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Energy Price Reform in China

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Summary

The Chinese leadership has determined to assign the market a decisive role in allocating resources. To have the market to play that role, getting the energy prices right is crucial because this sends clear signals to both producers and consumers of energy. While the overall trend of China's energy pricing reform since 1984 has been moving away from the prices set by the central government in the centrally planned economy and towards a more market-oriented pricing mechanism, the pace and scale of the reform differ across energy types. This article discusses the evolution of price reforms for coal, petroleum products, natural gas, electricity and renewable power in China, and provides some analysis of these energy price reforms, in order to have the market to play a decisive role in allocating resources and help China's transition to a low-carbon economy.

Keywords: Energy Prices, Tiered Prices, Differentiated Tariffs, Coal, Electricity, Natural Gas, Petroleum Products, Renewable Power, Desulfurization and Denitrification, State-owned Enterprises, China

JEL Classification: H23, H71, O13, O53, P22, Q41, Q43, Q48, Q53, Q58

This article is prepared for Ross Garnaut, Ligang Song and Cai Fang (Editors), China's Forty Years of Reform and Development: 1978-2018, Australian National University Press and Social Sciences Academic Press.

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Abstract

The Chinese leadership has determined to assign the market a decisive role in allocating resources. To have the market to play that role, getting the energy prices right is crucial because this sends clear signals to both producers and consumers of energy. While the overall trend of China's energy pricing reform since 1984 has been moving away from the prices set by the central government in the centrally planned economy and towards a more market-oriented pricing mechanism, the pace and scale of the reform differ across energy types. This article discusses the evolution of price reforms for coal, petroleum products, natural gas, electricity and renewable power in China, and provides some analysis of these energy price reforms, in order to have the market to play a decisive role in allocating resources and help China's transition to a low-carbon economy.

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1. Introduction

Before the post-1978 economic reform, China's economic management structure was modeled principally on that of the former Soviet Union, an essential feature of which was the adoption of a united state pricing system. Under this pricing system, the state-set prices of goods, including those of energy, reflect neither the production costs nor the influence of market forces. The structure of state-set prices was also irrational: the same type of goods was set at the same prices regardless of their qualities, thus resulting in the underpricing and undersupply of goods of high quality. Over a very long period, this pricing system remained unchanged so that its inflexible and restrictive nature became increasingly apparent.

In 1984, the government required state-owned enterprises (SOEs) to sell up to a predetermined quota of goods at state-set prices but allowed to sell above the quota or surplus at prices within a 20 percent range above the state-set prices. In February 1985, the 20 percent limit was removed and prices for surplus could be negotiated freely between buyers and sellers (Wu and Zhao, 1987). At that point, the dual pricing system was formally instituted. Such a pricing system introduced, among others, economic efficiency in the use of resources and was generally considered a positive, cautious step towards a full market price.[1] Based on a survey of 17 provincial markets in March 1989, SOEs still received allocation for part of their energy inputs, particularly crude oil and electricity, at the state plan prices much lower than their market prices, after four years of introducing the dual pricing system (Zhang, 1998).

Confronted with energy shortage and insufficient energy conservation investment, China had been reforming its energy prices as part of sweeping price reforms initiated in 1993. The pace and scale of the energy pricing reform differ across energy types. This article discusses the evolution of price reforms for coal, petroleum products, natural gas, electricity and renewable power, provides some analysis of these energy price reforms, and suggests that few areas of reforms could take place in order to have the market to play a decisive role in allocating resources.

