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Energy Prices, Subsidies and Resource Tax Reform in China

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Summary
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Energy Prices, Subsidies and Resource Tax Reform in China[*]

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Abstract

The Chinese leadership in November 2013 determined to embark upon a new wave of comprehensive reforms in China. This is clearly reflected by the key decision of the Third Plenum of the 18th Central Committee of Communist Party of China 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 it 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 pricing completely set by the central government in the centrally planned economy towards a more market-oriented pricing mechanism, the pace and scale of the reform differ across energy types. This paper discusses the evolution of price reforms for coal, petroleum products, natural gas and electricity in China, provides some analysis of these energy price reforms, and suggests few areas of reforms could take place in order to have the market to play a decisive role in allocating resources and to 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, did not 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. Thus, the outdated pricing system had to be changed.

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]

Table 1 presents some data on plan and market prices as well as data on plan allocations from a survey of 17 provincial markets. It can be seen that after four years of introducing the dual pricing system there had continued to rely heavily on the plan in the allocation of energy goods, particularly crude oil and electricity. This means that SOEs still received allocation for part of their energy inputs at the state plan prices. As shown in Table 1, however, the sate-set plan prices of energy goods were kept much lower than their market prices. As a result, these enterprises have weak incentive for investment in energy conservation.

Confronted with energy shortage and insufficient energy conservation investment, China has 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 paper discusses the evolution of price reforms for coal, petroleum products, natural gas and electricity, provides some analysis of these energy price reforms, and suggests few areas of reforms could take place in order to have the market to play a decisive role in allocating resources.

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[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.

Table 1

Ratio of market price to plan price, and percentage of plan allocation of selected goods by volume and value, March 1989

Selected goods	Ratio of market price to plan price	Percentage of plan allocation by volume	Percentage of plan allocation by value
Crude oil	3.13	80	56
Heavy oil	2.60	41	13
Copper	2.50	17	7
Coal	2.49	46	21
Gasoline	2.25	64	44
Aluminum	2.24	28	15
Fertilizer	2.23	39	26
Timber	2.12	22	12
Diesel fuel	2.05	55	36
Steel products	2.05	30	19
Electric power	1.89	75	60
Nitric acid	1.82	40	20
Soda ash	1.81	40	28
Plate glass	1.63	41	29
Aluminum products	1.63	6	4
Caustic soda	1.60	47	24
Kerosene	1.60	73	67
Copper products	1.49	8	5
Cement	1.36	16	11
Iron ore	1.33	78	74
Pesticide	1.33	62	54
Sulphuric acid	1.30	40	32
Crude salt	1.23	86	83
Pig iron	1.10	47	42

Source: China Price, September 1990 (quoted in Zhang (1998)).

2. Coal prices

Coal dominates in China's energy mix, accounting for 65.7 percent of total energy use in 2013. 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-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, NDRC abolished its guidance price for power coal and set price bands for negotiations between coal producers and electricity generators. 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. That increased the risk of power shortages. To respond to electricity generators' concerns, NDRC proposed in May 2005 a coal-electricity price "co-movement" mechanism that would raise electricity tariffs 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 as 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, 2012b). Given that electricity generators used to obtain coal at low prices and coal producers are facing sluggish demands, both coal producers and electricity generators are gradually adapting to each other under this changing market. As a reflection of the buyer market situation, pricing for annual contract for utility coal in 2014 between two sides of coal supply and demand has been very flexible, taking a multiple form on the yearly, quarterly or monthly pricing basis, which did not experience before (Hu, 2014).

It should be pointed out that this new co-movement mechanism is not an automatic trigger mechanism, implying that it may not be implemented even if the conditions met. As has been the case, coal prices in the beginning of 2014 declined by more than 5 percent relative to the prices one year ago, but the co-movement mechanism has not been implemented. Unlike previous frictions between coal producers and

electricity generators when coal prices increased, this time, both coal producers and electricity generators find that lowering power tariffs is not in their best interest and thus do not like to see power tariffs to be cut (China Securities Journal, 2014; Tang, 2014). For electricity generators, it is understandable because that will cut their profits. Besides, they insist that they shouldered a lot of burden both for not raising power tariffs when the conditions met in the earlier years and for mandating desulfurization and denitrification (see Section 5.1). For coal producers, given sluggish demands for coal, 70 percent or more of small coal mines in key coal-producing regions, such as Inner Mongolia and Shanxi, have ceased production (Tang, 2014). There is a great concern that at this point of the time, implementing the co-movement mechanism by lowering power tariffs will make coal producers' situations even worse because electricity generators are most likely to pass through their profit losses to coal producers.

