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## **China's Market-Oriented Reforms in the Energy and Environmental Sectors**

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## EXECUTIVE SUMMARY

This paper presents a brief overview of the policies, regulations, measures, plans, and schemes aimed at facilitating and accomplishing market-oriented reforms of China's energy sector in recent decades.

### *Main Argument*

With China's high-growth era coming to an end, the country's energy demand will be entering a new phase characterized by steady growth in total energy demand. As a result, China's energy sector is bound to be confronted with a series of challenges associated with transiting to a new growth pattern. Market-oriented reforms in the energy sector are fundamental to accomplishing this transition, and a series of such reforms across some specific areas of China's energy sector have been implemented with fairly positive results and effects. However, reforms of the country's energy sector as a whole have been overcautious and conservative compared with those in other key sectors. Since taking office in 2012, the Xi Jinping administration has adopted several new measures to improve energy price formation mechanisms and to encourage market competition, which collectively have accelerated the pace of relevant reforms of the energy sector significantly. This paper argues that there are a wide spectrum of factors driving China's efforts in liberalizing its energy market and puts forward a series of recommendations on taking forward the market-oriented reforms in the energy sector in the broader context of nationwide strategic development of energy sector.

### *Policy Recommendations*

- Unified market access shall be institutionalized and the diversification of sources of investment in the energy sector should be promoted. Price reforms must continue to be advanced in oil and gas, electricity, and other related energy subsectors. Prices for relevant competitive areas shall be liberalized in an orderly manner.
- Reforms should be deepened in priority areas such as electricity grids and oil and gas pipeline networks, with the objectives of clearly defining these networks and gradually establishing supply-and-demand oriented, reliable, and flexible electricity and gas transmission system with fair access. Power sector reforms are to be accelerated and direct trading between supply and demand sides shall be promoted to build a competitive electricity market.
- The development and implementation of energy strategy, planning, policy and standards shall be further strengthened. The government should accelerate the process of decentralization to streamline administrative procedures through deregulation or delegation of authority.

Energy is the fundamental basis of modern societies, and energy supply and security are closely related to the overall economic development of a country. China is the world's largest energy consumer, and since the turn of the 21st century, its energy industry has made great achievements, including a remarkable enhancement in supply capacity and the constant optimization of energy systems and utilities.

According to the National Bureau of Statistics of China, the total energy consumption of China in 2014 reached approximately 4.26 billion tons of standard coal equivalent. Given its rapid economic development, China's existing energy supply and consumption patterns create new challenges to sustaining the country's economic growth. According to the U.S. Energy Information Administration, China's energy intensity in 2011 was 2.4 times the world average, 3.4 times that of the United States, and 5.4 times that of Japan.<sup>1</sup> In particular, as the smog and haze thickens and conflicts between economic growth and environmental protection become increasingly significant, the country urgently needs to restructure its energy sector toward a highly efficient, clean, reliable, and sustainable energy development path.

With the country's high-growth era coming to an end, China's energy demand will be entering a new phase characterized by steady growth in total energy demand. As a result, the energy sector is bound to be confronted with a series of challenges associated with transitioning to a new growth pattern, one which requires adjustment and optimization of the energy structure, adoption of innovative energy systems and mechanisms, improved energy efficiency, accelerated development of clean energy, and enhanced security of energy supply to support China's economic transformation. Market-oriented reforms in the energy sector are fundamental to accomplishing this transition.

Since the implementation of nationwide reform and opening-up policies, China's energy sector has adopted a step-by-step reform model. Initial efforts to enact a series of market-oriented reforms have included relaxing investment restrictions, deregulating price controls, separating government functions from enterprise management, fostering market participants, and promoting market competition. However, despite fairly positive results from these efforts, overarching reforms of the energy sector as a whole have been widely acknowledged to be overcautious and conservative when compared with the remarkable and encouraging pace and

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<sup>1</sup> U.S. Energy Information Administration, "International Energy Statistics," <http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=92&pid=46&aid=2>.

intensity of reforms in other key sectors. As a result, many in-depth sectorial reform measures have yet to be implemented systematically. Meanwhile, behaviors such as the strengthening of administrative examination and approval in the name of macro-level control and reinforcing the government's intervention in the name of market failures have intensified gradually. "The state advances, the private sector retreats" has become a prominent paradigm and blurs the originally clear vision of market-oriented reforms in the energy sector.<sup>2</sup>

### **Recent Developments in China's Energy Sector**

Having recognized the insufficiencies and inefficiencies resulting from the lack of a market mechanism in the country's energy sector, the government has been looking for opportunities to release its new reform agenda for restructuring the sector on a gradual and progressive basis. The administration that took office in 2012 emphasizes reforms of the economic system as the core of comprehensive and deeper reforms. The key issue for achieving this objective is handling the relationship between the government and the market to allow the market to play a decisive role in allocating resources.<sup>3</sup> Against this backdrop, a series of new actions have since been taken by the government to improve energy price formation mechanisms and encourage market competition, collectively accelerating the pace of relevant reforms significantly.

The following sections present a brief overview of the policies, regulations, measures, plans, and schemes aiming for market-oriented reforms of the energy sector over the past decades in coal, electricity, oil and gas, and renewable energy and energy efficiency. For each subsector, the milestones of major reforms are briefly reviewed, with the emphasis placed on the most recent development that best presents the status quo of the subsector. The paper then

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<sup>2</sup> Typical examples of insufficient reforms include, inter alia, administrative examination and approval of energy investment projects have been strengthened instead of being streamlined and standardized; energy prices cannot be determined effectively by market forces and administrative controls remain; state-owned enterprises in the energy industry are reluctant to fully implement reforms, and the separation of government functions from business activities is yet to be achieved; the administrative monopoly in the energy sector has yet to be broken up to end its long-standing monopoly on the power grid as well as the "three barrels of oil" monopoly in the oil and gas market; the energy-related legal system is far from satisfactory; and the energy tax system needs to be further improved and to place more emphasis on environmental concerns.

<sup>3</sup> This information comes from the Chinese eighteenth CPC Central Committee third plenary meeting documents.

examines market-based mechanisms to strengthen environmental protection and address climate change.

