

**DETAILED SECTOR ASSESSMENT :  
AGRICULTURE, NATURAL RESOURCES, AND RURAL DEVELOPMENT; ENERGY;  
FINANCE; AND TRANSPORT**

**A. Agriculture Natural Resources, and Rural Development Sector Road Map**

**1. Sector Performance, Problems, and Opportunities**

1. **Environmental pressure and climate change.** The unprecedented speed of economic development in the People's Republic of China (PRC) has beneficially transformed the lives of all people in the country and made the PRC economy the second largest in the world. These achievements, however, have not been without adverse environmental consequences, and the ongoing development is considered not environmentally sustainable. Availability of sufficient clean water is increasingly a concern, and land resources are declining because of urbanization, pollution, and degradation. Frequent water pollution incidents, rising reports of soil pollution and land degradation, long-lasting haze and smog pollution occurrences, and concerns about food safety and human health have become challenges for national and local governments. According to recent estimates by the Ministry of Environmental Protection (MEP), the national cost of pollution damage is equivalent to around 6% to 9 % of gross domestic product (GDP).

2. The agricultural sector provides food and employment but also contributes to increased environmental degradation, greenhouse gas (GHG) emissions, and air pollution. In 2016, the sector produced 21% of the PRC's GHG emissions.<sup>1</sup> Ammonium salts (i.e., ammonium sulphate and ammonium nitrate) released as by-products of chemical fertilizer use and livestock farming account for about 7% to 57% of the total ambient particulate matter less than 2.5 microns in diameter (PM<sub>2.5</sub>), a hazardous air pollutant that poses severe health risks.<sup>2</sup> Nitrous oxides, another by-product of excessive fertilizer use, also contribute to PM<sub>2.5</sub> formation, GHG imbalance in the atmosphere, as well as stratospheric ozone loss. Its terrestrial impacts include soil acidification and freshwater eutrophication that threaten long-term food security; and marine ecosystems.

3. **Agricultural production.** Agriculture has developed rapidly and has made substantial contributions to the overall economic development of the PRC. Total grain production has grown for 12 consecutive years since 2004. Meanwhile, agricultural production has become more diversified and product quality has improved. As a result, farmers' incomes have increased substantially, supporting inclusive growth. Contributing factors include better introduction of market mechanisms and participation of multiple private stakeholders in the sector; larger scale production facilitated by land transfer practices, as well as increased application of equipment and advanced technologies.

4. However, the transition to modern agriculture has not been able to keep pace with urbanization and industrialization in the PRC. Natural disasters, which have become more severe and frequent because of climate change, have severely impacted agriculture in the country because of weak agricultural infrastructure and facilities. There is an urgent need to improve the resilience of the sector to climate change. The sector is also facing challenges such as (i) rising

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<sup>1</sup> Mainly from rice paddies, livestock, manure management and nitrous oxide (N<sub>2</sub>O) emissions from fertilizer application, and energy-related CO<sub>2</sub> emissions which account for about 8% of the total CO<sub>2</sub> emissions.

<sup>2</sup> Studies conducted in Europe indicate that the contribution from agricultural ammonia to PM<sub>2.5</sub> ranges between 10% to 40%. In Europe, total emissions of ammonia from the agricultural sector are around 94%, thus control strategies to reduce ammonia emissions can considerably influence particulate matter concentrations.

prices of labor and inputs; (ii) increasing demand for safe; (iii) high-quality agricultural products; and (iv) constraints on environmental and land resources.

5. **Agriculture sector in the greater Beijing–Tianjin–Hebei (BTH) region.**<sup>3</sup> In 2015, agricultural contributions to provincial GDP in Hebei Province and Henan Province were 11.5% and 11.4% respectively, higher than the national average of 9.2% in the same year. Seasonal stalk burning is one of major sources for air pollution in Hebei and Henan Provinces especially in harvesting seasons of wheat and corn in June and November. Shandong Province is the largest agricultural province in the PRC, producing about 10% of the country’s biomass stalk. The utilization of the biomass resources for energy recovery will be one of the focused areas to reduce air pollution in Shandong Province. The utilization of the biomass resources for energy recovery will also reduce unnecessary on-field biomass burning.

## 2. Government’s Sector Strategy

6. **Overarching objectives.** The government recognized the massive environmental and ecological challenges that the country is facing, and placed building of an “ecological civilization” as one of the most important policy areas for the country in the Third Plenary Session of the 18th Central Committee of the Communist Party Congress.<sup>4</sup> Renewed emphasis has been placed on control of air, water, and soil pollution. The unprecedented level of new actions plans and investments provides the timing and opportunity to accelerate the transition to the new path of addressing environmental and ecological challenges. The government’s rural focus under the 13th Five-Year Plan is to continue its efforts to (i) improve resource conservation; (ii) undertake environmental friendly development; and (iii) use and manage land, water, and other natural resources more sustainably.

7. **Agricultural transformation.** Given its fundamental contribution to food security and improvement of rural livelihood, agricultural modernization has been prioritized by the Government of the PRC. The primary objectives are to ensure adequate supply of agricultural products and continuously raise farmers’ incomes so as to close the rural-urban gap. Policies to promote agricultural modernization will focus on (i) improving the capacity, competitiveness, and resilience of agricultural production; (ii) supporting development of agri-business and agricultural value chain systems; (iii) promoting investment in technology, human resources, and innovative management for sector upgrading; and (iv) encouraging participation of private entities and partnership among multiple stakeholders in the sector.

8. The 2015 Decree No. 1 issued by the central government identified several approaches and tasks for accelerating agricultural modernization. They include (i) protecting farmland and upgrading, developing, or rehabilitating large or medium-sized irrigation districts, and constructing on-farm infrastructure to strengthen agricultural production capacity; (ii) developing agriculture suited to local geographical conditions; (iii) establishing information platforms to trace and share quality and safety information of agricultural products; and (iv) promoting water-saving techniques, eco-friendly fertilizers and pesticides, and other pollution-mitigating measures.

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<sup>3</sup> The greater Beijing–Tianjin–Hebei region includes Beijing and Tianjin municipalities; Hebei, Henan, Shandong, Shanxi and Liaoning provinces; and Inner Mongolia Autonomous Region.

<sup>4</sup> According to the PRC Government, “ecological civilization” refers to achieving harmony between growth, people, and nature, requiring people to respect, protect, and maintain a harmonious relationship with nature. It includes activities to mitigate ecological damage, relieve pressures on natural resources, and improve the balance between the environment and the economy.

9. The PRC Government has acknowledged the environmental risks posed by the agricultural sector and has committed to promoting and introducing mitigation and adaptation strategies to combat climate change. In its Intended Nationally Determined Contributions on climate change, the government has committed to (i) promote the low-carbon development in agriculture, making efforts to achieve zero growth of fertilizer and pesticide utilization by 2020; (ii) control methane emissions from rice fields and nitrous oxide emissions from farmland; and (iii) construct a recyclable agriculture system, promoting comprehensive utilization of straw, reutilization of agricultural and forestry wastes and comprehensive utilization of animal waste by 2030.