3. Petroleum product prices

Domestic crude oil prices have tracked international prices since 1998, 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. Since its implementation, China adjusted domestic petroleum product prices 25 times, with upward adjustments 15 times and downward adjustments 10 times. 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 adapt to fluctuations in global crude oil prices, NDRC launched in March 2013 a market-oriented petroleum product pricing mechanism. This new automatic pricing mechanism will shorten the current 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, will also be adjusted (Liu, 2012; Zhu, 2013). This new pricing mechanism means that China's retail prices will be subject to more frequent changes. Indeed, to the end of February 2014, or slightly less than one year since its implementation, China adjusted domestic petroleum product prices

17 times, with upward adjustments 8 times, downward adjustments 9 times and no adjustments 7 times (Jiang and Han, 2014). Clearly, this pace of adjustment is much frequent compared to the aforementioned pricing mechanism introduced in May 2009. These ups and downs of prices will better reflect the real cost of oil consumption and will benefit China's drive to save energy and abate emissions. However, this new pricing mechanism is just one step towards a more market-oriented petroleum product pricing mechanism. It is still not a complete liberalization of petroleum product prices because it does not enable to reflect the relationship between its domestic supply and demand.

4. Natural gas prices

Given coal-dominated energy mix, increasing a share of cleaner fuel, like natural gas, has been considered as the key option to meet the twin goal of meeting energy needs while improving environmental quality. However, 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. On June 1, 2010, China increased domestic producer price of natural gas by 25 percent (Wan, 2010). Since July 10, 2013, China raised natural gas prices for non-residential users based on a two-tiered approach. Under this reform, 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 of 112 billion cubic meters, whose ceiling city-gate prices will not increase by more than RMB 0.4 per cubic meter. 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 85 percent is lower than that of the 90 percent of the pilot scheme in Guangdong and Guangxi, resulting in an average city gate price of RMB 2.95 per cubic meter for any gas consumption exceeding the 2012 level. Overall, this price reform would raise the city-gate wholesale price of natural gas to a national average of RMB 1.95 per cubic meter from RMB 1.69 cubic meter (Xinhua Net, 2013). This would represent an increase of 15.4 percent. The government aims to steadily raise the lower tier prices so that both price bands converge to create a fully market-oriented gas price by 2015.

Given that residential natural gas prices have been capped at much lower levels than those for non-residential users, natural gas prices for residential users will undergo a gradual increase. On June 1, 2010, China increased domestic producer price of natural gas by 25 percent. On December 26, 2011, China carried out the pilot reform of natural gas pricing mechanism in Guangdong province and the Guangxi Zhuang Autonomous region. Widely considered as a breakthrough in China's natural gas price reform, this reform changes the existing cost-plus pricing method to the "netback market value pricing" approach. Under this new 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. Gas prices at various stages will then be adjusted accordingly on this basis (NDRC, 2011). This new mechanism, which has been widely adopted in Europe, will better trace and reflect market demand and resource supplies, as well as guiding reasonable allocations. Provinces like Jiangsu, Henan and Hunan have implemented tier-tariffs for household use of natural gas. NDRC announced in March 2014 to lunch this pricing mechanism across the whole country before the end of 2015. The new pricing mechanism will set three pricing 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 will be accordingly charged at 120 percent and 150 percent of the first tier price (China Economic Net, 2014). Based on the guidance and taking its own circumstance into account, each province will determine the consumption volume at each tier level.

These price reforms and the aforementioned pilot scheme in Guangdong and Guangxi help to establish a market-oriented natural gas pricing mechanism that fully reflects demand and supply conditions. Gao et al. (2013) argue that it is feasible to implement the Guangdong and Guangxi pilot reform program to the entire country, with some adjustments and improvements regarding the choice of alternative fuels, the selection of the pricing reference point and the creation of netback market value pricing formula.

5. Electricity tariffs

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. While a comprehensive power pricing reform will be an ideal option, the reality in China suggests that this will not come any time soon. Until this long-awaited reform is undertaken, the government has offered power price premium for desulfurization and denitrification, and has charged differentiated power tariffs and tiered power tariffs.

5.1 Power price premium for desulfurization and denitrification
With one-third of China's territory widely reported to be affected by acid rain, reducing SO_2 emissions has been the key environmental target in China. In its economic blueprint for 2006 to 2010, China incorporated for the first time the goal of reducing SO_2 emissions by 10 percent by 2010. 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 has 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.