### *Coal Market Reform*

Coal, as a basic energy resource in China, accounts for around 70% of primary energy production and consumption. Thermal coal is the most dominant type, accounting for over 50% of total coal consumption. Since 1993, the government has begun lifting price controls and instigating other key reforms.

In the mid-1990s, coal reforms quickened and have since passed through three stages: (1) planning, (2) combination of planning and market, and (3) the linkages among supply and demand sides. In 1996, the coal market started using a dual-track pricing system of regulated and market prices for thermal coal. As part of that initiative, an official guided price for thermal coal was posted. In 1999, the government offered key contracts to selected enterprises in power, metallurgy, fertilizer, and eight other industries, wherein the related resources supply and railway capacity were allocated and guaranteed by the government. All coal prices, with the exception of prices for thermal coal, were liberalized. In 2002, the guided price for thermal coal was canceled, and only the reference price was retained.

Since 2004, the government has gradually canceled these organized contracts. To replace them, the government allowed coal suppliers and buyers to sign contracts under the framework of transportation allocation. The scope of this key order, however, has been limited to electricity, fertilizer, and residential consumption. As for thermal coal, the practice of publishing reference price remained in place for several years, until the next round of significant reform was announced in 2012.

In 2012, as production picked up while demand was moderate, concerns about a coal shortage were further eased. Term rates and spot prices subsequently began to converge, with some regions having lower spot prices than term rates. In addition, the performance of power utilities also improved. All these factors together allowed the central government to liberalize the thermal coal market. In December 2012, the State Council of China issued its “Guideline on Deepening Market-Oriented Reform of the Thermal Coal Sector” and ended the dual-track

pricing system launched in 1996 for thermal coal.<sup>4</sup> Key contracts between miners and power utilities were canceled, and starting from 2013, the cross-provincial allocation rights of railway transportation capacity were released by the National Development and Reform Commission (NDRC). These changes enabled coal suppliers and power generators to sign contracts at their own discretion and encouraged them to rely on medium to long-term contracts.

Meanwhile, the NDRC ordered local governments not to intervene in the normal business activities of coal-based power enterprises and tasked the China National Coal Association (CNCA) to consolidate execution and performance of contracts and the transportation department to organize shipment and distribution. As the main part of coal price reforms, market reforms for thermal coal ended the sixteen-year dual-track pricing system, but the introduction of coal-electricity price linkages is also a big step forward in coal price reforms. As a result, domestic prices were effectively liberalized and left to market forces.<sup>5</sup>

In October 2014, China's Ministry of Finance and State Administration of Taxation presided over tax reforms for coal resources to bring order to coal-related charges and shift to valuation taxation from specific duty taxation.<sup>6</sup> Coal mineral compensation payments were reduced to zero, the collection of a price-regulating fund for coal was stopped, and the various fees for coal, such as ecological compensation fees, were canceled. Local governments below the provincial level were banned from the collection of coal-related charges. The reforms implemented an *ad valorem* structure for the coal resource tax levy, with the tax rate ranging between 2% to 10%. The provinces, autonomous regions, and municipalities were directed to prepare the applicable tax rate and were provided greater autonomy at the regional level for approving taxes, before reporting these to the ministry. The coal tax reforms were an important measure that reflected the scarcity of resources and established the market property tax system to further promote a market-based system of coal prices.

In January 2015, Shanxi Province released a document entitled “Opinions on Reforming of the Coal Management System,” which proposed bid invitation, auction, and listing mechanisms for the primary market of coal resources and actively promoted the development of mixed

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<sup>4</sup> [http://www.gov.cn/zwggk/2012-12/25/content\\_2298187.htm](http://www.gov.cn/zwggk/2012-12/25/content_2298187.htm).

<sup>5</sup> This information comes from an NDRC press conference on deepening thermal coal market-oriented reforms.

<sup>6</sup> [http://szs.mof.gov.cn/zhengwuxinxi/zhengcefabu/201410/t20141011\\_1148669.html](http://szs.mof.gov.cn/zhengwuxinxi/zhengcefabu/201410/t20141011_1148669.html).

ownership.<sup>7</sup> The document also announced a proposal to remove regulatory barriers during production, processing, trade, transportation, and consumption, along with reforming the coal management system and pushing forward the development of the coal market in Shanxi.

Shanxi Province accounts for approximately 25% of China’s total coal reserves and for over 25% of the country’s annual coal production. Given this strategically significant position as a major coal-producing base with great abundance of coal resources and its consistent ranking as first in terms of coal production volume over the past few decades, the proposed market-oriented reform measures in the province, if effectively implemented, are expected to influence policies in other major coal-producing provinces, including Inner Mongolia, Shaanxi, Henan, Shandong, Anhui, and Guizhou. This is expected to further accelerate the overall marketization progress of coal industry across China.

**Figure 1** *Progress of Coal Market Reform in China*



<sup>7</sup> <http://www.sxfzb.gov.cn/Article/ShowArticle.asp?ArticleID=2519>.

### *Electricity Market Reform*

Since the implementation of reform and opening-up policies in China, power sector restructuring has undergone a series of key developments.

*Centralized power development projects under circumstances of electricity shortage.* Until 1985, China's power sector was highly centralized under the sole command and control of the central government, which performed all the operation and control functions, allocated electricity quotas, and planned new supply and infrastructure development. The centralized planning model seriously hindered the development of the power industry, resulting in more than twenty years of serious power shortages. In response to this shortfall, reforms were forced on the power industry in 1985 through the adoption of two major reform measures.

The first one was the collective construction of power plants and regulation of the power grid by the central government, which aimed to promote fundraising for new generation capacity and to create investment incentives for private sector capital. New plants received tariffs based on a repayment method of the capital investment, finance costs, and profit.<sup>8</sup> The second measure was to gradually decentralize control and regulation of pricing and access mechanisms through the devolution of certain authorities and responsibilities to provincial governments. These reforms led to the rapid development of the power industry and largely alleviated the nationwide power shortages by 1995.