2. Coal prices

Coal dominates in China's energy mix. Its price has been set differently since 1993, depending on its use. Under a two track system for coal prices, the price of coal for non-

[1] See Wu and Zhao (1987) and Singh (1992) for general discussion on pros and cons of the dual pricing system and Albouy (1991) for its impact on coal.

utility use, the so-called "market coal", was determined by the market, whereas the price of coal for utility use, the so-called "power coal", was based on "guidance price" set by the National Development and Reform Commission (NDRC), often at rates lower than prevailing market rates. Coal producers are required to sell to large power producers at the controlled prices for utility coal (IEA, 2009). However, as the increasing portion of coal is used for utility and coal prices have risen over the years while power tariffs remained fixed, electricity generators found it increasingly difficult to obtain coal and cover the cost of generation (Rosen and Houser, 2007). In 2004, the NDRC abolished its guidance price for power coal and set price bands for negotiations between coal producers and electricity generators. The NDRC widened those bands in 2005; in 2006 it scrapped them altogether (Williams and Kahrl, 2008).

With electricity tariffs remaining controlled and flat, many electricity generators were unable to absorb the ensuing fuel cost increases and suffered huge losses. To respond to electricity generators' concerns, the NDRC proposed in May 2005 a coal-electricity price "co-movement" mechanism through which electricity tariffs were raised if coal prices rose by 5 percent or more in no less than six months and allowed electricity generators to pass up to 70 percent of increased fuel costs on to grid companies, and grid companies to pass costs on to consumers. However, because of fears of inflation, the co-movement policy had not been implemented even if the conditions met, and power tariffs continue to remain flat while coal prices rise (Li, 2009; Williams and Kahrl, 2008; Fisher-Vanden, 2009). This had put greater pressure on electricity generators and led to lobbying efforts on the part of generators to receive higher tariffs.

In December 2012, the State Council announced to abolish the two track system for coal prices. The price of coal for utility use will also be determined by the market just as the price of coal for non-utility use does. Moreover, it revises the coal-electricity price "co-movement" mechanism. Under the revised mechanism, electricity tariffs would be adjusted if fluctuations in coal prices go beyond by 5 percent or more in 12 months and electricity generators are allowed to pass up to 90 percent of increased fuel costs on to grid companies instead of the existing 70 percent threshold (The State Council, 2012).

To implement the co-movement mechanism in a more open and transparent manner, the NDRC (2015) in December 2015 further specified the details of its operation. Since the beginning of 2016, within an one-year cycle, electricity tariffs would be adjusted if utility coal prices increased by within the range of Yuan 30-150 per ton relative to the 2014 average reference prices for utility coal. The more fluctuations in coal prices, the less co-movement coefficients are. When coal prices rise below Yuan 30 per ton, generators have to absorb all the fuel cost increases, whereas coal prices rise beyond Yuan 150 per ton, the co-movement mechanism is not triggered either.

It should be pointed out that this co-movement mechanism is not an automatic trigger mechanism, implying that it may not be implemented even if the conditions met. Indeed, the average increases in coal prices in the whole year of 2017 fell in the aforementioned range in the beginning of 2018, but the co-movement mechanism had not been implemented. This may be because implementing the co-movement mechanism by raising power tariffs will hurt downstream power users' profitability in the current less favorable economic environment worldwide.

3. Petroleum product prices

Domestic crude oil prices have since 1998 tracked international prices, but this has not been the case with petroleum products. While China has since raised its producer prices of gasoline and diesel several times, domestic oil refiners have still been feeling the pinch as crude oil prices have been since linked directly to international prices and thus have been allowed to rise, but refined oil product prices have not. To address this disconnect, the government has implemented since May 2009 the pricing mechanism whereby domestic petroleum product prices would be adjusted upward if the moving average of international crude oil prices based on the composited Brent, Dubai and Cinta crude oil price rose by more than 4 percent within 22 consecutive working days. However, this 22-working-day cycle of price adjustments has triggered wide complaints, as it often failed to reflect fluctuations in the international market.

To better reflect refiners' costs and timely adapt to fluctuations in global crude oil prices, the NDRC launched in March 2013 a market-oriented petroleum product pricing mechanism. This automatic pricing mechanism shortens the 22-working-day adjustment period to 10-working-day and remove the 4 percent threshold. The composition of the basket of crudes, to which oil prices are linked, is also adjusted (Liu, 2012; Zhu, 2013).