To address unprecedented environmental pollution and health risks across the country, electricity generators are mandated to install flue gas denitrification facility as well during the 12th five-year period running from 2011 to 2015. 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. By 2015, all flue gas desulfurization and denitrification facility installed needs to achieve the overall desulfurization rate of 95 percent and the denitrification rate of at least 75 percent in order for the power industry to cut SO_2 emissions by 16 percent and NOx emissions by 29 percent by 2015 relative to 2010 levels (The State Council, 2012a).

While electricity tariffs remain controlled and flat, the government offered since 2004 a 0.015 RMB/kWh 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 a 0.015 RMB/kWh 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. Moreover, the capital cost of FGD has fallen from 800 Yuan/kW in the 1990s to the level of about 200 Yuan/kW (Yu, 2006), thus making it less costly to install FGD facility. As a result, 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 coal-fired units installed with FGD increased to 630 gigawatt (GW) from 53 GW in 2005. Accordingly, 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). Based on the SO_2 emissions data from 113 cities at the prefecture level from 2001 to 2010, Shi et al. (2014) found that with this price premium for desulfurization when the number of power plants in a city increases by one, the SO_2 reduction rate increases by one percent, the amount of SO_2 reduction increases by 3.5 percent, and the amount of emission decreases by 1.2 percent. As a result of this incentive compatible policy, by the end of 2009, China had cut its SO_2 emissions by 13.14 percent relative to its 2005 levels (Xinhua Net, 2010), having 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 11th 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 0.008 RMB/kWh premium for electricity generated by power plants with flue gas denitrification facility in 14 provinces or equivalent. By the end of 2012, 27.6 percent of coal-fired units were installed with denitrification facility, with the average rate of denitrification facility of 48 percent (Zhang, 2014). With 72 percent of existing coal-fired units having not been equipped with denitrification facility, NOx emissions in 2012 rose, rather than reduced as mandated. Given that this price premium is 15-20 percent lower than the projected NOx control cost of a 0.0095 RMB/kWh (Harvard China Project, 2014), this result should not come as a surprise.

Given this grim situation, 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). In 2013, the coal-fired units installed with denitrification facility amounted to 190 GW, and NOx emissions were estimated to cut by 3.5 percent, the cut for the first time below 2010 reference levels (Zhang, 2014). Based on estimates by China Electricity Council, the average cost of denitrification is estimated to be 0.012 RMB/kWh for new plants and 0.015 RMB/kWh for plants already in operation. This cost can go beyond 0.020 RMB/kWh for some specially designated plants. To comply with the new NOx emissions standards of 100 mg/m^3 by July 1, 2014, only taking denitrification into consideration, retrofit costs for existing coal-fired units of 707 GW are estimated to be Yuan 200-250 billion. Factoring in new addition of coal-fired units of 250 GW over the period 2006-10, the yearly operation costs of denitrification facility to meet the new stringent standards are estimated to increase by Yuan 90-110 billion. This will significantly increase the generation cost of coal-fired units, which is estimated to increase by 20 percent in the short term (Li, 2013). Given the current level of price premium for denitrification, this raises the issue of whether all coal-fired units will install denitrification facility, and if installed, whether it will run continuously and reliably. Given that it is much more costly to install and run denitrification facility than FGD facility, and that field inspections reported that the installed FGD facilities are not in use or do not run continuously and reliably (Liu, 2006; Xu et al., 2009; Zhang, 2011, 2012), this can merit a great concern.

Indeed, given that the compliance costs may be higher than the offered price premium and are increasing as emissions targets become increasingly stringent on the one hand and that dodging of environmental regulations is widespread and common in China on the other hand, implementation holds the key, and will determine whether or not to actually achieve the desired outcomes. In its 2008 assessment of the total volume reduction of major pollutants, the Ministry of Environmental Protection (MEP) found that FGD facilities of five coal-fired power plants were either in improper operation or their on-line monitoring and control data were false. These plants were ordered to return the compensation for their desulphurization costs in proportion to the time when their FGD facilities were not in operation and to make necessary adjustments in the specified period (Zhang, 2009). Based on its 2012 assessment of the total volume reduction of major pollutants in all provinces or equivalent and eight central state-owned enterprises, MEP issued the penalty on 15 enterprises involving improper operation of their desulfurization facilities and monitoring desulfurization data falsification. These enterprises were ordered not only to return the compensation for their desulphurization costs in proportion to the

time when their desulfurization facilities were not in operation, but also had to pay a fine up to five times that the compensation amount they received (Qin and Qi, 2013).