*The separation of government functions from business activities.* In March 1997, the second round of the electricity market reforms started, establishing the wholly state-owned and financially independent State Power Corporation (SPC), mandated to take over all electricity assets from the Ministry of Electricity Power and manage the operation of the power system. A year later the ministry was fully dissolved and spun off its administrative and regulatory responsibility to the State Economic and Trade Commission, formally separating the administrative and regulatory system from the business operations of the power industry. In nature, SPC was a public utility operating the state-owned generation and transmission assets, without any government authorities and functions. Nevertheless, SPC featured a highly vertical integration of power generation, transmission, distribution, and power sales. It still maintained a

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<sup>8</sup> New plants included those plants constructed after 1986 without government financing and all plants constructed after 1992 regardless of financing.

vertical monopoly by controlling half of the generation capacity and nearly all the transmission and distribution infrastructure in the country.

*The separation of electricity generation from the grid.* By the late 1990s, the nationwide electricity shortages had been almost relieved and electricity supply and demand were more balanced, with oversupply in some regions. Along with increasingly intense competition in the electricity-generation market, the drawbacks of a vertically integrated monopoly operation mode started to emerge and became increasingly evident. SPC owned all transmission assets and was responsible for scheduling, thereby putting provincial plants and other independent power producers in an unfavorable position against the SPC-affiliated generating plants. Furthermore, provincial protectionism as an emerging phenomenon began to create barriers to the opening of inter-provincial electricity transmission and distribution.

“The Notice of the State Council on the Plan Regarding the Restructuring of the Power Industry,” issued in 2002, presented the roadmap for power industry reform. The document aimed to break up the monopoly and promote competition, improve efficiency and lower costs, improve pricing mechanisms and optimize resource allocation, promote national grid interconnections, and develop a fair, open, competitive, and orderly electricity market with government-supervised separation of business activities from government functions. The period marked a new era of market-oriented reforms in China’s power industry.

The same year, SPC was reorganized into two grid companies, five generating companies, and four auxiliary corporations in line with the governing principle of separation of generation and grid. The State Electricity Regulatory Commission was set up in 2003 to regulate the development market and experiment with the initiative of separating regulatory and governing functions. The Power Tariff Reform Plan was promulgated in the same year. In 2004, benchmark electricity-pricing policies (for feed-in tariff) and a coal-electricity price-linkage mechanism were introduced.

Subsequently, China continued to explore specific measures for a thorough operational and administrative restructuring toward further marketization. The period from 2002 to 2006 was focused on the development of regional electricity generation markets with a “single buyer” mode. The second phase reformed the retail market, with direct transactions between power-generation companies and users at the core, starting from 2004. After 2009, a consensus was reached to replace regional generation market reforms with direct trade reforms as the dominant

option for reforming the electricity market. In 2011, two auxiliary power industry groups, the Power Construction Corporation of China Ltd. and China Energy Engineering Corporation Ltd., were officially founded, and they signed separation agreements with State Grid Corporation of China and China Southern Power Grid. This ended nine long years of separation of major business and minor business in the power sector.

On October 23, 2014, the NDRC issued the “Notice for Transmission and Distributing Rate Reform Pilot in Shenzhen,” which officially launched a new round of reforms of transmission and distribution prices. The document changed the prevalent existing revenue model of grid companies by establishing price differences through power trading.<sup>9</sup> The new regulation caps the total revenue of the grid company by appraising and determining the permitted costs and profits based on effective assets. Independent electricity transmission and distribution prices will also be published. At the same time, a methodology for determining allowable costs will be developed. The regulation is to create incentive mechanisms to curb excessive costs of grid companies.

The above-mentioned pilot reform in Shenzhen was the first in China that adopted the international pricing practice as a means of strengthening the regulation of the costs of grid companies as well as incentivizing the grid companies to take up measures to improve efficiencies. The move marked a change in the regulatory stance toward grid companies and also an important signal to accelerate electricity pricing reforms. The pilot reform in Shenzhen was intended to accumulate experience for wider adoption of a new transmission and distribution pricing system and to lay solid groundwork for the further restructuring of the electricity market.

*Deepening power sector reform.* In March 2015 the State Council issued a document entitled “Opinions Regarding Further Deepening of the Power Sector’s Reform,” which considered experiences gained and lessons learned in past reforms, including the Shenzhen pilot. The specified priorities and routes for further deepening reforms are centered on the orderly deregulation and liberalization of tariffs for relevant competitive areas in the value chain of the power sector, except transmission and distribution; the grant of market access to electricity distribution and retail businesses to private sector capital in an orderly manner; the orderly deregulation and liberalization of the planning of power generation and consumption, except for

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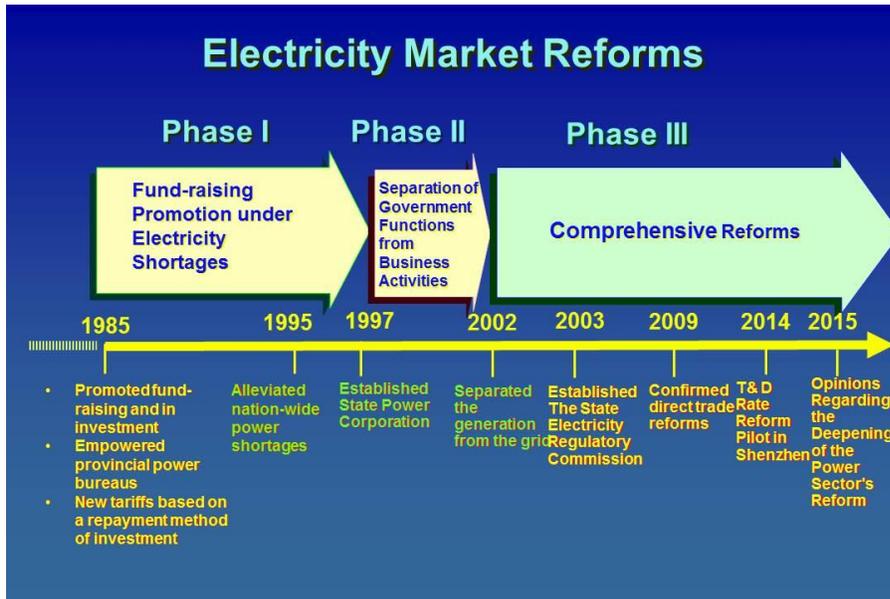
<sup>9</sup> [http://jgs.ndrc.gov.cn/zcfg/201411/t20141104\\_639639.html](http://jgs.ndrc.gov.cn/zcfg/201411/t20141104_639639.html).

public welfare and adjustment purposes; and the establishment and regulation of electricity trading agencies with a certain level of independence. Furthermore, as power system security is extremely important to China's economy, strengthening government oversight to address electricity security challenges during the transition to a market-oriented electricity system is an integral part of the reform.