### 3. ADB Sector Experience and Assistance Program

10. The PRC Government and the Asian Development Bank (ADB) have developed a diverse portfolio of projects in agriculture, natural resources, and rural development. Environmental sustainability and climate resilience have been promoted through projects supporting water resource management and conservation, ecosystem management and biodiversity conservation, lake and wetland protection, renewable biomass energy development, and support for dryland farming. Sovereign lending in the natural resources and agricultural sector in the PRC increased sharply during 2011–2015. Non-sovereign lending to agribusiness was also initiated with two transactions (one in cold storage and one in greenhouse agriculture) during 2012–2015.

11. **ADB's sector strategy.** ADB will support the PRC to realize its "ecological civilization" ambitions and will assist in identifying and applying innovative interventions that demonstrate increased climate resilience and environmental sustainability through more sustainable use and better protection of natural resources, in particular for those areas where environmental degradation and climate change most impact rural and urban livelihoods. ADB will promote inclusive growth and improve rural livelihoods by helping to increase agricultural productivity, strengthening agricultural and rural infrastructure, promoting application of information technologies, and expanding financial services in rural areas, in line with ADB's Operational Plan for Agriculture and Natural Resources.<sup>5</sup> Support will be provided for developing value chains, including linking agribusinesses and local entrepreneurs with poor farmers through extension services, rehabilitating rural infrastructure, food safety and possibly food security, environmental sustainability and climate resilience, sustainable agribusiness mitigating soil and water pollution, and access to credits and markets. Non-sovereign assistance will be targeted to farming companies including large-scale livestock farms, food processors, logistics companies, financial intermediaries, and to other projects that enhance productivity and standardization, inclusion of smallholder farmers in value chains, food safety, and pollution control.

12. Financial assistance could play a role in emission reduction efforts, offsetting the higher costs that, at least initially, farmers will face to convert to more sustainable agricultural methods. Investment will target (i) provision of financing to farmers to purchase low-carbon equipment and agriculture inputs; (ii) increase farmer access to and adoption of technology and information; (iii) promote agroforestry and sustainable livestock practices by improving the quality and utilization of crop residues and fodder; (iv) enhancing manure management; and (v) capture of the biogas produced during the anaerobic decomposition of manure in biogas digesters and replace traditional coal and biomass burning in rural PRC.

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<sup>5</sup> ADB. 2015. *Operational Plan for Agriculture and Natural Resources: Promoting Sustainable Food Security in Asia and the Pacific in 2015–2020*. Manila.

## B. Energy Sector Road Map

### 1. Sector Performance, Problems, and Opportunities

13. Rapid economic development has accelerated energy demand growth in the PRC. In 2009, the PRC surpassed the United States to become the world's largest energy consumer. In 2015, the PRC's energy consumption accounted 23.1% of global energy consumption, or 4.3 billion tons of standard coal equivalent. Because 64% of the PRC's primary energy consumption comes from coal in 2015, economic growth has also been carbon-intensive. From 1990–2015, CO<sub>2</sub> emissions from the PRC increased by 279%, from 2.360 billion to 8.948 billion tons per year.<sup>6</sup>

14. The government recognizes the negative and long lasting impacts of high-carbon development and in 2006 started to introduce energy saving and emission control strategies, especially in the energy sector. The government has also set targets to reduce the share of coal in primary energy consumption to 62% by 2020. Since then, substantial progress has been made. Between 2011 and 2015, energy intensity in production improved by 18.4% while CO<sub>2</sub> emissions intensity has decreased by over 20% from 2010 to 2015.<sup>7</sup> In 2015 annual coal consumption declined for the second consecutive year after a peak in 2013. Compared to 2014 the PRC coal consumption decreased by 3.72% in 2015.<sup>8</sup>

15. The PRC has also made significant progress in increasing the share of non-fossil fuel energy consumption in its energy mix from 9.4% in 2010 to 12% in 2015 and is a world leader in wind power, hydropower generation, and in solar photovoltaic manufacturing. The PRC's energy sector has grown at a slower rate than the overall economy since 2006, in response to government efforts to reduce the energy intensity.<sup>9</sup> The PRC's energy intensity declined by 18.4% during the 12th Five-Year Plan (2011–2015) and the government has set a target of further energy intensity reduction of 15.0% during the 13th plan (2016–2020). The PRC's carbon intensity declined by over 20% during the 12th plan period and the government has set a target of further carbon intensity reduction of 18.0% during the 13th plan period.

16. Other achievements in adjusting the PRC's energy mix include: (i) an optimization of the energy structure, leading to 34.07% of the total national power generation capacity coming from hydro, nuclear, wind and solar, with only 65.93% left from coal in 2015; (ii) an increase in the ratio of large capacity, high parameter and high efficiency units instead of having smaller but fewer;<sup>10</sup> and (iii) a significant achievement in energy saving and emission reduction, with the national net coal consumption rate of fossil fuel fired units falling by 109 gram per kilowatt hour to 318 gram per kilowatt hour by 2015 since 1990.

17. The PRC's increased renewable energy production has had a positive impact in reducing overall CO<sub>2</sub> emissions, but CO<sub>2</sub> emissions from coal-fired power generation continues to outpace the increase in renewables and efficiency improvements in fossil fuel-based power generation.

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<sup>6</sup> CO<sub>2</sub> emission intensity is the ratio between energy consumption and gross domestic product measured at constant prices.

<sup>7</sup> Energy intensity is the ratio between energy consumption and gross domestic product measured at constant prices. Average energy intensity in the PRC was 0.709 tce in 2014.

<sup>8</sup> There was a 0.7% reduction of greenhouse gas emissions in 2014 compared to 2013.

<sup>9</sup> CO<sub>2</sub> emission intensity is the ratio between energy consumption and GDP measured at constant prices.

<sup>10</sup> 77.7% of fossil fuel fired plants in 2014 had a capacity of 300 megawatts or above.

## 2. Government's Sector Strategy

18. The PRC Government recognizes that its commitment to peak CO<sub>2</sub> emissions by 2030 needs low-carbon transformation and sustainable development that will require substantial capital and willingness to refocus industries and energy production away from high emission production and fossil fuel use. In 2014, the Government passed the “National Plan for Addressing Climate Change (2014–2020),” which stresses the importance of promoting climate change through a holistic and integrated approach. The policy framework focuses on key areas such as energy saving, streamlining energy mix, adjusting industrial structure, ecological construction, and environmental protection. On 16 March 2016, the PRC adopted its 13th plan. The 13th plan, building on the success of the previous plan, sets specific emissions reduction goals and for the first time, includes a total energy consumption cap of 5 billion tce. The 13th plan calls for any new coal-fired power plants to be “ultra-low emissions,” a standard that attempts to make coal-fired power plants as clean as natural gas plants. Moreover, the plan calls for the replacement of coal in non-power sectors either with electricity or natural gas. The plan explicitly calls for the PRC's oil industry to produce gasoline and diesel suitable for vehicles at the China V standard. China V is equivalent to Euro V, a standard adopted in the European Union in 2009.

19. Successful implementation of both plans will require close coordination between policy, technology and capital, especially between the governments at the provincial level. The low carbon development especially in the BTH region needs to include optimizations of energy consumption for end-user, adjustments of energy mix, energy efficiency improvements and CO<sub>2</sub> capture, utilization and storage. While different measures are important for major energy producing regions with low energy efficiency in Hebei Province, Shanxi Province and Inner Mongolia Autonomous Region than in urban centers such as Beijing and Tianjin Municipality, the entire BTH area needs to make efforts.