The NDRC in January 2016 further specified that no price adjustments will be made if international crude oil prices fall below US$40 per barrel. Confronted with high costs of domestic production, this floor price is said to maintain domestic production close to current level, in response to China's stagnating domestic oil production and a growing hunger for foreign oil (Zhang, 2016).

4. Natural gas prices

Natural gas price has long been set below the producers' production costs, and does not reflect the relationship between its supply and demand, or alternative fuel prices. This has not only led Chinese domestic gas producers to be reluctant to increase investments in production, but also has constrained the imports of more costly natural gas from abroad. In June 2010, China increased domestic producer price of natural gas by 25 percent (Wan, 2010). In December 2011, China carried out the pilot reform of natural gas pricing mechanism in Guangdong province and the Guangxi Zhuang Autonomous region. This reform changes the long held cost-plus pricing method to the "netback market value pricing" approach. Under this pricing mechanism, pricing benchmarks are selected and are pegged to prices of alternative fuels that are formed through market forces to establish price linkage mechanism between natural gas and its alternative fuels (NDRC, 2011).

Since July 2013, the pilot scheme in Guangdong and Guangxi was implemented nationwide for any volumes above the 2012 gas consumption level. At the same time, natural gas prices were raised for non-residential users based on a two-tiered approach. Under this reform, the NDRC sets caps on city-gate gas prices for different provinces, instead of setting the ex-factory prices for domestic onshore and imported piped gas, while consumers and suppliers are allowed to negotiate their specific prices as long as the prices do not exceed the ceilings. Moreover, a lower price is set for the 2012 consumption volume, with the city-gate prices capped. A higher price is set for any volumes above the 2012 consumption level. This price is pegged to 85 percent of the basket price of alternative fuels such as fuel oil and liquefied petroleum gas using 60 percent and 40 percent weight respectively. The government aims to steadily raise the lower tier prices so that both price bands converge by 2015 (NDRC, 2013c). Given declining costs of alternative fuels, natural gas prices for non-residential users were lowered in November 2015 and again in September 2017 (NDRC, 2015 and 2017b,c).

Given that residential natural gas prices have been capped at much lower levels than those for non-residential users, provinces like Jiangsu, Henan and Hunan implemented tier-tariffs for household use of natural gas. The NDRC (2014) in March 2014 mandated to lunch this pricing mechanism across the whole country before the end of 2015. The pricing mechanism set three price bands associated with three tier levels of consumption, with the first covering 80 percent of the average monthly consumption volumes for household users, and the second the next 15 percent. The third tier would cover any consumption above 95 percent of the monthly household average. Consumption at the second and third tiers are accordingly charged at 120 percent and 150 percent of the first tier price (NDRC, 2014). Based on the guidance and taking its own circumstance into account, each province determines the consumption volume at each tier level.

In the meantime, China has gradually let the market to determine the prices for a variety of gas. Since 2013, the prices of shale gas, coalbed methane and coal gas have completely been liberalized. Since then, LNG prices since September 2014, prices for all other direct users except for gas used for fertilizers since April 2015, prices of gas storage facilities since October 2016, and prices of natural gas for fertilizers since November 2016 have been liberalized. Fujian province has since November 2016 piloted city-gate gas prices. Since September 2017, all volumes traded at the Shanghai and Chongqing gas exchange centers are set by the market (NDRC, 2013c, 2015 and 2017b).

