Golley and Ligang Song (eds.), *China, The Next Twenty Years of Reform and Development*. Canberra: Australian National University Press, 53–71.

Zheng, Yongnian. 2007. *De Facto Federalism in China: Reforms and Dynamics of Central–Local Relations*. Singapore: World Scientific.

Zhou, Li-an. 2007. “zhongguo difang guangyuan de jinsheng jinbiaosai moshi yanjiu (Governing China’s local officials: an analysis of promotion tournament model).” *Jingji yanjiu* (*Economic Research Journal*). 7, 36–50.

Zhou, Xueguang, Hong Lian, Leonard Ortolano and Yinyu Ye. 2013. “A behavioral model of “muddling through” in the Chinese bureaucracy: the case of environmental protection.” *The China Journal*. 70,120–147.

Zhou, Xueguang. 2010. “The Institutional logic of collusion among local governments in China.” *Modern China*. 36(1), 47–78.

Zhou, Yiyi, Sophie Lu. 2017. “China’s renewables curtailment and coal assets risk map,” Bloomberg New Energy Finance Report, Shanghai.

Zhu, Xufeng. 2016. “Dynamics of central–local relations in China's social welfare

system." *Journal of Chinese Governance* 1(2), 251–268.

Zhu, Yi. 2018. "Dianwang touzi zengsu weijiang, jianshe zhuanxiang pei yong dian ce (Investment in electricity grid slightly declined with infrastructure construction focused on distribution networks)." *Zhongguo dianli bao (Newspaper of China Electric Power)*, February 07, 2018.