## 3. Provincial Energy Sector

### 3.1 Hebei Province

20. **Hebei's Energy Sector.** In 2015, Hebei's energy intensity was 0.99 substantially higher than the national average of 0.67 and its ferrous metals industry, and power and heating sector accounted for 16% and 15% of the PRC's total energy consumption respectively. Industry has been identified as a critical sector for intervention as it consumed about 79% of the province's total energy consumption and produced more than 30% and 44% of the province's PM<sub>2.5</sub> and CO<sub>2</sub>. The province's other energy intensive heavy industries include power, steel, cement, coking, glass, and other manufacturing industries and should be the key targets for energy conservation and air pollution reduction.

21. **Hebei Provincial Government's Energy Sector Strategy.** Since 2010, the province has issued comprehensive policies to improve energy efficiency and reduce emissions especially in energy and carbon intensive industries. Implementation and monitoring of the policies has proved to be challenging as many actions related to upgrading the facilities takes time. In its 12th plan, Hebei Province set targets to (i) reduce its energy intensity by 18%, (ii) reduce coal consumption to below 85% of its primary energy source, and (iii) introduce more than 6% of non-fossil fuel to its energy mix by the end of 2015. The implementation of energy consumption and energy intensity reduction measures has had mixed results. In 2015, the total energy consumption was 294 million tce, a slightly decrease of 751,000 tce, and energy intensity only fell by 1% from 0.997 in 2014 to 0.986 in 2015.

22. **Focused Areas for the Hebei Province.** The following areas should be considered for Hebei under the proposed project: (i) Industry facilities upgrade to conserve energy and reduce air emission. In Hebei Province, 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; (ii) Adjustment of energy mix by reducing coal consumption and promoting clean energy. For medium- and long-term development objectives, Hebei Province 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; and (iii) Promotion of biomass and other clean energy in rural area. Hebei is also an agricultural province. Contribution of the agriculture sector to the provincial GDP was 11.5% in 2015, compared to only 0.61% in Beijing and 1.3% in Tianjin with a national average of 9.2%. In the agriculture sector, seasonal stalk burning is one of the major sources for air pollution in Hebei especially in harvesting seasons of wheat and corn in June and November. In 2015, about 9.3% of agriculture stalk was utilized for energy recovery. Increase biomass utilization to reduce unnecessary on-field biomass burning will be one of the focused areas in Hebei energy sector.

### 3.2 Shanxi Province

23. **Shanxi's Energy Sector.** In 2015, the province's overall energy intensity at 1.235 was the worst within the BTH region and more than double the national average. The province's industrial sector consumed about 75% of Shanxi's total energy consumption in 2015 with near 97.6% of energy consumed by heavy industry and only 2.4% was consumed by light industry. The processing of petroleum, coking, processing of nucleus fuel in Hebei Province accounting for 10% of the PRC's respective total energy consumption in the same year. Apart from the power sector, energy intensive heavy industries including steel, cement, coking, glass, and other manufacturing industries should be the key targets to address both energy conservation and air pollution issues in Shanxi.

24. **Shanxi Provincial Government's Energy Sector Strategy.** Since 2010, the Shanxi Province has issued a number of policies to improve energy efficiency and reduce emissions, including comprehensive measures for energy and carbon intensive industries. In its 12th plan, Shanxi Province set targets of PM<sub>2.5</sub> reduction of 20% by 2017, energy intensity reduction by 16% and CO<sub>2</sub> emission reduction of 17% by the end of 2015. By implementing these measures, both energy consumption and energy intensity fell during the planning period. However, in 2015, the total energy consumption was 158.1 million tce, an increase of 14.4% and energy intensity also increased by 14% compared to 2014 levels from 1.08 in 2014 to 1.24 in 2015.

25. **Focused Areas for the Shanxi Province.** The following areas should be considered as the focused areas for Shanxi under the proposed project: (i) Industry facilities upgrade to conserve energy and reduce air emission. In Shanxi Province, the key industries for both energy conservation and air pollution control are energy intensive heavy industries including mining, washing of coal, processing of petroleum, coking, processing of nucleus fuel, power, steel, cement, coking, glass, and other manufacturing industries. Shanxi set target to phase out (a) coal-fired boilers with capacity below 20 tons per hour by 2016, (b) 6.7 million tons of excessive capacity in iron and steel sector by 2017, and (c) 18 million tons of excessive capacity in coking sector by 2017; and (ii) Adjustment of energy mix by reducing coal consumption and promoting clean energy. Shanxi needs to intensify efforts to further reduce the share of coal in their energy mix and increase the use of low carbon energy sources and cleaner fuels.

### 3.3 Inner Mongolia Autonomous Region (IMAR)

26. **IMAR's Energy Sector.** In IMAR, the industrial and power sectors are key sectors for intervention as they produced more than 24% and 68% of IMAR's emissions, respectively. In 2015, IMAR's overall energy intensity was 1.05, the second highest within the BTH region and higher than the national average. IMAR's industrial sector consumed about 72.5% of IMAR's total energy consumption in 2015, while in 2014 mining and washing of coal accounted for 12% of the PRC's respective total energy consumption.

27. **IMAR Government's Energy Sector Strategy.** Since 2010, IMAR has issued a number of policies to improve energy efficiency and reduce emissions. In its 12th plan, IMAR set targets to reduce energy intensity by 15% at the end of 2015 and reduce PM<sub>2.5</sub> emissions by 10% by the end of 2017. By implementing measures, energy intensity fell during the planning period. In 2015, the total energy consumption of industry increased by 34.3% to 127.4 million tce comparing to 94.5 million tce in 2010, but energy intensity fell by 3.94% compared to 2013 levels and the energy intensity has been increased by 1.9% from 1.03 in 2014 to 1.05 in 2015.

28. **Focused area for IMAR.** The following areas should be considered as the focused areas for IMAR under the propose project: (i) Industry facilities upgrade to conserve energy and reduce air emission. In IMAR, the key industries for both energy conservation and air pollution control are energy intensive heavy industries including mining, washing of coal, processing of petroleum, coking, processing of nucleus fuel, power, steel, cement, coking, glass, and other manufacturing industries. IMAR set a target to phase out (a) coal-fired boilers with a capacity below 20 tons per hour by 2016 (b) 0.8 million tons of calcium carbide excessive capacity by 2014, (c) 1.82 million tons of excessive capacity in coking sector by 2017, (d) 4.59 million tons of cement excessive capacity by 2017, and (e) 1.82 million tons of excessive capacity in coking sector by 2017; and (ii) Adjustment of energy mix by reducing coal consumption and promoting clean energy. IMAR needs to intensify efforts to further reduce the share of coal in their energy mix and increase the use of low carbon energy sources and cleaner fuels as IMAR is endowed with rich renewable resources.