Table 2

Differentiated power tariffs for eight energy-guzzling industries in China

		Existing additional charge (Yuan/kWh)	Additional charge since 1 October 2006 (Yuan/kWh)	Additional charge since 1 January 2007 (Yuan/kWh)	Additional charge since 1 January 2008 (Yuan/kWh)
Eight energy-guzzling industries	Eliminated types	0.05	0.10	0.15	0.20
	Restrained types	0.02	0.03	0.04	0.05

Source: NDRC (2006).

5.2 Differentiated power tariffs

To shut down plants that are inefficient and highly polluting, and to keep the frenzied expansion of offending industries under control, 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 (see Table 2). 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 reason for this repeated violation is the lack of incentive for local governments to implement this policy, because all the revenue collected from these additional charges goes to the central government. To provide incentives for local governments, this revenue should be assigned to local governments in the first place, but the central government requires local governments to use the revenue specifically for industrial upgrading, energy saving and emissions cutting (Zhang, 2007, 2010). In the recognition of this flaw, the policy was adjusted in 2007 to allow local provincial authorities to retain revenue collected through the differentiated tariffs, providing stronger incentives for provincial authorities to enforce the policy (Zhou et al., 2010). Partly for strengthening China's longstanding efforts to restructure its inefficient heavy industries, and partly faced with the prospect for the failure to meet the ambitious energy

intensity target set for 2010, the NDRC and other five ministries and agencies jointly ordered utilities to stop offering preferential power tariffs to energy-intensive industries by June 10, 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. On July 1, 2012, 29 provinces in China abolished single-block, low prices and set up the new, three-tier tariffs for household electricity use. Under this new tariff system, the tier-one maintains the old quota price that applies to, on average, 89 percent of households of 29 provinces and the tier-two shifts to slightly higher electricity price for those electricity use exceeding the amount of basic use, which is differentiated across regions, with the tier-three set much higher tariffs for the amount of electricity for luxury use (People Net, 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.

In December 2013, NDRC expanded the three-tiered electrify pricing approach to the aluminum sector to phase out outdated production capacity and promote industrial

restructuring more quickly. From the beginning of 2014, power tariffs remain unchanged for aluminum smelters that do not use more than 13,700 kWh per ton of electrolytic aluminum. Smelters that use more than 13,700 kWh but less than 13,800 kWh per ton will charge an additional RMB 0.02 per kWh, and those smelters that consume more than 13,800 kWh per ton will charge an additional RMB 0.08 per kWh. Moreover, smelters that consume more than 13,700 kWh per ton are not allowed to directly purchase electricity from power plants (NDRC and MIIT, 2013; Gao, 2013). Similar tiered power pricing policy is expected to implement in other industries, such as cement, to force upgrades in the drive for sustained and healthy development.

6. Energy subsidies

Even if the aforementioned price of coal for non-utility use, the so-called "market coal", has been determined by the market, it does not fully reflect the cost of production. Mao et al. (2008) estimate that if the government's controlled costs and the distorted prices in other production factors, such as land and resources, are factored in, the cost of coal would increase by 54 percent. If externalities such as conventional environmental and health impacts are added, the cost of coal would go up by 70 percent. The negative externalities do not include damage costs of global climate change as a result of CO_2 and other greenhouse gas emissions, and are therefore underestimated. Even if the conservative estimate puts the economic costs of coal exploration, transportation and use at Yuan 1745 billion in 2007, or 7.1 percent of that year's gross domestic product (GDP) (Mao et al., 2008). Differing from this estimate and other estimates shown in Figure 1 and Table 3 by the ADB (2014) and the IEA (2014), International Monetary Fund (IMF) factors in damage costs of global climate change. Assuming the costs of US$25 per ton of CO_2 equivalent, post-tax coal subsidies, namely the sum of pre-tax and tax subsidies, are estimated to be US$ 236 billion in 2011 in China, or 3.23 percent of that year's GDP. Compared with the amount of post-tax subsidies for petroleum products, natural gas and electricity, which amounted to 0.20 percent, 0.09 percent, and 0.30 percent of GDP in 2011 respectively, post-tax coal subsidies are substantial (Clements et al., 2013). This is mainly because coal dominates in China's energy mix, accounting for accounting for 65.7% of total energy use in 2013 and because coal prices are far below the levels needed to address negative environmental and health externalities.

