SECTOR ASSESSMENT: ENERGY

Sector Road Map

1. Sector Performance, Problems, and Opportunities

1. In 2009, the People’s Republic of China (PRC) became the world’s largest energy consumer. In 2014, the PRC consumed 4.26 billion tons of standard coal equivalent (tce), which accounted for 23% of the global energy consumption. As the national government’s effort on improving energy efficiency progresses, the PRC’s energy consumption has grown at a slower rate than the overall economy since 2006. Energy intensity has improved by 13.4% in 2011–2014 with reduction of 4.9% in 2014 compared to 2013. The government launched various command and control measures to address energy conservation, especially in energy intensive secondary industry. A distinctive characteristic of the PRC’s energy sector is its heavy reliance to coal. The share of coal in PRC’s primary energy consumption remained over 70% although the 2014 annual coal consumption declined for the first time in the last 2 decades by 2.9% compared to 2013. However the figure is much higher than the global average. The PRC government has set a target to reduce the share of coal in primary energy consumption to 62% by 2020. In parallel, although slowly, the PRC makes gradual progress in increasing the share of renewable energy generation in its energy mix. The PRC became a world leader in wind power, hydropower generation, and in solar photovoltaic manufacturing. The share of non-fossil fuel sources in the PRC’s energy consumption has increased from 7.8% in 2009 to 11.3% in 2014. However, the national energy consumption maintains to grow because of continuous industrialization and urbanization process. Moreover, the overemphasis on supply measures to meet the growing demand is considered unsustainable in the medium- to long-term in the PRC while rebalancing the economy through development of the less energy-intensive service sector.

2. Hebei Provincial Government’s Sector Strategy

2. Hebei is the PRC’s second largest energy consumer with total energy consumption of 302.5 million tce in 2012, which increased by 2.5% from 2011. Hebei’s energy intensity remained at 1.14 in 2014, which is 0.44 higher than the national average. The main cause of high intensity is the industrial sector, which consumes 79.6% of the total energy. The province’s natural gas consumption was 7.3 billion cubic meter (m³) in 2014, which is only 2.3% of the primary energy consumption. In its 12th five-year plan, Hebei set targets of energy intensity reduction by 18%, reduce coal consumption to below 85% of its primary energy source, and more than 6% of non-fossil fuel based energy in the energy mix by the end of 2015. The plan commitments pushed Hebei provincial government (HPG) to take actions to (i) reduce energy intensity; (ii) improve industrial energy structure by strictly controlling the industries with high energy consumption and high pollution; (iii) optimize the industrial structure; (iv) speed up technology upgrade; (v) conduct energy consumption benchmarking; (vi) reduce share of coal in its energy mix; and (vii) increase share of renewable energy by promoting clean coal utilization and improving efficiency, and develop renewable energy sources such as wind, solar, biomass, and geothermal. By implementing these measures, both energy consumption and energy

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1 Energy intensity is the ratio between energy consumption and gross domestic product measured at constant prices. Average energy intensity in the PRC was 0.70 tce in 2014.

2 The carbon intensity of PRC economy has declined by 15.8% in 2014 compared to 2010 as against the target of 17% reduction by 2015 compared to 2010. In 2014, there was a 0.7% reduction of greenhouse gas emissions in 2014 compared to 2013.

3 Total energy consumption data for Hebei in recent years are missing in all related statistics because the PRC government is revising the format of the energy consumption data.
intensity demonstrated a continuous drop during the plan period. In 2014, the total energy consumption of high revenue generating industrial enterprises was 203 million tce, a reduction of 4.1% and energy intensity fell by 7.2%, higher than national average of 4.9%. Hebei province was ranked second in the PRC that achieved the highest reduction in energy intensity, next to Shanghai. Hebei’s energy sector strategy will continue to follow the same path during the upcoming 13th five-year plan (2016–2020). Upgrade of industry sector by industrial transformation, and fuel switch from coal to cleaner energy source are two important pillars for HPG.