### 3.4 Shandong Province

29. **Shandong's Energy Sector.** More than 27% of PM<sub>2.5</sub> emitted in Jinan City is from coal consumption and about 24% from dust production. When looking at CO<sub>2</sub> emissions in Shandong Province, 35% of emissions are generated in the industrial sector and 57% in the power sector, clearly highlighting the areas where an intervention is necessary to successfully improve air quality and reach GHG emission targets in Shandong. In 2015, the province's overall energy intensity was 0.58, almost the same as the national average and the industrial sector alone consumed about 82% of the province's total energy consumption. Within Shandong's industrial sector, processing of petroleum, coking, processing of nucleus fuel accounted for 14% and manufacture of raw chemical material and chemical products for 12% of the PRC's respective total energy consumption in 2014.

30. **Shandong Government's Energy Sector Strategy.** Since 2010, the province has issued policies to improve energy efficiency and reduce emissions. In its 12th plan, Shandong set targets to reduce energy intensity by 9% in the power and heating sector, 10% in the petrochemical, iron and steel, cement and glass sectors, 15% for refineries, 12% for coking, and 17% for the nonferrous industry by the end of 2015. It also set PM<sub>2.5</sub> emission reduction targets of 20% by the

end of 2015, 35% by end of 2017, and 50% by end of 2020.<sup>11</sup> By implementing these measures, both energy consumption and energy intensity fell during the plan period. In 2015, the energy intensity increased by 4% compared to 2014 levels.

31. **Focused areas for the Shandong Province.** The following areas should be considered as the focused areas under the propose project in Shandong: (i) Industry facilities upgrade to conserve energy and reduce air emission. In Shandong, the key industries for both energy conservation and air pollution control are power generation and energy intensive heavy industries including processing of petroleum, coking, processing of nucleus fuel; (ii) Adjustment of energy mix by reducing coal consumption and promoting clean energy. Shandong 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; and (iii) Promotion the utilization of biomass. As the biggest agricultural province, Shandong produced about 10% of the biomass stalk in the PRC. The utilization of the biomass resources for energy recovery will also be another focused area to reduce air pollution in Shandong.

### 3.5 Liaoning Province

32. **Liaoning's Energy Sector.** In Liaoning Province, 34% of CO<sub>2</sub> emissions are generated in the industrial sector and 51% in the power sector. These numbers show that an intervention is necessary both in the power and the industrial sector to successfully improve air quality and reach GHG emission targets. In 2015, the province's overall energy intensity was 0.71, just above the national average. In the same year, the province's industrial sector consumed 84% of Liaoning's total energy consumption. In 2014, Liaoning's mining and washing of coal and production and distribution of electric power and heat accounted for 11% and 30% of the PRC's respective total energy consumption. Apart from the power sector, energy intensive heavy industries including steel, cement, coking, glass, and other manufacturing industries should be key targets to improve energy conservation and reduce air pollution in Liaoning.

33. **Liaoning Provincial Government's Energy Sector Strategy.** Liaoning set target of reducing PM<sub>2.5</sub> by 10% by 2017 and 17% of energy intensity reduction by 2015. By implementing measures, both air pollution and energy intensity fell during the planning period. In 2015, energy intensity had fallen by 0.3% comparing to 2014 from 0.72 in 2014 to 0.71 in 2015.

34. **Focused areas for the Liaoning Province.** The following areas should be considered as the focused areas under the propose project in Liaoning: (i) Industry facilities upgrade to conserve energy and reduce air emission. In Liaoning, the key industries for both energy conservation and air pollution control are energy intensive heavy industries including smelting and pressing of ferrous metals and production and distribution of electric power and heat power; and (ii) Adjustment of energy structure by reducing coal consumption and promoting clean energy. Liaoning 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.

### 3.6 Henan Province

35. **Henan's Energy Sector.** In Henan Province, 22% of CO<sub>2</sub> emissions are generated in the industrial sector and 72% in the power sector. These numbers show that an intervention is necessary both in the power and the industrial sector to successfully improve air quality and reach GHG emission targets. In 2015, the province's overall energy intensity was 0.63, similar to the

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<sup>11</sup> Shandong's Clean Air Action Plan is more comprehensive than others and expanded their plan to 2020.



national average. During 2015 the province's industrial sector consumed about 75% of Henan's total energy consumption while in the previous year the manufacture of non-metallic mineral products accounted for 11% of the PRC's respective total energy consumption.

36. **Henan Provincial Government's Energy Sector Strategy.** In its 12th plan, Henan set targets to reduce carbon intensity by 24%, PM<sub>2.5</sub> by 10%, and PM<sub>10</sub> by 15%. By implementing measures, both energy consumption and energy intensity fell during the planning period. In 2015, the energy intensity fell by 4.48%, from 0.655 in 2014 to 0.626 in 2015.

37. **Focused Areas for the Henan Province.** The following areas should be considered as the focused areas under the propose project in Henan: (i) Industry facilities upgrade to conserve energy and reduce air emission. In Henan, the key industries for both energy conservation and air pollution control are energy intensive heavy industries including manufacture of raw chemical material, smelting and pressing of ferrous metals and manufacturing of nonmetallic mineral products. During the 12th plan period, Henan set targets to reduce production in key industries including: 4.07 million tons of steel, 2.47 million tons of iron, 5.9 million tons of coking, and 15.65 million tons of cement; (ii) Adjustment of energy mix by reducing coal consumption and promoting clean energy. During 12th plan period, Henan set a target to increase non-fossil fuel energy in the energy mix to 5.5% and a target to increase natural gas use in the urban residential sector to at least 95% by end of 2015. Henan needs to intensify efforts to further reduce the share of coal in their energy mix and increase the use of low carbon energy sources and cleaner fuels; and (iii) Promotion the utilization of biomass. Henan is one of the top 10 biggest agricultural provinces. Contribution of the agriculture sector to the provincial GDP was 11.4% in 2015. In the agriculture sector, seasonal stalk burning is one of the major sources for air pollution in Henan. In 2015, 9% of the biomass resources were used for energy recovery in Henan, this should be increased to reduce unnecessary on-field biomass burning.

## C. Environment (Air Pollution) Sector Road Map

### 1. Sector Performance, Problems, and Opportunities

38. **Air pollution problems in the PRC.** Decades of economic growth in the PRC have resulted in the severe degradation of the air, water, and soil quality throughout the country. The sustained economic growth has lifted around 500 million people out of poverty, but the growth has been resource- and energy-intensive, driven by heavily polluting industries and coal-fired energy production, and driving an explosion in automobile use. Air quality, in particular, has suffered. In the BTH region, a very dry climate with little precipitation and a high concentration of pollutants, the effects have been pronounced. The region accounts for 42% of total CO<sub>2</sub>, 39.6% of sulfur dioxide (SO<sub>2</sub>), and 39.5% of total nitrogen oxides (NO<sub>x</sub>) in the PRC in 2015.<sup>12</sup>

39. Recognizing the importance of combating air pollution as part of its wider plan for economic restructuring and sustainable, low-carbon development, the Government of the PRC has taken steps to improve air quality. Significant progress has been made so far, but the region's air quality is still consistently the worst in the country, and far below World Health Organization (WHO) and national ambient air quality standards (NAAQS).<sup>13</sup> Based on the 2015 monitoring data of PM<sub>2.5</sub> concentration levels in 366 Chinese cities found that among them 293 cities experienced an annual mean PM<sub>2.5</sub> concentration meeting NAAQS and all of them failed to meet WHO guidelines. A recent study found that more than 95% of the urban population in the BTH region resided in cities with annual mean PM<sub>2.5</sub> concentrations that exceeded NAAQS.<sup>14</sup> More recently, the MEP, which measures the status of air quality in key regions and 74 prefecture-level cities,<sup>15</sup> reported that the top 10 cities with the poorest air quality in 2016 were all in the BTH region.<sup>16</sup> PRC's worst air pollution levels for the year 2016 (occurring in mid-December) exposed 460 million people to smog levels six times greater than WHO daily guidelines.<sup>17</sup> These conditions resulted in Beijing's third ever pollution red alert,<sup>18</sup> with the first red alert having been issued in December 2015. In 2016, Beijing's air quality standards were met for only 198 days of the year, and 39 days had heavy pollution.<sup>19</sup> In the first quarter of 2017, PM<sub>2.5</sub> levels rebounded in the region for the first time since 2013 in tandem with high economic growth rates.