The announced latest round of reforms of the power sector is widely perceived as compromised due to a range of factors and constraints. The intensive agenda of key tasks to be undertaken includes (1) further advancing tariff reforms in an orderly manner and rationalizing pricing mechanisms, (2) advancing reforms of the electricity trading system and improving market-based trading mechanisms, (3) establishing electricity trading agencies with a certain level of independence in order to inform a fair, equitable, and properly functioning market platform, (4) accelerating reforms on the planning of power generation and consumption and unleashing the decisive role of market mechanisms, (5) steadily promoting and advancing reforms on electricity retail and granting market access to electricity distribution and retail businesses to private sector capital in an orderly manner, (6) enabling open and fair access to the grid in order to establish mechanisms promoting the development of distributed power generation, and (7) strengthening overall planning and scientific supervision and enhancing the security of power systems.

These key tasks and the specific detailed activities present a panoramic view of the current situation of China's power sector. They pinpoint a series of fundamental issues and critical gaps that remain, despite rounds of reform over the past three decades, and show the particular complexities, difficulties, and challenges associated with the market-oriented reforms of China's power sector.

**Figure 2** Progress of Electricity Market Reforms



### Oil and Gas Market Reform

*Oil pricing: Four phases of market oriented pricing reforms.* For several decades after the foundation of the People’s Republic of China, China’s petroleum prices were uniformly set by the government under central planning. However, with the transition of the economic system toward a market-based economy, petroleum-pricing mechanisms shifted. From 1998 onward, the government has relaxed price controls and begun a four-phased process of market-oriented pricing reforms.

1. On June 3, 1998, the former State Development and Planning Commission promulgated the Crude Oil and Refined Oil Price Reform Program, which marked the start of pricing reforms of petroleum products, by announcing that both domestic crude oil and refined oil prices would follow the Singapore market. To further improve pricing mechanisms, a new system was announced in November 2001 to incorporate the prices in the Rotterdam and New York markets, in addition to the Singapore market. With this new mechanism, domestic prices remained unchanged when the prices of the three markets fluctuated within the scope of 5% to 8%, while the commission intervened when the prices fluctuated beyond these ranges.
2. In the second phase of reforms during the period from 2003 to 2008, the NDRC retained macro-level control by making the state and companies absorb the high costs of oil

products. This policy was implemented in response to the considerable fluctuations and rapid price rises in international markets and in an effort to minimize the impacts on domestic economic development to the extent possible.

3. In 2009, the NDRC launched a new refined oil price reform program allowing it to adjust domestic refined oil prices accordingly when the moving average of international crude prices fluctuated outside 4% around the established price within 22 consecutive working days. These reforms accelerated market-oriented reforms and further linked domestic oil prices to international markets. However, the new pricing mechanism was criticized by many market participants and experts for its long price-adjustment period and for lagging behind developments and price changes in the international market.
4. The fourth phase of domestic oil product reforms commenced when the NDRC revised its pricing regime on March 26, 2013, in three respects: (1) shortening the price adjustment period to every ten working days, (2) cancelling the 4% floating band for oil price changes, and (3) adjusting the varieties of crude against which the domestic refined oil prices were benchmarked.<sup>10</sup> The reforms made domestic oil prices more reflective of changes in international prices. However, some market players believe that the latest pricing mechanism safeguards the profits of domestic oil-refining companies and fails to reflect actual domestic supply and demand.

*Natural gas pricing: Steps in the right direction.* For a long time, China used “cost-plus” pricing mechanisms for natural gas to protect the interests of producers, but the Chinese government has begun the process of reforming this sector. In November 2011, in order to explore reform paths and mechanisms for natural gas pricing, the NDRC launched a pilot program for natural gas price reform in the southern provinces of Guangdong and Guangxi.<sup>11</sup> By simulating the market through linking the city gate prices to the market-guided prices of certain alternative energy sources, a “netback market value pricing method” was adopted to calculate the corresponding gas prices. A dynamic price adjustment mechanism was built that reflected market supply and demand and the scarcity of resources.

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<sup>10</sup> [http://jgs.ndrc.gov.cn/jggs/sytrqjg/201303/t20130326\\_534087.html](http://jgs.ndrc.gov.cn/jggs/sytrqjg/201303/t20130326_534087.html).

<sup>11</sup> [http://www.sdpc.gov.cn/zfwz/zfdj/jggg/tyq/201112/t20111227\\_452950.html](http://www.sdpc.gov.cn/zfwz/zfdj/jggg/tyq/201112/t20111227_452950.html).

Afterward, in June 2013, the NDRC issued a “National Development and Reform Commission Notice on Adjusting the Natural Gas Prices” clearly articulating the scope and basic ideas of the price adjustment and shifting the pricing management of natural gas factories to gate stations.<sup>12</sup> The pipeline natural gas prices were linked to fuel oil and liquefied petroleum gas prices in accordance with the government-guided ceiling prices. The implementation of “stock gas plus incremental gas” gate station price-adjustment programs was emphasized. To distinguish between stock gas and incremental gas, the stock gas price adjustment will be implemented in three phases, with the ultimate plan of realizing unification with the incremental gas price by 2015. The NDRC also decided to adjust nonresidential natural gas prices and create a distinction between stock gas and incremental gas. In this round of price adjustments, the stock gas price was raised by 0.4 yuan per cubic meter, and this adjustment of the price for incremental gas was directly aligned with international markets. This price change is widely recognized as a first step in the right direction for China.