As the result of these market-oriented natural gas pricing reforms, over 80 percent of natural gas consumption of non-residential users are determined by the market, of which more than 50 percent are completely set by the market, and around 30 percent are set by the flexible mechanism characterized by the reference prices supplemented with allowed fluctuation ranges (NDRC, 2017c; Zhu, 2017). Despite significant progress, more work needs to be done to formulate a fully market-oriented price. On specific prices, reforms involve introducing differential pricing policies to reflect seasonal price disparities, off-peak price disparities, interruptive gas prices and gas storage prices. More fundamentally, further progress in natural gas pricing reforms requires the deepening reform of overall natural gas industry chain under the guidance principle of "opening the natural gas upstream-and-downstream market and regulating the midstream pipeline transport market", as market-oriented natural gas price can only be formed based on a competitive natural gas industry structure. The NDRC has been laying the foundation for third party access to pipeline network by reforming the network transportation price mechanism under the principle of allowable costs plus reasonable profits. The NDRC (2017a) in August 2017 released the verified pipeline network transportation costs of 13 natural gas long distance pipeline transport enterprises under the common method, principle and standards. On average, the verified pipeline network transportation costs of these enterprises are cut by 15 percent, reducing the burden of Yuan 10 billion on downstream enterprises (Zhu, 2017). The National Energy Administration needs to develop a third-party access policy so that parties as well as the owners are able to access the pipeline network, starting formulating specific procedures and regulations for pipeline network access and establishing a platform for pipeline network information disclosure and access. Moreover, various types of investors should be encouraged to participate in the construction of pipeline networks, LNG terminals, gas storage facilities, and other related facilities. By ownership unbundling, setting up an independent system operator and building an independent transmission operator, China could gradually separate natural gas pipeline transport and natural gas production and marketing, eventually leading to the independence of the natural gas pipeline network (Dong et al., 2017).

5. Electricity tariffs

The electricity industry in China was nationalized since its government assumed power in 1949, and has been in a process of reforms since the 1980s (Ngan, 2010; Zeng et al., 2016). In 2002, the State Council (2002) issued the unbundling reform of "separating power plants from grids". By dismantling the vertically integrated power system into independent companies, this was the first attempt to establish a market-oriented mechanism and has since framed China's power management mechanism. While China's unbundling reform has accomplished a degree of success in the generation sector (Xie et al., 2012), electricity tariffs have remained controlled by the central government since China split State Power Corporation and separated electricity generation from its transmission and distribution in 2002. While electricity tariffs were raised few times under the aforementioned coal-electricity price "co-movement" mechanism, they still remain flat and regulated. This not only reduces the effectiveness of addressing the daunting challenges to cut emissions and strengthen industrial upgrading, but also complicates implementing the pilot carbon trading schemes in the power sectors in China. The latter creates a new impetus for power pricing reforms to allow the pass-through of carbon costs in the electricity sector as a result of implementing carbon trading.

China has launched a new round of power industry reform since March 2015 (CCCPC and the State Council, 2015). The pricing mechanism reform features prominent in this round. Grids will not make profits by charging the gap between on-grid price and the electricity price for users. Instead, grids are supposed to earn their source of income by charging transmission and distribution fee, which is determined by the NDRC. As piloted in Yunnan province, large power users are encouraged to directly negotiate with generators. Generators then sell power to grids at transaction prices, which are negotiated by generators and users. As a result, the transaction price, transmission and distribution fee and government funds combined form the price of electricity for these types of industrial and commercial users, whose power use accounts for over 80 percent of the national power use. The volume of power transacted and traded on the market increased from 10 percent in 2015 to 23 percent of total electricity sale in 2016 (Zhu, 2017). The government aims to further increase this portion. Meantime, tariffs for residential and agricultural power use remain regulated by the government (CCCPC and the State Council, 2015).

In the course of this long-awaited comprehensive and complex power pricing reform, the government has offered power price premium for desulfurization and denitrification, and has charged differentiated power tariffs and tiered power tariffs for the purpose of saving electricity and protecting the environment (NDRC, 2013a,b; NDRC and MIIT, 2013).

5.1 Power price premium for desulfurization and denitrification

With burning coal contributing 90 percent of the national total SO_2 emissions and coal-fired power generation accounting for half of the national total, the Chinese central government had mandated that new coal-fired units must be synchronously equipped with a flue gas desulphurization (FGD) facility and that plants built after 1997 must have begun to be retrofitted with a FGD facility before 2010. During the 12th five-year period, Eelectricity generators were mandated to install flue gas denitrification facility as well. All coal-fired plants with unit capacity of 300 megawatt (MW) or more across the country and with unit capacity of 200 MW in eastern part of the country and the capitals of other provinces or equivalent are mandated to install denitrification facility.