### 2. Government's Sector Strategy

40. **Government initiatives, plans, and challenges.** The central government is scaling up its efforts to address this environmental challenge, together with climate change. The NAAQS were updated in 2012 to be equivalent with those in most developed countries. The new environmental protection law came into force in 2015. In 2013, the State Council issued the Comprehensive Action Plan on Prevention and Control of Air Pollution (CAAP) 2013–2017, which sets targets for the key regions including BTH. The CAAP set the toughest targets for the BTH

<sup>12</sup> PRC National Environment Report 2015 (Statistical Bulletin).

<sup>13</sup> A 14.1% reduction in PM<sub>2.5</sub> comparing to 2014 data [55 microgram per cubic meter (µg/m<sup>3</sup>)] or more than 50% higher than the national standard. The air quality standard for PM<sub>2.5</sub> (GB 3095-2012) in the PRC is 35µg/m<sup>3</sup>, compared with 15 µg/m<sup>3</sup> in the United States and Japan, and 10µg/m<sup>3</sup> recommended by the World Health Organization.

<sup>14</sup> Zhang, Y.L. and Cao, F., 2015. *Fine particulate matter (PM<sub>2.5</sub>) in China at a city level*. *Nature, Scientific Reports*, 5.

<sup>15</sup> Nine out of ten cities were in Hebei Province with one city in Shandong Province.

<sup>16</sup> Air quality indicators include the following pollutants: PM<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub>, NO<sub>x</sub>, carbon monoxide, and ozone.

<sup>17</sup> Yang Yuan. 2016. *China's 'airpocalypse' hits half a billion people*. Financial Times.

<sup>18</sup> In December 2015, Beijing Air Pollution Emergency Headquarters first time issued a 'red alert' for Beijing. Red alert is the most severe warning while orange alert is the second most severe warning in a four-tier weather warning system. The AQI threshold for a red alert is greater than 500 for 1 day, greater than 300 for 2 successive days, or greater than 200 for 4 successive days.

<sup>19</sup> Kai, Zhang. 2016. *Red alert: What's happening with Beijing's air pollution?* Greenpeace.

region (Table 1), through 10 key measures (Table 2). To further improve its environmental monitoring and enforcement, PRC has amended and strengthened the Environmental Protection Law.

41. On 16 March 2016, the PRC adopted the 13th plan. The 13th plan builds on the success of the previous plan, requiring greater reductions in the emissions of many pollutants and adding a major air pollutant, volatile organic compounds (VOCs), to those with specific reduction goals, or “hard” targets (Table 3). For the first time, the plan includes a total energy consumption cap of 5 billion tce. The plan sets ambitious targets for air quality progress, requiring hundreds of cities to meet “good” or “excellent” standards 80% of the time (meaning they must score below 100 on PRC’s Air Quality Index of 0–500). The 80% target is additional to a target to reduce by 25% the number of polluted days, and to reduce by 18% the number of days when PM<sub>2.5</sub> exceeds allowable limits.<sup>20</sup> The plan also steps up the reduction targets for SO<sub>2</sub> and NO<sub>x</sub>, two major air pollutants that had been in previous plans.

**Table 1: Average Annual PM<sub>2.5</sub> Concentration Reduction Targets**

Province (key area)	Target (%) (baseline year: 2012)
Beijing	(25)
Tianjin	(25)
Hebei	(25)
Category 1 polluted cities <sup>a</sup>	(33)
Category 2 polluted cities <sup>b</sup>	(30)
Shanxi	(20)
Shandong	(20)
Henan	(15)
Liaoning	(10)
Inner Mongolia	(10)

<sup>a</sup> Shijiazhuang, Tangshan, Baoding, Langfang, Dingzhou, and Xinji.

<sup>b</sup> Xingtai and Handan.

Source: Asian Development Bank.

**Table 2: 10 Key Areas of Air Pollution Prevention and Control Measures**

- (a) Reduce coal consumption by 83 million tons in the BTH region. This target is to be achieved by (i) improving energy efficiency in the industrial, power, and building sectors; and (ii) increasing the use of clean energy, particularly natural gas and renewable energy, with specific targets to increase natural gas consumption by 50 billion cubic meters and the share of non-fossil fuels in primary energy to 15% in the BTH Region by 2017.
- (b) Reduce emissions from (i) point sources in the industrial and power sectors by implementing end-of-pipe measures for particulates removal, desulfurization, and denitrification; (ii) area sources to reduce dust emissions; and (iii) mobile sources in the transport sector by increasing public transport, improving fuel quality, phasing out inefficient vehicles, and promoting electric and compressed natural gas.
- (c) Increase the use of market mechanisms and expand green financing to energy efficiency, clean energy, and emission reduction investments by scaling up green financing from domestic banks and piloting innovative financing models and products.
- (d) Adjust economic structure by closing down inefficient energy-intensive industries.
- (e) Accelerate technological innovation.
- (f) Strengthen environmental standards and permitting for newly built infrastructure.
- (g) Strengthen legal framework and enforcement.
- (h) Establish regional collaboration mechanisms, particularly in the BTH Region.
- (i) Establish environmental monitoring and warning systems.
- (j) Specify the responsibilities of the government, enterprises, and citizens.

**Table 3: Key Targets for 13<sup>th</sup> Five-Year Plan (%)**

	12th Plan Targets (Compared to 2010)	12th Plan Achievements (Compared to 2010)	13th Plan Targets (Compared to 2010)
<b>Energy Intensity (Energy Consumption per Unit of GDP)</b>	(16)	(18.2)	(15)
<b>Carbon Intensity (Carbon Emissions per Unit of GDP)</b>	(17)	(20)	(18)
<b>Non-Fossil Fuel Percentage</b>	11.4	12	15
<b>Sulfur Dioxide (SO<sub>2</sub>)</b>	(8)	(18)	(15)
<b>Nitrogen Oxides (NO<sub>x</sub>)</b>	(8)	(18.6)	(15)
<b>Ammonia Nitrogen</b>	(10)	(13)	(10)
<b>Chemical Oxygen Demand (COD)</b>	(10)	(12.9)	(10)
<b>Forest Coverage</b>	21.7	21.63	23.04

42. One major addition to the 13th plan is the target to reduce VOCs, which are emitted from a wide range of industrial processes not limited to fossil fuels (especially gasoline) such as paints and solvents. This is the first time a VOC target has appeared in a five-year plan, and VOCs are a critical component of both PM<sub>2.5</sub> and ozone formation. The plan aims to reduce VOCs nationwide by 10% or more, with an emphasis on major cities and industries. Most media coverage of the PRC's air pollution problems is focused on PM<sub>2.5</sub>, but PM<sub>2.5</sub> is a secondary pollutant, produced in the air from other pollutants that the PRC regulates, including SO<sub>2</sub> and NO<sub>x</sub>. The addition of a target for VOCs is ambitious because it requires regulating many more sources of pollution than SO<sub>2</sub> and NO<sub>x</sub>.