A subsidy is made of producer subsidy and consumer subsidy. A producer subsidy increases the price received by producers, while a consumer subsidy lowers the price paid by consumers. Measured on a tax-inclusive basis, virtually all of the world's

economies provide energy subsidies of some kind (IEA, 2006 and 2014; Zhang, 2008; Clements et al., 2013). Such subsidies differ by energy type across countries. As a share of GDP, post-tax subsidies are roughly eight times larger in the Middle East and North African region than in advanced economies. In absolute terms, the US, China and Russia are the top three subsidizers across the world, providing subsidies of US$ 502 billion, US$ 279 billion, and US$ 116 billion in 2011, respectively (Clements et al., 2013). Widespread use of energy subsidies leads to inefficient production and use of energy and resources, creates no incentive for energy and resource conservation, and gives rise to significant amount of emissions that can otherwise be avoided if subsidies are removed and energy prices get right. By lowering the prices of fossil fuels, such fossil fuel subsidies also are widely considered to distort international trade (Zhang and Assunção, 2004).
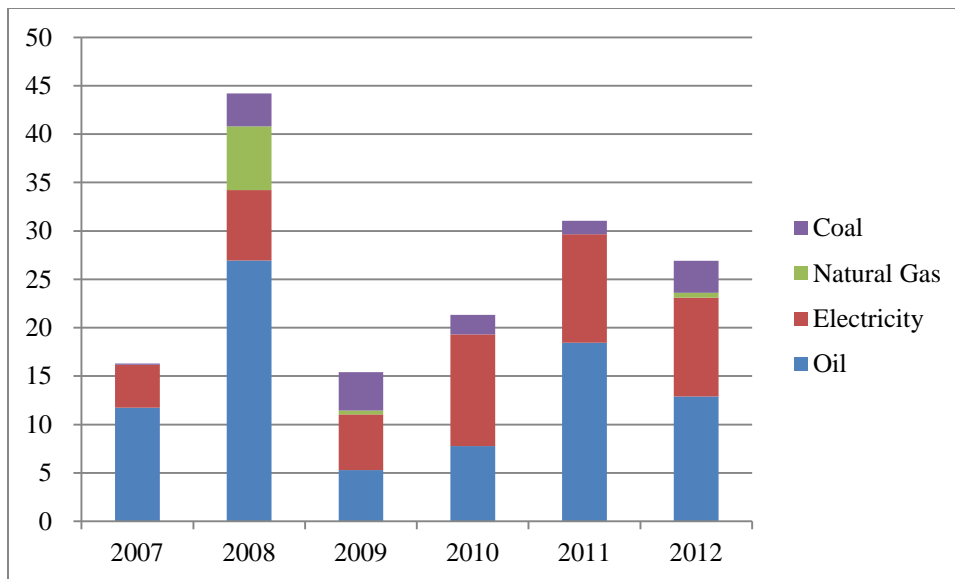
Figure 1 Estimates of fossil fuel consumption subsidies in China (US$ billion), 2007-12
Source: Drawn based on data from the IEA (2014).

Clearly, removing these subsidies is essential to provide incentives for investment and production of cleaner energy on the supply side and efficient energy use and adoption of clean technologies on the demand side that reduce emissions at sources. This helps the economic recovery in the short term and serves as the driver of sustainable and balanced economic growth in the long run. Thus, in 2009, the Group of 20 advanced and emerging market economies called for a phase out of inefficient fossil fuel subsidies in all countries, and reaffirmed this again in 2012. Eliminating energy subsidies would generate

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substantial environmental benefits. IMF estimates that raising energy prices to levels would eliminate tax-inclusive subsidies for petroleum products, natural gas and coal would reduce 4.5 billion tons of CO_2 emissions, representing a 13 percent cut in global energy-related CO_2 emissions (Clements et al., 2013).

Table 3

Estimates of fossil fuel consumption subsidies in selected countries

	ADB estimates in 2011-12		IEA estimates in 2012		IMF pre-tax estimates in 2011		IMF post-tax estimates in 2011	
	US$ bn	% GDP	US$ bn	% GDP	US$ bn	% GDP	US$ bn	% GDP
China	NA	NA	26.7	0.3	11	0.15	279	3.82
India	48.8	2.66	42.8	2.3	NA	1.74	NA	4.46
Indonesia	36.0	4.12	26.5	3.0	NA	3.24	NA	5.36
Thailand	7.0	1.92	9.6	2.6	NA	2.18	NA	4.72
Russia	NA	NA	46.2	2.3	38	2.08	116	6.29
US	NA	NA	13[*]	NA	6	0.05	502	3.33

Notes: [*] The IEA estimate for the US is 2011; NA—not available.
Sources: ADB (2014), Clements et al. (2013), IEA (2014), OECD (2012).