While electricity tariffs remain controlled and flat, the government offered since 2004 a premium for all new coal-fired units. Given that China's SO_2 emissions in 2005 were mandated to keep at the 2000 level but actually were 5 percent more than the 2000 level, the government decided to extend since 2007 this premium to electricity generated by existing coal-fired power plants (that is, those built before 2004) with FGD facility installed to encourage the installation and operation of FGD facility at large coal-fired power plants (NDRC and SEPA, 2007). The premium was equivalent to the average estimated cost of operating the technology. Other policies favorable to FGD-equipped power plants are implemented, e.g., priority given to be connected to grids, and being allowed to operate longer than those plants that do not install desulphurization capacity. Some provincial governments provide even more favorable policies, leading to priority dispatching of power from units with FGD in Shandong and Shanxi provinces. Combined with the declining capital cost of FGD, newly installed desulphurization capacity in 2006 was greater than the combined total over the past 10 years, accounting for 30 percent of the total installed thermal (mostly coal-fired) capacity. By 2011, the portion of coal-fired units with FGD rose to 90 percent in 2011 of the total installed thermal capacity from 13.5 percent in 2005 (Sina Net, 2009; CEC and EDF, 2012). As a result of this incentive compatible policy, China had met the 2010 target of a 10 percent cut one year ahead of schedule. Harvard China Project estimates that China's SO_2 reduction policy in the 11^{th} five-year plan period resulted in negative economic costs and enormous human health benefits -- from 12,000 to 74,000 avoided premature deaths in 2010 (Nielsen and Ho, 2013).

The government also offered since November 2011 a premium for electricity generated by power plants with flue gas denitrification facility in 14 provinces or equivalent. Since the beginning of 2013, the price premium for denitrification was extended to all coal-fired power plants equipped with denitrification facility (NDRC, 2013a), and was further increased to 0.01 RMB/kWh since September 2013 (NDRC, 2013b).

5.2 Differentiated power tariffs

NDRC (2006) ordered provincial governments to implement the differentiated tariffs that charge more for companies classified as 'eliminated types' or 'restrained types' in eight energy-guzzling industries including cement, aluminum, iron and steel, and ferroalloy from October 1, 2006 onwards. While provinces like Shanxi charged even higher differentiated tariffs than the required levels by the central government (Zhang et al., 2011), some provinces and regions have been offering preferential power tariffs to struggling, local energy-intensive industries. The NDRC and other five ministries and agencies jointly ordered utilities to stop offering preferential power tariffs to energy-intensive industries by June 2010. Such industries will be charged with the punitive, differentiated tariffs. Those utilities that fail to implement the differentiated tariffs will have to pay a fine that is five times that of differentiated tariffs multiplied by the volume of sold electricity (Zhu, 2010).

5.3 Tiered power tariffs

With residential electricity demand set to increase as income grows on the one hand and the price of residential electricity remaining below actual costs on the other hand, NDRC implemented three-tier-tariffs for household electricity use since July 2012. The effectiveness of the new tariff mechanism depends on the price and income elasticities of residential electricity demand among income groups. However, very little information exists in China regarding these parameters. Based on the monthly micro-level data of Beijing urban households from 2002 to 2009, Jin and Zhang (2013) estimate these two parameters with both the almost-ideal-demand-system and the linear double-logarithmic model specifications. Their estimated price elasticity is close to unity and increases as income grows. This suggests that it might be effective to use pricing policies for demand-side management to adjust the electricity consumption of high-income groups. On the other hand, given that the estimated income elasticity is low, supporting policies are needed for low-income groups severely hit by increasing tariffs. In this regard, the authors suggest that either directly subsidizing low-income families or rationally setting the price levels of different tariff blocks can help improve the distributional effects of tariff reform.