43. The largest sources of air pollution are coal combustion for electricity and heat, and automobiles. The 13th plan calls for any new coal-fired power plants to be "ultra-low emissions," a standard that attempts to make coal-fired power plants as clean as natural gas plants. The plan also calls for the replacement of coal in non-power sectors either with electricity (where pollution is easier to treat) or natural gas. The plan explicitly calls for PRC's oil industry to produce gasoline and diesel suitable for vehicles at the China V standard. China V is equivalent to Euro V, a standard adopted in the European Union in 2009.

### 3. Air quality and emissions in the BTH Region

44. **Sources of pollution in BTH.** Among the pollutants, PM<sub>2.5</sub> has the most severe impact on public health. WHO has concluded that no amount of PM<sub>2.5</sub> is safe. An epidemiological study by the Chinese Academy of Sciences in Beijing showed the correlation between levels of ambient particulate matter and mortality from cardiovascular and respiratory diseases.<sup>21</sup> The results confirm research findings from the United States and Europe. In the greater BTH region, PM<sub>2.5</sub> is generated and formed in the atmosphere by emissions from (i) industries, (ii) continuous coal

<sup>21</sup> Yang, et. al. 2013. *Rapid Health Transition in China, 1990-2010: Findings from the Global Burden of Disease Study*. *Lancet* 381.

burning for electricity generation and heating boilers in urban and rural areas, (iii) motor vehicle emissions, and (iv) the burning of agricultural biomass waste.<sup>22</sup>

45. The sources of primary PM<sub>2.5</sub> in the region, accounting for 54% and 29% of pollution are industrial processes and the residential sector, respectively. Industrial processes include the steel, cement, and coking sectors. The residential sector emissions are from coal and stalk burning. The sources of secondary PM<sub>2.5</sub> are SO<sub>2</sub>, NO<sub>x</sub>, VOCs, and ammonia (NH<sub>3</sub>), primary air pollutants that are produced from a wide range of industries. Industrial boilers, industrial processes (sinter and industrial furnaces), the power sector, the residential sector, and the heating sector contribute 39%, 19%, 17%, 15%, and 8% of SO<sub>2</sub> emissions, respectively.<sup>23</sup> The transportation sector, industrial boilers, the power sector, heating and industrial processes (mainly cement industry) are the main sources of NO<sub>x</sub> emissions, accounting for 28%, 27%, 24%, 10%, and 7%, respectively. And about 40%, 26%, and 9% of VOCs emissions are from solvent use, industrial process, and residential sector, and transportation sector, respectively. NH<sub>3</sub> emissions are mainly from nitrogen fertilizer application and livestock farming. Pollution sources in the region contribute to 28%–36% of PM<sub>2.5</sub> recorded in Beijing, and under certain weather conditions, to as much as 50%. Much of the pollution is attributable to sources in Hebei Province. Table 4 and Figure 1 show SO<sub>2</sub>, NO<sub>x</sub>, and PM<sub>2.5</sub> emissions in the greater BTH region and their proportions in 2015.

**Table 4: SO<sub>2</sub>, NO<sub>x</sub> and PM<sub>2.5</sub> Emissions in the Greater BTH Region in 2015**

<b>Region</b>	<b>SO<sub>2</sub></b> (thousand tons)	<b>NO<sub>x</sub></b> (thousand tons)	<b>PM<sub>2.5</sub></b> (µg/m <sup>3</sup> )
Beijing	71.2	137.6	80.4
Tianjin	185.9	246.8	71.5
Hebei	1,108.4	1,350.8	77.3
Total in core BTH Region	1,365.5	1,735.2	
Proportion of core BTH to national total	7.34%	9.37%	
IMAR	1,230.9	1,139	41.0
Shandong	1,525.7	1,424	66.4
Liaoning	968.8	828.1	55.0
Henan	1,144.3	1,262.4	80.7
Shanxi	1,120.6	930.7	50.2
National total	18,591	18,518	
Proportion of greater BTH to national total	39.57%	39.53%	

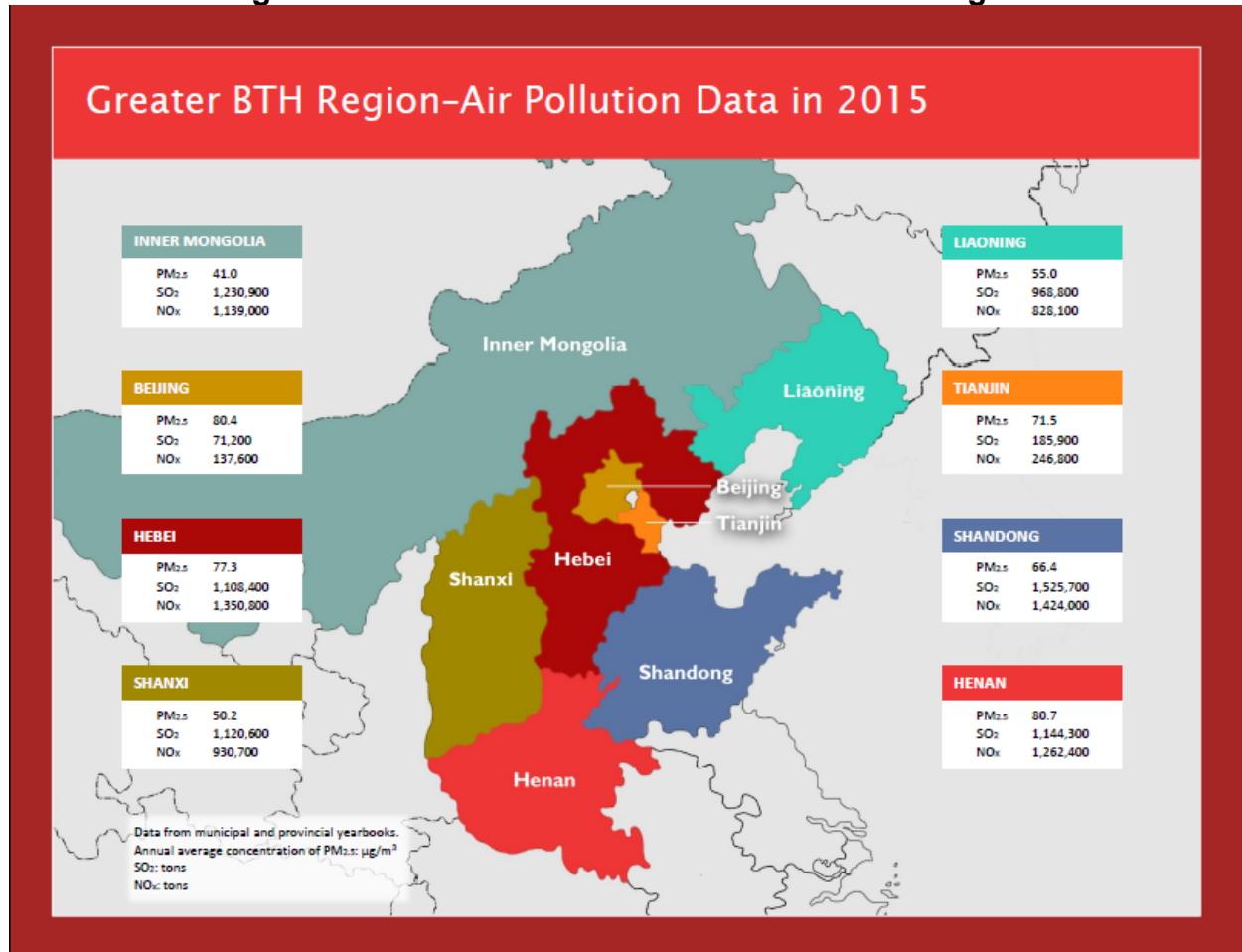
µg/m<sup>3</sup> = micrograms per cubic meter, BTH = Beijing–Tianjin–Hebei, NO<sub>x</sub> = nitrogen oxides, PM<sub>2.5</sub> = fine particulate matter, SO<sub>2</sub> = sulfur oxide.