7. Putting resource taxes and reform in context

In physical terms, on average, coal production in China increased yearly by 200 million tons over the past 10 years, but increased by 50 million tons in 2013; in percentage terms, coal use increased yearly by 9 percent over the past 10 years, but increased by 2.6 percent in 2013. If strict measures would be taken, coal consumption could be estimated to peak in 2015-2020, with the resulting CO_2 emissions estimated to peak in 2025-2030, and coal's share in the total energy mix would be estimated to be below 50 percent in 2030 (Wang, 2014).

The imposition of environmental taxes or carbon taxes clearly helps to keep coal use under control. The Chinese legislature is considering the revision of existing environmental law and the promulgating of environmental tax law. However, this legislation process takes time, and until it is completed, there is no legal basis to authorize the levy of these taxes.

To avoid wasteful extraction and use of resources while alleviating the financial burden of local governments, China needs to reform its current coverage of resource taxation and to significantly increase the levied level. Since the tax-sharing system was adopted in China in 1994, taxes are grouped into taxes collected by the central

government, taxes collected by local governments and taxes shared between the central and local governments. All those taxes that have steady sources and broad bases and are easily collected, such as the consumption tax, tariffs and vehicle purchase tax, are assigned to the central government. VAT and income tax are split between the central and local governments, with 75 percent of VAT and 60 percent of income tax going to the central government. This led the share of the central government in the total government revenue to go up to 55.7 percent in 1994 from 22.0 percent in the previous year. In the meantime, the share of the central government in the total government expenditure just rose by 2 percent. By 2009, local governments only accounted for 47.6 percent of the total government revenue, but their expenditure accounted for 80.0 percent of the total government expenditure in China. To enable to pay their expenditure for culture and education, supporting agricultural production, social security subsidiary, and so on, local governments have little choice but to focus on local development and GDP. That will in turn enable them to enlarge their tax revenue by collecting urban maintenance and development tax, contract tax, arable land occupation tax, urban land use tax, and so on (Zhang, 2008, 2011).

Alleviating the financial burden of local governments is one avenue to incentivize them not to focus on economic growth alone. Enlarging their tax revenue is the key to helping them cover a disproportional portion of the aforementioned government expenditure. In the tax-sharing system adopted in 1994, onshore resource taxes are assigned to local governments, while the central government is collecting revenues from resource taxes offshore. In 1984, resource taxes have been levied at Yuan 2–5 per ton of raw coal and Yuan 8 per ton of coking coal, with the weighted average of Yuan 3.5 per ton of coal. For crude oil, the corresponding tax is levied at Yuan 8–30 per ton. While the prices of coal and oil have significantly increased since 1984, the levels of their resource taxes have remained unchanged over the past 25 years (Zhang, 2011). As a result, the resource taxes raised amounted to only Yuan 33.8 billion, accounting for about 0.57 percent of China's total tax revenues and about 17.5 percent of the national government expenditure for environmental protection that amounted to Yuan 193.4 billion in 2009 (NBS, 2010). Therefore, to avoid wasteful extraction and use of resources while alleviating the financial burden of local governments, the way of levying taxes on resources in China should be changed.

Economic theory suggests that resource rent taxes are preferable to resource revenue taxes because the latter introduces distortion and thus imposes the more economic burden (e.g., Garnaut, 2010). However, given the difficulty of accurate measurement of "costs", as required for a rent tax, such resource taxation should be

levied based on revenues, rather than volume. In addition, current resource taxes are only levied on seven types of resources including coal, oil and natural gas. This coverage is too narrow, falling far short of the purposes of both preserving resources and protecting the environment. Thus, overhauling resource taxes also includes broadening their coverage so that more resources will be subject to resource taxation.

Clearly, broadening the current coverage of resource taxation and significantly increasing the levied level also help to increase local government's revenues while conserving resources and preserving the environment. The Chinese central government started a pilot reform on resource taxation in Xinjiang, China's northwestern border area of abundant resources and numerous opportunities for growth and expansion. Since June 1, 2010, crude oil and natural gas are taxed by revenues rather than volume in Xinjiang. While it is enacted as part of a massive support package to help Xinjiang achieve leapfrog-like development, which is considered a strategic choice to deepen the country's Western Development Strategy and tap new sources of economic growth for China, this new resource tax will help to significantly increase the revenues for Xinjiang. It is estimated that the new resource tax levied at a rate of 5 percent will generate additional annual revenues of Yuan 4–5 billion for Xinjiang (Dai, 2010). This is a significant increase, in comparison with the total resource tax revenues of Yuan 1.23 billion in 2009, inclusive of those from other resources than crude oil and natural gas (NBS, 2010). This will contribute to 17–21 percent of the total tax revenues for Xinjiang, in comparison with the contribution level of about 4.1 percent in 2009.