From the beginning of 2014, the NDRC expanded the three-tiered electrify pricing approach to the aluminum sector to phase out outdated production capacity and promote industrial restructuring more quickly (NDRC and MIIT, 2013; Gao, 2013). Similar tiered power pricing policy applies to other industries, such as cement, to force upgrades in the drive for sustained and healthy development.

6. Renewable power tariffs

From a long-term perspective, widespread use of renewable energy is a real solution. Increasing the share of renewable energies in the total primary energy supply not only enhances energy security, but also is environmentally friendly and conducive to good health. China has targeted alternative energy sources to meet 15% of its energy requirements by 2020 and has aimed the share of non-fossil fuel use to around 20% by 2030, respectively.

The Chinese government initially supported solar energy through so-called Golden Sun investment subsidies (Zhang, 2011 and 2013). After years of simply taking advantage of overseas orders to drive down the cost of manufacturing solar panels, feed-in tariffs for solar power were enacted in July 2011 to create China’s own solar power market. Wind power had benefited from bidding-based tariffs since 2003 (Zhang, 2010, 2011 and 2013). With total installed capacity of 5.9 GW at the end of 2007, China had already surpassed its goal to achieve 5 GW in 2010, and China had met its 2020 target of 30 GW ten years ahead of schedule. With both power demand and new installations of wind power capacity increasing faster than planned and the further deterioration of the environment, combined with the fact that the country is facing great pressure both inside and outside international climate negotiations to be more ambitious in combating global climate change, China has raised its wind power target to 200 GW of wind power capacity in operation by 2020. This revised target is 170 GW more than the 30 GW target set in September 2007, and three times the UK’s entire current power capacity.

In August 2009, this supportive policy for wind power was replaced by feed-in tariffs. Under the policy, four wind energy areas were designated based on the quality of wind energy resources and the conditions of project engineering construction (NDRC, 2009). On-grid tariffs were set accordingly as benchmarks for wind power projects. The levels were comparable to the tariffs that the NDRC had approved in the past several years in most regions, and were substantially higher than that set through bidding. By letting investors know the expected rate of return on their projects through announcing on-grid tariffs upfront, the Chinese government aims to encourage the development of wind energy resources of good quality. In the meantime, this will encourage wind power plants to reduce the costs of investment and operation and increase their economic efficiency, thus promoting the healthy development of the whole wind industry in China (Zhang, 2010, 2011 and 2013).

Under the Renewable Energy Law, registered power generators are granted access to grids, which are mandated to purchase the full amount of generated renewable energy. Moreover, over the past ten years, the cost of wind power projects has been declining (IRENA, 2018) but on-grid tariffs benchmarks in each zone remained unchanged until 2015. These induce wind power developers to focus only on production costs side and overlook the demand side, and thus have led to a huge surplus in installed capacity, in particular in northern and western China of richer wind resources where the installed capacity is concentrated but are far from the load center. Consequently, a large amount of generated wind power has to be curtailed due to limited local demand or grid system stability constraints (Xia and Song, 2017). Moreover, China now aims to increase its total installed wind power capacity to 200 GW by 2020 and implements a green dispatch system to favor renewable power generation in the electric grid. In this context, China needs to significantly improve its power grids and coordinate the development of wind power with the planning and construction of power grids, including smart grids. New transmission lines should be constructed at the same time wind power farms are built. Given the significantly scaled-up wind power capacity planned for 2020, China should now place more emphasis on companies ensuring the actual flow of power to the grid than on meeting capacity (Zhang, 2010, 2011 and 2014). Taken all these issues together, the policies of feed-in-tariff and guarantee of renewable power purchase need to adapt to the new situation and alternative policies need to explore to solve curtailment problem and to encourage the wind power developers to choose locations close to the load center.