Source: Municipal and Provincial Yearbooks.

<sup>22</sup>Open burning of harvesting waste and direct burning of biomass, such as crop stalks and firewood, for cooking, water heating, and space heating emit black carbon, an ingredient of PM<sub>2.5</sub> and short-lived climate forcing agent.

<sup>23</sup>Secondary PM<sub>2.5</sub>, formed through the chemical transformation of gaseous primary pollutants such as SO<sub>2</sub>, NO<sub>x</sub>, certain VOCs, and NH<sub>3</sub>, accounts in Hebei for 59% of the total fine particulate.

Figure 1: Air Pollution Data in 2015 in the BTH Region



## D. Finance (Green and Environmental Protection Fund) Sector Road Map

### 1. Sector Performance, Problems, and Opportunities

46. The development of green industries and the restructuring of traditional industries toward more energy saving and environmentally friendly systems require substantial investment. In recent years, the environmental protection industry of the PRC has maintained an annual growth of more than 15%. In 2016, scale of the environmental industry exceeded CNY5 trillion. It is estimated that this industry will maintain a growth rate of 18% from 2017 to 2020 and reach to CNY10 trillion by 2020. The greater BTH region, one of the most important economic regions in the PRC generates more than a third of the country's gross domestic product.<sup>24</sup> However, the region's impressive economic growth, based on energy intensive and highly polluting industries has resulted in widespread air pollution.<sup>25</sup> In the next 5 years, the region's estimated annual environmental protection market is about CNY2,500 billion. State budgetary funds are an important source of investment with a rough estimate of 10%–15% of this total. The remainder must come from private investors. The levels of investment in green development fall far short of what is needed. Most private sector investment comes as commercial loans or from companies' own revenues. Bond and equity markets for green investment are less developed. More diversified and innovative market-based financing mechanisms must be developed to meet the needs in the market and also government's investment targets. The market currently fails to reward investors for the positive externalities of green projects. Setting up a fund, especially a dedicated green fund to support environmental projects as one of the innovative financing mechanism is a good option to attract financial resources to green industries.

47. As of now, there is no regional air pollution control fund in the PRC, especially there is none green fund dedicated to the greater BTH region. The corresponding functions are partly undertaken by the local government guidance funds<sup>26</sup> and partly done by the merging and acquisition (M&A) funds by the enterprises who are focusing on environmental protection. By the end of 2016, nine hundred and one government guidance funds had been launched in the PRC, with a total size of CNY2,396.6 billion. Among them, the fund size in the geographic areas covered the greater BTH region is about CNY828 billion. Based on the statistics for current public-private-partnership projects, normally there are about 5% of the funds are used for environmental protection and related projects, we assume the similar percentage of funds will be on green and environmental protection, then the annual estimated investment for environmental protection by government guidance funds in the greater BTH region is about CNY40 billion. In 2015, more than 30 listed companies in the PRC have set up environmental protection industry M&A funds, with a total size of nearly CNY40 billion. In 2016, the estimated size was estimated to close to \$60 billion. Among them, about 1/3 of the funds will invest into the greater BTH region, then the annual

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<sup>24</sup> The greater BTH region accounts for more than 32% of national gross domestic product (CNY23.5 trillion in 2016).

<sup>25</sup> The region includes more than half of the PRC's highly energy and pollution intensive steel and cement production capacity, about one-third of PRC's cars and other automobiles, and heavy concentration of urban and rural housing and energy use as about 370 million of PRC's 1.3 billion population live in the region.

<sup>26</sup> Government guide fund, refers to the kind of funds that (i) the government initiated fund to attract the relevant local government, finance, investment institutions and social capital, (ii) not for profit, and (iii) using equity or debt financing to support the development of venture capital special funds. Government guidance fund through the guidance of venture investment behavior, support the start-up of small and medium-sized enterprises of science and technology entrepreneurship and technological innovation. The purpose of the government to guide the fund is to leverage the limited financing resources from the government to overcome the market failure. Especially by encouraging venture capital enterprises to invest in the seeding period, the early-stage enterprises to fill the gap that the general venture capital funds only invest in the enterprises in growth and maturity stage.

investment amount of related M&A funds is expected to be CNY20 billion. There is still big short fall which can be filled up using fund mechanism.

48. **Market gaps and opportunities.** Environmental protection projects require heavy investment, and long payback period. Most of the investors use the credit rating of enterprises to finance projects, which has seriously restricted the project investment and the development of domestic environmental protection industries, including that in the BTH region. The following issues, among others, are key challenges that will need to be addressed in order to promote green fund in the PRC.

49. **Lack of long-term investors.** Due to the low return rate of environmental projects, a substantial proportion of such projects depend on government support. Recently, the support from the local governments has been greatly weakened because the state strictly controls the issuance of bonds and external guarantees were prohibited. The government financing platforms or government's investment bodies have also undergone more stringent supervision on their investment and guarantee operations. The investment in environmental protection originally supported by the government guidance funds, will also be more difficult and costly to obtain. As for the listed companies, their debt financing capacity is weak and their leverage level is low. M&A funds normally require relatively higher return, making it difficult to hold large-scale environmental protection projects.

50. **Lack of project development and execution capability.** As mentioned above, the largest proportion of funds in domestic environmental protection market are government guidance funds. Its sponsors are generally government-owned financing companies and financial institutions, both with weak capacities to design and develop projects and generate deal flow, or to promote innovative technologies. On the other hand, the M&A funds are normally sponsored by the listed companies. The recently published strict regulatory policy greatly weakens the financing capacity and acquisition ability of listed companies, the project execution of those funds is often poor.<sup>27</sup>

51. **Lack of capital support to promote environmental technology.** The promotion of environmental protection technology depends on the support of investment and financing at different stages of development. Although PRC's green financing has made great progress, project financing remains a pain point for technical companies, which is the bottleneck of the development of environmental protection technology.