The resource tax levied on crude oil and natural gas by revenues rather than by existing extracted volume, which was applied nationwide since November 1, 2011, is the first step in the right direction. There have been intensified discussions on levying resource tax on coal by revenues along this line. It is most likely that China will overhaul the current practice and levy on coal by revenues in 2014. Coal-rich provinces, like Shanxi and Inner Mongolia, have studied options to levy on coal by revenues. The tax rates are proposed to be in the range of 2-10 percent, depending on the extent to which current fees and charges are cut or abolished. Specifically, assuming coal price of Yuan 465 per ton, Shanxi proposes to levy at 2.2 percent if the charge for coal sustainable development fund (which charges Yuan 8-23 per ton, depending on the type of coal) remains; 7.4 percent if that charge is abolished. If coal price is assumed at Yuan 440 per ton, then Shanxi proposes to levy at 2.4 percent if the charge for coal sustainable development fund remains; 7.6 percent if that charge is abolished (Xing, 2013; Wang et al., 2014).

8. Conclusions

The Third Plenum of the 18th Central Committee of Communist Party of China in November 2013 strongly signaled the Chinese leadership's determination to embark upon a new wave of comprehensive reforms in China. This is clearly reflected by the Plenum's key decision of assigning the market a decisive role in allocating resources. To have the market to play that role, getting the energy prices right is crucial because it sends clear signals to both producers and consumers of energy. Since 1984, China has been reforming energy prices. While the overall trend of such energy pricing reform has been moving away from the pricing completely set by the central government in the centrally planned economy towards a more market-oriented pricing mechanism, the pace and scale of the reform differ across energy types.

Coal pricing reform has been most extensively in terms of both pace and scope. The dual pricing system was introduced in 1984 wherein enterprises were required to sell up to a predetermined quota of coal at prices that were set by the central government but were allowed to sell above the quota at prevailing market prices. As part of sweeping price reforms initiated in 1993, the price of coal has since been set differently, depending on use. Under a two track system, the price of coal for non-utility use, the so-called "market coal", would be determined by the market. But the price of coal for utility use, the so-called "power coal", was based on "guidance price" set by the NDRC, often at rates substantially below prevailing market prices. In 2004, NDRC abolished its guidance price for power coal and set price bands for negotiations between coal producers and electricity generators. NDRC widened those bands in 2005, and scrapped them altogether in 2006. NDRC proposed in May 2005 a coal-electricity price "co-movement" mechanism that would allow electricity tariffs to be raised if coal prices rose by 5 percent or more in no less than six months. This mechanism also allowed electricity generators to pass up to 70 percent of increased fuel costs on to grid companies. In December 2012, the State Council announced the abolition of the two track system for coal prices, allowing the price of coal for utility use to 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, allowing adjustment in electricity tariffs if fluctuations in coal prices go beyond by 5 percent or more in 12 months and electricity generators to pass up to 90 percent of increased fuel costs on to grid companies instead of the existing 70 percent threshold.

Similar to coal, a dual pricing system for crude oil was introduced in 1984, and was virtually eliminated in 1993. Since 1998 domestic crude oil prices have tracked

international prices, but refined oil product prices have not. To address this disconnect, the government has, since May 2009, implemented the pricing mechanism whereby domestic petroleum product prices would be adjusted upward if the moving average of a basket of international crude oil prices, on a composite basis, rise by more than 4 percent within 22 consecutive working days. To better reflect refiners' costs and adapt to fluctuations in global crude oil prices, in March 2013 NDRC launched an automatic petroleum product pricing mechanism, shortening the 22-working-day adjustment period to 10-working-day and removing the 4 percent threshold. The government also decided to adjust the composition of the basket of crude to which oil prices are linked.

Reforms have also been undertaken for natural gas prices. A breakthrough in the reform area has been changing the existing cost-plus pricing to the "netback market value pricing" in Guangdong province and the Guangxi Zhuang autonomous region. Under this new pricing mechanism, pricing benchmarks are selected and pegged to prices of alternative fuels, which are formed through market forces, to establish a price linkage between natural gas and its alternative fuels. Gas prices at various stages will then be adjusted accordingly on this basis. Before introducing the Guangdong and Guangxi pilot reform program to the entire country, NDRC plans to implement three-tier-tariffs for household use of natural gas across the whole country before the end of 2015. These price reforms and the pilot scheme in Guangdong and Guangxi help to establish a market-oriented natural gas pricing mechanism that fully reflects demand and supply conditions.