7. Conclusions

China has determined to assign the market a decisive role in allocating resources. To have the market to play that role, getting the energy prices right is crucial. Since 1984, China has been making great efforts towards reforming energy prices, and has accomplished great achievements. However, such reforms are far from complete. While under the current pricing mechanism for petroleum products petroleum product prices fluctuates along with global crude oil prices, they decouple from the domestic market. The future reform of petroleum product pricing mechanism should take domestic factors into account so that petroleum product prices can better reflect the relationship between domestic supply and demand. From a long-term perspective, however, a complete marketedlization of petroleum product prices depends on the extent to which the central government is able to break down the monopoly power of the three national oil corporations in oil imports, exploration, production and pipeline networks.

While over 80 percent of natural gas consumption of non-residential users are determined by the market, more work needs to be done to formulate a fully market-oriented price. Fundamentally, further progress in natural gas pricing reforms requires the deepening reform of overall natural gas industry chain under the guidance principle of "opening the natural gas upstream-and-downstream market and regulating the midstream pipeline transport market". In this context, reforming the network transportation price mechanism and laying the foundation for third party access to pipeline network are crucial. The NDRC moves in the right direction, verifying the pipeline network transportation costs of natural gas long distance pipeline transport enterprises under the common method, principle and standards. It needs to develop a third-party access policy so that parties as well as the owners are able to access the pipeline network. Gradually, China could separate natural gas pipeline transport and natural gas production and marketing, eventually leading to the independence of the natural gas pipeline network.

While China has been reforming its electricity industry structure since 2002, transmission, distribution and sale of electricity are undertaken by two main grid corporations, the State Grid and China Southern Power Grid. As the designated sole buyers of electricity from generators, and distributors and sellers of electricity, they hold monopolies in their respective areas. Their monopoly power and the lack of competition in the electricity market have often attracted criticism. However, in my view, splitting grid is not a necessary option to achieve this goal, but separating electricity sale from grid's transmission and distribution is a must for establishing a competitive power market. Only then can the electricity sale side be opened up, and electricity selling companies independent of grids, can be set up in each region. This has been the key goal of a new round of power industry reform China has launched since March 2015. Grids will not make profits by charging the gap between on-grid price and the electricity price for users. Instead, grids are supposed to earn their source of income by charging transmission and distribution fee, which is determined by the NDRC. However, this mode of verified transmission and distribution fee could confront with a variety of thorny issues. One is power dispatching when selling prices differ but the grids' source of income is already set based on this mode. Other could be how to lower power tariffs. This requires either power generators or grids giving up some profits in the whole value chain, given that power generators have low profit margin and the grids' source of income is based on the verified transmission and distribution fee and allowable profits. Regarding renewable power, the policies of feed-in-tariff and guarantee of renewable power purchase help widespread use of renewable power. Going forward, these favorable policies need to adapt to the new situation of surplus and mismatch between generation locations and the load center, and alternative policies need to explore to solve curtailment problem and to encourage the wind power developers to choose locations close to the load center, in addition to increasing the grid transmission capacity and transporting electricity from western and northern China to southeastern China by building more ultra-high voltage transmission lines.

For coal, whether the revised coal-electricity price "co-movement" mechanism is able to address potential conflict of coal producers and power generators remains to be seen. This is because an one-year cycle of adjustment is long and the reference prices for utility coal remain stable, relative to the rapid pace of China's overall reform and the rapidly changing market conditions. Moreover, though the two track system for coal prices has been abolished, it is still very difficult to establish a nationwide coal market as railway freight capacity has not been liberalized. This means that if the train wagons are not included for liberalizing, coal purchased cannot reach the load centers. Thus, future reform has to be undertaken from a perspective of a whole coal value chain, targeting reform of those parts of the whole value chain, which need to be liberalized but are, to a large extent, still controlled by the government. However, even if such reform is undertaken, coal prices would not fully reflect the cost of production because of officially controlled costs and distorted prices in other production factors. Coal prices also do not include negative externalities. Clearly, the imposition of market-based environmental instruments can internalize externality costs into the market prices. Indeed, implementing carbon trading not only creates a new impetus for power pricing reforms to allow the pass-through of carbon costs in the electricity sector, but can also help internalize externality costs into the market prices.

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