In August 2014, the NDRC enacted the second phase of natural gas price reforms by issuing a notice wherein from September the gate station price of nonresident stock natural gas was raised by 0.4 yuan per cubic meter, while gas for residents remained unchanged.<sup>13</sup> A further liberalization in the pricing policy of imported liquefied natural gas (LNG), shale gas, coal-bed methane, and coal to gas was announced. This was the second step of natural gas price reforms.

*Encouraging private investment in energy infrastructure.* In addition to movement on natural gas pricing, the Chinese government worked to increase investment in private energy infrastructure. By the end of 2014, the State Council promulgated the “Guidelines on Innovation of Investment and Financing Mechanisms for and Encouraging Private Investment in Key Sectors” to explicitly encourage private capital to invest in the construction and operation of oil and gas pipelines and storage facilities, as well as coal storage and transportation infrastructure.<sup>14</sup> Private companies and local state-owned enterprises were also encouraged to support the construction of oil and gas pipeline networks, coastal LNG-receiving stations, underground gas storage, urban distribution pipeline networks, and city gas facilities, as well as investing as major

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<sup>12</sup> [http://www.sdpc.gov.cn/zwfwzx/zfdj/jggg/tyq/201306/t20130628\\_547973.html](http://www.sdpc.gov.cn/zwfwzx/zfdj/jggg/tyq/201306/t20130628_547973.html).

<sup>13</sup> [http://www.sdpc.gov.cn/gzdt/201408/t20140812\\_622009.html](http://www.sdpc.gov.cn/gzdt/201408/t20140812_622009.html).

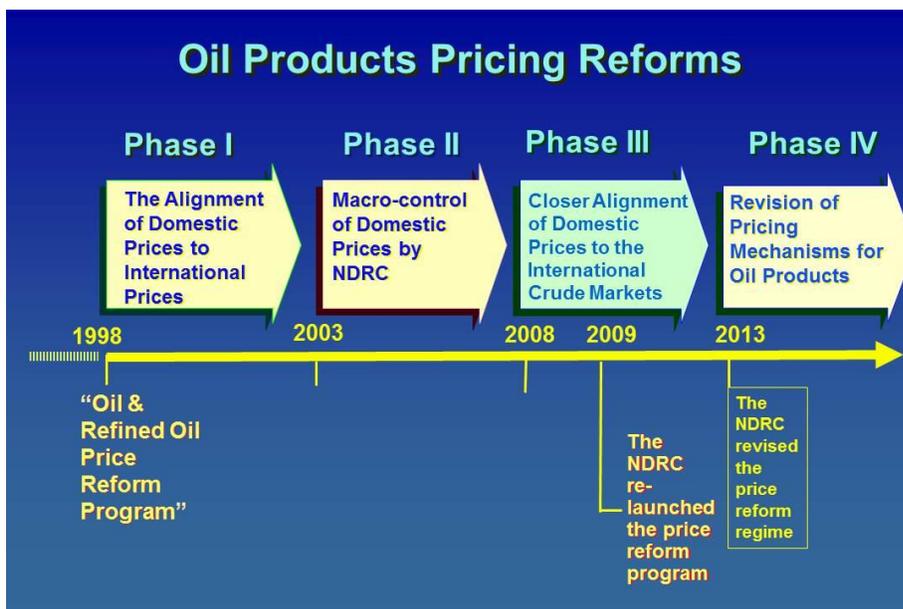
<sup>14</sup> [http://www1.www.gov.cn/zhengce/content/2014-11/26/content\\_9260.htm](http://www1.www.gov.cn/zhengce/content/2014-11/26/content_9260.htm).

shareholders in the construction of oil and gas pipelines and commercial repositories for both crude and refined oil.

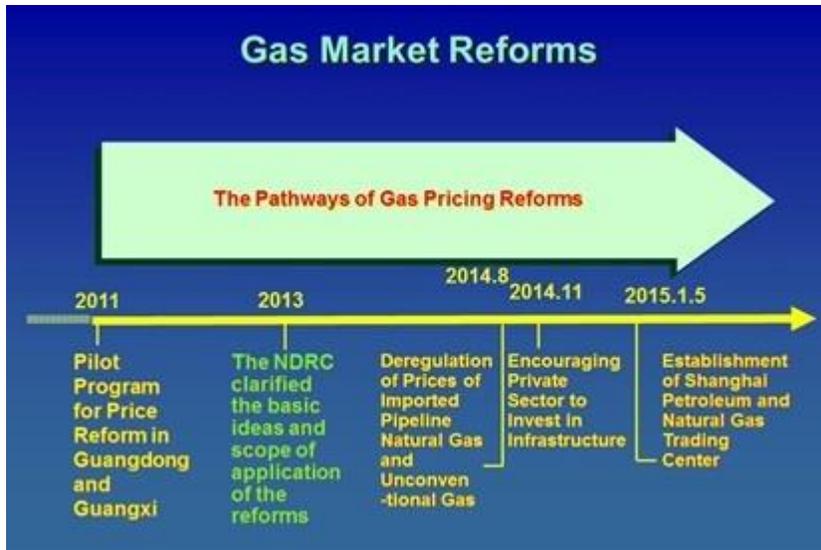
At present, more than 80% of the existing long-distance pipeline networks are controlled by PetroChina. The so-called “three barrels of oil” monopoly—Sinopec, PetroChina, and China National Offshore Oil Corporation (CNOOC)—together with other state-owned oil enterprises, own more than 97% of long-distance gas pipelines, and the participation of the private sector is noticeably limited. According to the new policy, the prospect for attracting private capital to new pipeline design and construction is enormous. However, there are still barriers—Sinopec, PetroChina, and CNOOC have significant experience and expertise in the key technologies of pipelines construction. In addition, the huge upfront investment required is a major constraint on the participation of private capital.

On January 5, 2015, the Shanghai municipal government approved the establishment of the Shanghai Petroleum and Natural Gas Trading Center funded by the Xinhua Financial Investment Co. Ltd and nine other companies. The establishment of the center will help revolutionize the energy pricing system and is an important step in reforming natural gas pricing. As the Chinese market becomes increasingly liberalized, the natural gas trade may be shifted from long-term contracts to short-term contracts or even spot trading. Nonetheless, long-term contracts are not expected to be replaced entirely.