The government still retains control over electricity tariffs. But in order to encourage coal-fired power plants to install and operate flue gas desulfurization and denitrification facility it has offered, since 2004, a price premium on electricity generated by coal-fired power plants with FGD facility installed and, since November 2011, a price premium for electricity generated by power plants with flue gas denitrification facility. The level and scope of the price premium were amended since their initial implementation in order to achieve the mandated emissions reductions. From October 2006, China has also charged differentiated power tariffs for companies classified as 'eliminated types' or 'restrained types' in eight energy-guzzling industries. From July 2012 NDRC implemented three-tier-tariffs for household electricity use, and since January 2014 the three-tiered electrify pricing approach has been expanded to the aluminum sector in order to phase out outdated production capacity and speed up industrial restructuring. A similar tiered power pricing policy is expected to be introduced in other industries, such as cement, to force upgrades in the drive for sustained and healthy development.

Clearly, China has made great efforts towards reforming energy prices. However, such reforms are far from complete. While the new pricing mechanism for petroleum products is one step towards a more market-oriented system, it is still not a full marketisation. Petroleum product price fluctuates along with global crude oil prices, but decouples 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, liberalizing petroleum product prices needs to go far beyond this. The success will depend 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.

The aforementioned pilot schemes in Guangdong and Guangxi provide the right direction to establish a market-oriented natural gas pricing mechanism. China needs to take lessons learned from the two pilot schemes and examine what kinds of adjustments and improvements are needed regarding the choice of alternative fuels, the selection of the pricing reference point and the creation of netback market value pricing formula in order to implement the Guangdong and Guangxi pilot reform program to the entire country.

While China has been reforming its electricity industry structure since 2002, transmission, distribution and sale of electricity are undertaken by two main grid companies, State Grid and China Southern Power Grid, and several local grid companies, such as Inner Mongolia Grid and Shaanxi 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, separation of transmission and distribution is not a viable option. The feasible approach should start reforming electricity sale side by setting up the electricity power trading market. The direct purchase for major electricity users, as piloted in Yunnan province, should be actively promoted. This would help to infer the actual cost of electricity transmission and its effective distribution and help government to set the appropriate level of the grid's transmission and distribution charges in future electricity power structure reform. While splitting grid is not a necessary option to achieve this goal, 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. As such, an open nationwide electricity power market will be established to create a market-based system

for electricity pricing. These are considered the most realistic options for pushing forward power reforms. In the meantime, given that meeting the goal of cutting NOx emissions has lagged far behind the schedule for the 12th five-year plan as a result of the high costs and hence the reluctance of coal-fired power plants to install and operate denitrification facilities, the government could also consider raising the current level of price premium for denitrification in order to encourage the installation of such plants and run denitrification facilities continuously and reliably.

For coal, 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. Given uneven geographical distribution of coal production and economic output, coal has to be transported over the long distance to the load centers, with over 40 percent of the total freight shifted by railways having been coal since 1980s (Zhang, 1998; Tu, 2013). 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 environmental taxes or carbon taxes can internalize externality costs into the market prices. In terms of timing, given that China has not levied environmental taxes yet, it is better to introduce environmental taxes first, not least because such a distinction will enable to disentangle China's additional efforts towards carbon abatement from those broad energy-saving and pollution-cutting ones (Zhang, 2011). And given the ongoing lengthy legislation process to authorize the levy of these taxes, as well as the pressing need to avoid wasteful extraction and use of resources, China needs to reform its current narrow coverage of resource taxation and to significantly increase the tax level. The resource tax levied on crude oil and natural gas on a revenue basis, rather than by existing extracted volume, which has been applied nationwide since November 1, 2011, is a step in the right direction. China should broaden that reform to coal by overhauling the current practice and impose the levy on coal by revenues. This would also help to increase local government's revenues, alleviate their financial burden and incentivize them not to focus on economic growth alone.

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. Aligned with the implementation of low-carbon provinces and low-carbon cities in six provinces and thirty-six cities, China is experimenting the seven pilot carbon trading schemes. These pilot trading schemes share some in common but have differing features, and have been put into operation since June 2013, respectively. Based on these piloted schemes, China aims to establish a national carbon trading scheme before 2020.

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