3. **Necessary Policy Reforms and Actions for Air Pollution Control**

3. **Industry facilities upgrade to conserve energy and reduce air emission.** In Hebei, the key industries for both energy conservation and air pollution control are energy intensive heavy industries including power, steel, cement, coking, glass, and other manufacturing industries. Since 2010, HPG has issued a number of policies to improve energy efficiency and reduce emissions, and these policies are relatively comprehensive for those industries. Implementation and monitoring of the policies are challenging as many actions related to upgrading the facilities will take time for engineering design, purchase, and installment. Moreover, the actions must be taken by the private enterprises. Collaborations between the local government, the provincial government, and enterprises must be enhanced; and performance-based and/or results-based commitment may be useful to promote and monitor the progress.

4. **Adjustment of energy structure by reducing coal consumption and promoting clean energy.** For medium- and long-term development objectives, HPG needs to intensify efforts to further reduce the share of coal in their energy supply mix and increase the use of low carbon energy sources and cleaner fuels. Hebei needs to address the challenge through an integrated manner. For the supply side, the use of natural gas is considered the most appropriate energy source because it is technically matured, cost efficient, and is timely to combat air pollution. Eventually, other renewable energy sources are important but it should be carefully considered due to its technical complexities and slow market penetration. In fact, Hebei takes advantage of its natural resources and promotes renewable resources, especially in geothermal, biomass, wind, and solar energies. Some cities such as Xingtai, Chengde, Zhangjiakou, and Beidahe new district in Qinhuangdao were selected as “new energy cities” by the PRC’s national energy administration.

5. In Hebei, the main barriers to promote natural gas energy mix are (i) slow progress of the natural gas network infrastructure, (ii) a lack of storage facility for natural gas to meet demand during peak periods, (iii) a long construction period of pipelines, and (iv) delayed construction of

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4 These are enterprises with revenue of more than CNY20 million per annum.


pipelines at county level. By the end of 2014, 20 major natural gas trunk lines with 3,000 kilometers of pipelines had been built in Hebei. However, a portion of natural gas in the primary energy consumption remained 2.3% and insufficient to promote fuel switch within the province. The government commitment with clear vision is required to continue investing on the provincial gas network, so that the pipelines will be reached to county-level and village-level in the middle-to long-term. Such provincial plan will not only propose a ground design of natural gas supply network, but it will provide an idea of how to finance them with a strengthened financial scheme on how to promote the utilization of natural gas and absorb the price gap between coal and natural gas.

6. One of effective policies that can address energy conservation, pollution reduction, and promote fuel switch is to recycle coke oven flue gas. In 2014, Hebei is the second major producer of coke in the PRC, with many sources for rich coke oven flue gas. The flue gas is a synthetic gas, and can be further produced and used as a cleaner energy source. However, the resource is currently untapped. With supporting policy, the synthetic natural gas made of coke oven gas can be supplied and utilized through the natural gas networks, or further processed to the compressed natural gas and liquefied natural gas. The estimation indicates that Hebei can produce more than 6 billion m\(^3\) of synthetic natural gas annually. Disposing coke oven gas into the atmosphere is a waste of an energy resource and results in increased emissions and environmental pollution. With this proposed policy to guide the implementation of coke oven flue gas conversion, the available energy resources from coking industry can be maximized.

7. The supply side policies must be supported by appropriate demand side policies and actions to accelerate the fuel switch across the province, especially at the municipal level. This requires each of 11 municipal government to have a comprehensive plan for coal management and reduction, and commit for the numerical targets including raw coal reduction, and promotion of centralized and non-coal fired heating service. Such numerical targets should be recognized by HPG and monitored annually to ensure the progress, thereby achieve the overall provincial targets.