**Figure 3** *Progress of Oil Products Pricing Reforms*



**Figure 4** *Progress of Gas Market Reforms*



*Promotion of Renewable Energy and Energy Efficiency*

Since the adoption of its Renewable Energy Law in 2005, China has emerged as a world leader in the adoption of renewable energy. The law proposed five important measures: first, a total renewable energy target; second, rules for renewable energy grid-connected power generation and a full-payment purchasing system; third, feed-in tariffs and a cost-allocation system for renewable energy; fourth, support for energy access and rural renewable energy development; and fifth, fiscal measures, including setting up special renewable energy development funds and providing subsidized loans and tax incentives to renewable energy development and application projects. This set of measures, along with substantial support for the manufacturing industry, has resulted in enormous growth in renewable energy generation and deployment over the past decade.

*Wind power.* In recent years, China has shown rapid progress in the development of wind power. According to the latest wind power market data released by Bloomberg New Energy Finance, in 2014 China installed new onshore wind power capacity of 20.7 gigawatts (GW),

which makes it first in the world for added wind power capacity for the sixth consecutive year . At the end of 2014, China’s total wind power grid capacity reached 96 GW.<sup>15</sup> The rapid development of China’s wind power industry is closely related to its market-determined concessional bidding tariff structure and a series of other related market-oriented policies.

The wind power industry has been through an early demonstration phase (1986–93), an industrialization phase (1993–2004), and a scale and localization phase (2003–9), with gradual improvement in market conditions since 2009.<sup>16</sup> Wind power’s tariff structure has also been constantly adapted to reflect improvements in the industry. In the initial demonstration phase, the tariff was the same as the coal-fired electricity rate—less than 0.3 yuan per kilowatt-hour (kWh). In the industrial establishment phase, electricity purchase agreements were signed and prices negotiated between wind power plants and power-grid companies, with the price varying between 0.38 yuan per kWh and 1.2 yuan per kWh. With scale-up and localization after 2003, the NDRC organized the first national wind-power concession bidding to adopt a market-oriented approach to determine the tariff and bring competition into wind farm development. With the coexistence of tender pricing and an approved tariff, the national tender price keeps rising. Currently, four classes of benchmark prices have been assigned according to wind power resource area (0.51 yuan per kWh, 0.54 yuan per kWh, 0.58 yuan per kWh, 0.61 yuan per kWh).<sup>17</sup> In December 2014, the NDRC introduced new benchmark price adjustments in wind power whereby class I, II, and III wind resource area benchmark prices have been reduced by two cents per kWh, and the adjusted benchmark prices for each class now are 0.49 yuan per kWh, 0.52 yuan per kWh, and 0.56 yuan per kWh. The class IV wind resource area has been maintained as unchanged at the existing benchmark price of 0.61 yuan per kWh.<sup>18</sup>

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<sup>15</sup> Louise Downing, “BNEF on U.S. Wind-Power Installations Rose Sixfold in 2014: BNEF,” Bloomberg, January 22 2015, <http://www.bloomberg.com/news/articles/2015-01-22/u-s-wind-power-installations-rose-sixfold-in-2014-bnef>.

<sup>16</sup> Sino-Danish Wind Energy Development Programme, “Report of Chinese Wind Power Development Status and Wind Power Price,” 2009.

<sup>17</sup> NDRC, “Notice of the National Development and Reform Commission on Improving the Policies for On-Grid Wind Power Prices,” no. 1906, 2009.

<sup>18</sup> NDRC, “Circular of the National Development and Reform Commission on Adjusting the Benchmark On-Grid Tariffs for Onshore Wind Power Projects,” no. 3008, 2014.

Over this period, the Chinese government has continuously been trying to explore a reasonable market mechanism for pricing wind power. At different stages, the wind power price has fluctuated as prices increased across countries year by year. The new NDRC-approved tariff is slightly lower than previous levels, which is in line with the regulatory developments in the world's wind power industry, and makes China's wind power electricity more rationally grounded.

*Solar power.* In China, developments in the solar and wind power industries are fairly similar. In the case of solar, the government has also pushed through a major concession tender, promoted centralized photovoltaic (PV) power plant construction, and pushed the benchmark price to determine ways to guide social investment. In recent years, as China's PV industry has rapidly developed, the PV application market is also gradually expanding, and the cost of domestic power generation has significantly been reduced, marking a significant improvement in market competitiveness.

A number of comprehensive analyses are available outlining the rapid development of China's solar PV market.<sup>19</sup> Before 2006, PV policies were mainly administered at the local government level to establish targets, formulate local rules, and supervise the implementation of demonstration projects. From 2006 onward, national policies specific to PV R&D and manufacturing enterprises began to appear, followed by direct fiscal subsidies for technology R&D or PV cell production. Since 2007, there have been policies specific to the electricity generation sector, including PV power-generation feed-in tariffs and accommodation trading mechanisms, unified pricing, and guarantee mechanisms for full-payment purchasing of PV-generated power.

These supportive policies were given momentum through enabling a large-scale PV concession tender program, which added PV capacity of 4.3 GW between 2009 and 2012, and the Golden Sun program, through which 700 off-grid distributed PV systems were established with a combined capacity of 5.8 GW. The combination of these policies has established China as a world leader in both solar-cell manufacturing and in PV deployment. In 2013, China accounted for approximately 60% of the world's solar PV production and installed 11.3 GW of PV,

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<sup>19</sup> See, for example, Q. Zhi, H. Sun, Y. Li, Y. Xu, and J. Su, "China's Solar Photovoltaic Policy: An Analysis Based on Policy Instruments," *Applied Energy* 129 (2014); and F. Zhang, D. Hao, R. Margolis, and J. Su, "Analysis of Distributed-Generation Photovoltaic Deployment, Installation Time and Cost, Market Barriers, and Policies in China," *Energy Policy* 81 (2015).

representing almost a third of PV capacity installed worldwide. Other renewable energy technologies are similarly supported and also growing strongly.

*Energy efficiency.* Another important feature of China’s energy policy has been its acknowledgment of the important role that energy efficiency and conservation can play. From 1980 to 2001, China was able to limit energy demand growth to less than half of GDP growth through very aggressive energy-efficiency programs organized by the central government, working closely with provincial and municipal authorities.<sup>20</sup> This involved (1) tight oversight of industrial energy use, including monitoring requirements for large users, closing inefficient facilities, and promoting efficient technologies, (2) financial incentives for energy-efficiency investments and cogeneration, (3) information services at the national, provincial, and local levels, including the creation of over two hundred energy conservation service centers, (4) education and training, and (5) research and development (at modest funding levels) and demonstration projects (at more significant levels).

In the early 2000s, however, rapid growth in heavy industry and manufacturing saw trends in energy intensity reverse. In response to this, the NDRC released its “Medium and Long-Term Plan for Energy Conservation” in 2004 and implemented a wide-ranging set of measures between 2004 and 2008 marking a new beginning in its commitment to energy efficiency. Goals set out under this plan were to reduce energy intensity by 20% between 2005 and 2010 (an annual average of 3.6% per year) and to continue this decline at the same rate until 2020. At the time of writing, targets were being met, with a 4.8% fall in 2014. Ongoing restructuring is shifting China away from an economy dominated by energy-intensive industries and construction toward one focused more on consumption and the service sector.

#### *Market Mechanisms for Promoting Environmental Protection and Addressing Climate Change*

Amid China’s rapid growth and subsequent increasing thirst for energy, environmental sustainability has become a pressing issue. Emissions trading is an internationally accepted market-based regulatory approach that provides companies with the flexibility of adopting appropriate means to achieve their compliance with a set of environmental targets. Emissions trading can raise environmental protection awareness of pollution emitters, promote the

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<sup>20</sup> N. Zhou, M.D. Levine, and L. Price, “Overview of Current Energy-Efficiency Policies in China,” China Energy Group, Energy Analysis Department, Environmental Energy Technologies Division, 2009.

installation of more recycling and emission reduction units, contribute to accelerating industry structure adjustment, and improve environmental quality. Many countries use this mechanism with the aim to fully avail themselves of the decisive role of markets in allocating resources.

China's energy and environmental policies must address the challenges of environmental integrity and climate change in the future, and some have suggested the introduction of trading schemes into the Chinese energy sector and environmental protection industry as a potential solution.

*Recent progress on trading schemes.* Since 2007, the initiative of compensated use of pollution discharge rights and trading on a pilot basis has been carried out in eleven provinces, autonomous regions, and municipalities including Tianjin, Hebei, and Inner Mongolia, with some progress achieved. In August 2014 the Chinese government issued a guidance document titled “Guidance of the State Council on Further Promoting the Pilot Work of Compensated Use of Pollution Discharge Rights and Trading” with the aim of further facilitating and expanding the pilot work and providing direction for a long-term and effective drive to continuous and effective reduction of major pollutants.<sup>21</sup> This document articulated the government's plan to accomplish the institutionalization of compensated use of pollution discharge rights and the trading of pollution discharge rights at all pilots by 2017.

In China, carbon emissions trading at the national level started relatively late. First, in 2011 the NDRC approved the setup of pilot schemes for trading carbon emissions allowances in seven provinces and municipalities.<sup>22</sup> By 2013, five out of the seven pilot schemes (Shenzhen, Shanghai, Beijing, Guangdong, and Tianjin) were launched in sequence. By 2014, as the first five pilots completed their initial compliance period, the remaining two pilots, Hubei and Chongqing, were launched.

Further, in September 2014 the NDRC issued a “National Plan for Addressing Climate Change (2014–20).” The plan made it clear that in response to climate change, China will expand its pilot schemes for carbon trading and accelerate the pace of establishing a national market for carbon trading. As of the end of October 2014, the country has observed trading of carbon emission allowances equaling 13.75 million tons of carbon dioxide equivalent with a

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<sup>21</sup> [http://www.mof.gov.cn/zhengwuxinxi/zhengcefabu/201408/t20140825\\_1130901.htm](http://www.mof.gov.cn/zhengwuxinxi/zhengcefabu/201408/t20140825_1130901.htm).

<sup>22</sup> [http://qhs.ndrc.gov.cn/gzdt/201201/t20120113\\_456510.html](http://qhs.ndrc.gov.cn/gzdt/201201/t20120113_456510.html).

cumulative turnover of over 500 million yuan. With the size of its carbon market expanded significantly, currently China stands as the world’s second-largest carbon market.<sup>23</sup> Toward the end of 2014, the NDRC issued the “Interim Measures for Trading Carbon Emission Allowances” to “continue promoting the development of a unified national carbon market.”<sup>24</sup>

The existing market structure for trading pollution discharge rights and carbon emission allowances is divided into two levels: the primary market and secondary market. In the primary market, quotas are allocated by the government to emitters. For pollution discharge rights, the allocation of quotas is fee-based, requiring companies to pay for obtaining quotas. In contrast, for carbon emission allowances, the allocation of quotas is primarily free of charge, with some exceptions in the Guangdong and Shenzhen pilot schemes, where fee-based allocation in the form of auctioning has been carried out. On the contrary, in the secondary market, emission allowances are traded between companies. Companies with low abatement costs for emissions reductions can sell the surplus allowances for profit after meeting their emission targets, whereas companies facing high cost of internal abatement can purchase the allowances on the market.

In the context of environmental protection and climate change, the existing established mechanisms for trading pollution discharge rights and carbon emission allowances remain to be improved. It has been commonly observed that trading activities at various pilots have been very limited and stagnant. Apparently, the role of the market mechanism has not yet been realized, and improvements in the design of relevant market systems and institution are required.<sup>25</sup>

*Other measures for working toward a more sustainable environment.* After 2012, the Chinese government started to place more emphasis on applying fiscal, taxation, and price measures for guiding energy production and consumption and promoting energy conservation and emission reductions. In addition to the abovementioned coal resource tax, the government has also aimed to speed up resource tax reforms. In late 2014, Finance Minister Lou Jiwei announced a series of tasks relating to tax reforms in the energy sector, including implementation of coal resource tax reforms; implementation of nation-wide reforms on taxation on resources

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<sup>23</sup> [http://www.china.org.cn/business/2014-06/10/content\\_32627360.htm](http://www.china.org.cn/business/2014-06/10/content_32627360.htm).