8. The use of inefficient coal-fired boilers for heating service is one of the major causes of air pollution in winter. In Hebei, there are more than 11,000 small coal-fired boilers, of which about 98% is with the capacity less than 10 steam ton per hour. Promotion of a centralized heating system to upgrade and phase out small inefficient coal-fired boilers and replacement of such boilers with low-carbon energy efficient heating system are the most effective measure to improve energy intensity and reduce air pollution. In 2015, the government has issued the Implementation Plan on Coal-Fired Boiler Renovation with numerical targets in 2015–2017. The plan is supported by appropriate financial incentives on the capital investment for the facilities. However, the current policy framework is incomplete due to lack of measures to support their operation. Since coal is the cheapest and readily available energy source in Hebei, the cost of heat production with cleaner energy source need to be rationalized financially and technically. A study is necessary to build a sound policy framework on heating service in Hebei. This may include design of financial and market-based economic incentives, heating tariff structure, and its affordability especially for poor households in rural areas.

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7 The composition of coke oven flue gas is hydrogen (55–60%), methane (23–27%), carbon monoxide (5–8%), unsaturated hydrocarbon above carbon dioxide (1.5–3%), oxygen (0.3–0.8%), and nitrogen (3–7%).

8 Hebei annually produces around 64 million tons of coke. Typically, production of a ton of coke generates approximately 360 cubic meters (m\(^3\)) of coke oven gas, except for the portion recycled for captive heating in coking plants.
9. **Reduction of seasonal stalk-burning and promotion of clean energy in rural area.** Hebei is also an agricultural province. Contribution of the agriculture sector to the provincial gross domestic product was 12.4% in 2013, compared to only 1% in Beijing and Tianjin with a national average of 9%. In the agriculture sector, seasonal stalk burning is one of major sources for air pollution in Hebei especially in harvesting seasons of wheat and corn in June and November. In 2014, Hebei produced 61.8 million tons of agricultural stalk waste, among them 59.6 million tons are collectable and 86.5% of the collected stalk has been utilized. A large part of this biomass resource is used by reapplication to agricultural lands (43%), and as livestock feeds (38%).

Energy recovery accounted for 10%. Estimates from the Hebei Agriculture Department suggest that the practice of on-field burning still amounted to some eight to nine million tons in 2014, with a decreasing trend. Optimizing the use of stalk biomass resources needs to be carefully studied, but there is room to pursue higher energy recovery target. The utilization of the biomass resources for energy recovery will also reduce unnecessary on-field biomass burning. The government has issued the People’s Congress Standing Committee’s Decision on Promoting Integrated Utilization of Crop Stalk and Prohibiting Open Burning Hebei Province Action Plan for Agricultural Non-point Source Pollution Control in 2015.

10. The key to more efficiently and successfully utilize biomass resources includes (i) effective and affordable technologies, (ii) appropriate business model to deploy the technologies, and (iii) governments’ support, that makes biomass resources a preferable choice of energy in rural areas. HPG needs its own stalk utilization plan to further reduce open burning and promote better uses of agricultural residues, which should respond to the provincial target to cut coal usage by 15 million tons in the rural sector by the end of 2017. The plan recommends effective technologies and suitable business model on how to promote the deployment of those technologies. The plan should indicate the increased target rate for energy recovery from 10% with supporting policies to remove barriers for promoting energy recovery in rural areas. A robust fund management and monitoring system is very important to effectively implement clean energy development in Hebei as ad-hoc fund allocations and management may lead to unbalanced focus for clean energy development in rural Hebei. A number of policies was issued to support fuel switch from raw coal to cleaner energy in rural areas. However, bottlenecks were found: (i) a few players in the biomass briquette market (e.g. producer and retailer) in rural areas, and (ii) production and distribution cost of biomass briquette is not competitive to coal. The government is required to further strengthen financial support to lower the production cost of biomass briquette, while making the biomass briquette a financially attractive choice of fuel in the rural areas.

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9 Although reapplication of stalk as fertilizer to agricultural lands will help the crop yield, continuous and overdone reapplication will affect the planting quality and increase the chance of plant diseases and insect pests.


11 This may include (i) enhancing the subsidy of price difference between coal and biomass briquette with a more flexible subsidy scheme which should correlate to the coal spot market price with a small margin, (ii) enhancing the subsidy on stalk collecting and briquette producing machines, and (iii) considering the subsidy for stalk collecting, briquette storage, and transport.