<sup>24</sup> [http://qhs.ndrc.gov.cn/zcfg/201412/t20141212\\_652007.html](http://qhs.ndrc.gov.cn/zcfg/201412/t20141212_652007.html).

<sup>25</sup> [http://paper.people.com.cn/rmwz/html/2014-10/01/content\\_1505342.htm](http://paper.people.com.cn/rmwz/html/2014-10/01/content_1505342.htm).

other than crude oil, natural gas, and coal; and research on expanding the scope of levying resource taxes.

In an effort to promoting energy conservation, emission reductions, and environmental protection, national pricing departments have also adjusted the applicable rates of pollution discharge fees and water resource fees and improved the implementation of national tiered pricing for electricity, water, and gas for residential use.<sup>26</sup>

### **Conclusions and Recommendations**

From the review and discussion above, it is safe to conclude that there are a wide spectrum of factors that drive China's efforts to liberalize its energy market and promote a low-carbon economy and environmental protection. Yet while coal pricing has been generally liberalized, and oil and gas market reforms are making rapid progress, the electricity market reforms present particular complexities and challenges.

The experience and lessons of the overall development of China's energy sector over the past few decades have identified that administrative monopoly and price regulation by the government are the overriding challenges confronting further development of China's energy market and are also the underlying causes of a series of issues associated with the energy system and mechanisms. Effectively eliminating administrative monopoly and addressing price regulation are the major breakthroughs that future reforms in China's energy system and mechanisms shall be aimed at realizing. Moving forward, in the broader context of nationwide strategic development of energy sector, the following specific priorities of market-oriented reforms in the energy system are recommended to be carried out.

A modern energy market system featuring consolidation, openness, and healthy and orderly competition shall be established. The further separation of government functions from business activities must be pursued, as well as the separation of natural monopoly businesses and competitive businesses and the liberalization of relevant areas for competition. Unified market

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<sup>26</sup> For rates of pollution discharge fees, see [http://www.sdpc.gov.cn/zcfb/zcfbtz/201409/t20140905\\_624985.html](http://www.sdpc.gov.cn/zcfb/zcfbtz/201409/t20140905_624985.html); and [http://www.zhb.gov.cn/gkml/hbb/bgt/201502/t20150204\\_295447.htm](http://www.zhb.gov.cn/gkml/hbb/bgt/201502/t20150204_295447.htm). For water resource fees, see [http://www.gov.cn/zwgk/2013-01/14/content\\_2311387.htm](http://www.gov.cn/zwgk/2013-01/14/content_2311387.htm). For national-tiered residential pricing for electricity, water, and gas, see <http://www.gov.cn/gzdt/att/att/site1/20111201/782bcb8883ce1041152401.pdf>; [http://www.sdpc.gov.cn/fzgggz/jggj/zcfg/201401/t20140103\\_574403.html](http://www.sdpc.gov.cn/fzgggz/jggj/zcfg/201401/t20140103_574403.html); and [http://www.sdpc.gov.cn/zcfb/zcfbtz/201403/t20140321\\_603692.html](http://www.sdpc.gov.cn/zcfb/zcfbtz/201403/t20140321_603692.html).

access shall be institutionalized. With the development of a negative list, various types of market participants shall be encouraged and guided to set foot in fields and areas excluded by the negative list, in the manner of lawfulness, fairness, and equality, thereby effectively promoting the diversification of sources of investment in the energy sector. Additionally, the reform of state-owned energy companies shall be further deepened by improving incentive and performance-evaluation mechanisms and corporate competitiveness. Furthermore, market participants shall be encouraged to use the futures markets to hedge against rising prices, and the construction of a crude-futures market shall be accelerated.

Price reforms must continue to be advanced in oil and gas, electricity, and other related energy subsectors. Prices for relevant competitive areas shall be liberalized in an orderly manner. Natural gas wellhead prices and sales prices, electricity feed-in-tariffs, and retail prices should be determined by the market, whereas electricity transmission and distribution prices and pipeline-transported oil and gas prices should be regulated by the government.

Reforms should be deepened in priority areas such as the electricity grid and the oil and gas pipeline network. The target would be to clearly define the functions of the electricity grid and oil and gas pipeline network and to gradually establish reliable and flexible electricity and gas transmission systems with fair access that are responsive to supply and demand. In addition, power sector reforms are to be accelerated, and direct trading between supply and demand sides will be promoted, with the goal of building a competitive electricity market.

The government should improve energy sector legislations and regulations, including the promotion of the enactment of an energy law, and the revision of the Electric Power Law and Coal Law. The formulation or revision of administrative regulations, including the protection of offshore petroleum and gas pipelines, the management of nuclear power plants, and energy reserve, shall be actively pursued.

The formulation and implementation of energy development strategy, planning, policy, and standards shall be further strengthened. The government should accelerate the process of decentralization to streamline administrative examination and approval procedures through deregulation or delegation of authority. To create a favorable environment conducive to the sustainable development of the energy sector, the energy supervision system should be strengthened by improving the institutional and organizational system and legal and regulatory

framework, adopting innovative measures and approaches, enhancing regulatory efficiency, and upholding a fair, equitable, and impartial market order.

In conclusion, notwithstanding fairly considerable achievements in its development over the past few decades, China's energy sector remains confronted with a series of issues and challenges that will require dramatic strategic transition and overall improvement through ongoing efforts in the near future. Holistic and in-depth market-oriented reforms in key subsectors of electricity, coal, oil and gas, and new energy, supplemented with effective fiscal taxation and price policy interventions as well as market-based mechanism for environmental protection and climate change mitigation, shall be consistently and proactively pursued. Such reforms are needed to create an effective and efficient institutional environment enabling the development of a modern energy system that will strengthen the energy security of China.