52. **Lack of market mechanism in state-owned enterprises as investors.** In theory, the investment bottleneck can be tease through acquisitions or cooperative project development by the SOEs investing in technology companies, and supporting them with project financing. However, SOEs' investment for innovative environmental technology is often constrained by strict policies and rules imposed by the government, especially on lending, guarantees and M&A related to private sector.

53. The challenge of increasing public and private sector investment in green projects is not just a lack of financial resources. There are significant amounts of private capital seeking green investment opportunities. The challenge is efficiently matching this private capital to existing and new green opportunities. Development of the necessary financial infrastructure is the key to mainstream the green finance in the PRC. An effective investment mechanism that could fill in the market gap is to set up a market-oriented fund by a variety of entities including SOEs with

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<sup>27</sup> China Securities Regulatory Committee. 2017. *The New Regulations on Refinancing*. Beijing



discounted funding costs and strong industry background. At present, there is no environmental fund in the BTH region with this model. Once it is set up, more financial resources can be attracted to invest in the green and low-carbon industry.

## 2. Government's Sector Strategy

54. In 2016, the Environmental Protection Law was reformed with the strengthened regulatory system. With the issuance of the Environmental Protection Law, the top-level design was accelerated to provide support for promoting the ecological environment and the development of the environmental protection industry in depth. In May 2016, "The Key Areas of Soil Pollution and Control Measures" was officially released, with this the action plans for air, soil and water pollution prevention were complete. A campaign to protect the air, water and soil begins in full swing. The 13th plan of the PRC, 2016–2020, serves as a main document to help the PRC achieve its development goal of inclusive and sustainable growth by 2020. The government introduces financial and economic reforms to develop green financing markets and introduces incentives to expand green finance as part of steps to address the dominance of quasi-state-owned banks and relatively under-developed capital markets.

55. In 2012, the China Banking Regulatory Commission issued the Green Credit Guideline to encourage the banking sector to actively adjust credit structure, fend off environmental and social risks, better serve the real economy, and boost transformation to improve economic growth and adjustment to economic structures. In 2015, People's Bank of China introduced Green Bond Guidelines and a catalog for eligible subprojects to support diversifying green financing channels through capital markets. The PRC now accounts for 50% of the world's green bond market. In the past 6 months, \$80 billion worth of green bonds have been issued. These numbers are expected to grow rapidly, especially if the PRC Government implements its proposed policy and regulatory changes to increase the quantity of high quality green projects.

## 3. ADB Sector Experience and Assistance Program

56. The proposed project is aligned with the ADB Country Partnership Strategy, 2016–2020, on managing climate change and environment to support Government's priorities in realizing an ecological civilization in its 13th plan.<sup>28</sup>

57. ADB has been providing support to promote green finance in the PRC in line with the Government's shift towards a model of economic growth with environmental management. Specifically, ADB's targeted support to green finance is expanding access to finance for energy efficiency investments in the industry sector, and financing private sector-led initiatives to support climate change mitigation and adaptation. An emission trading mechanism was developed and tested under a pilot scheme. ADB will further assist in establishing a national emission trading system. In terms of debt instrument, ADB is formulating a technical assistance to promote green bond market development through policy and regulatory improvement that address existing barriers. Furthermore, ADB supported the establishment of green funds to leverage public and private capital for climate change finance. ADB also provided knowledge supports on green finance through various knowledge products including technical assistances such as innovative models for climate change financing<sup>29</sup> and Beijing's green finance development strategy.<sup>30</sup>

<sup>28</sup> ADB. 2016. *Transforming Partnership: People's Republic of China and Asian Development Bank, 2016–2020*. Manila.

<sup>29</sup> ADB. 2013. *Technical Assistance to PRC for Innovative Models for Climate Change Financing*. Manila.

<sup>30</sup> ADB. 2010. *Technical Assistance to PRC for Study on Beijing's Green Finance Development Strategy*. Manila

58. **Climate change mitigation and adaptation.** The PRC's intended nationally determined contribution committed the PRC to (i) peak CO<sub>2</sub> emissions by 2030; (ii) lower CO<sub>2</sub> per unit of GDP by 60% to 65% from the 2005 level; (iii) increase the share of non-fossil fuels in primary energy consumption to around 20%; and (iv) increase the forest stock volume by around 4.5 billion cubic meters from the 2005 level. ADB will work with the PRC to achieve those targets, or even to advance those targets, earlier than 2030. Among others, ADB will provide support in the areas of green financing to meet the target by (i) expanding access to finance for energy efficiency investments in the industry sector; (ii) strengthening the capacities of cities and rural areas in climate change adaptation and climate resilience, especially in vulnerable areas by helping to improve sustainable use of land and natural resources, strengthen water security, and enhance green infrastructure and disaster risk management; and (iii) financing private sector-led initiatives to support climate change mitigation and adaptation.

59. **ADB's financial support in the greater BTH region.** The importance of good air quality in the BTH region cannot be emphasized enough. ADB and the PRC government have agreed on a multi-year lending support program spanning 2015–2020 to address this national priority. ADB's planned lending support during 2016–2020 will be about \$500 million per year and will revolve around three key pillars (i) policy and regulatory framework in the region; (ii) tailored financing approaches; and (iii) technology leapfrogging in key sectors. The first loan approved in 2015 focused on policy reforms and strengthening regulatory capacity in Hebei province.<sup>31</sup> The second loan approved in 2016 targeted improved access to finance, especially for small and medium sized-enterprises, to scale-up of investments pollution reduction projects in the region.<sup>32</sup> This proposed third project will complement previous projects and will directly address barriers to deploying advanced technologies that reduce air pollution from industries, urban infrastructure, and agriculture sectors.<sup>33</sup> For the proposed loan, ADB will work with China Energy Conservation and Environment Protection Group (CECEP) to set up a facility to invest in funds and directly in enterprises to finance qualifying subprojects. By integrating high-level technical expertise across key sectors with a proven track record of successfully managing multiple investment funds, CECEP,<sup>34</sup> will give the needed confidence to commercial financial institutions to leverage additional financing. The proposed project will promote a new financing mechanism by setting up funds and leverage financing to fill the funding shortage for green projects in the greater BTH region.

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<sup>31</sup> ADB. 2015. *Report and Recommendation of the President to the Board of Directors: Proposed Policy-Based Loan to the People's Republic of China for Beijing–Tianjin–Hebei Air Quality Improvement—Hebei Policy Reforms Program*. Manila.

<sup>32</sup> ADB. 2016. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of China for Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region—China National Investment and Guaranty Corporation's Green Financing Platform Project*. Manila.

<sup>33</sup> "Advanced technologies" refers to technologies which have higher upfront costs but better lifecycle value, or which have been proven at scale in other countries but not deployed at scale in the PRC.

<sup>34</sup> CECEP is the PRC's largest technology-based and service-oriented industrial group in energy conservation and environmental protection with total assets of CNY144 billion. The group of company focuses their business on energy efficiency, clean energy, environmental protection, and resources recycling.

## E. Transport Sector Road Map

### 1. Sector Performance, Problems, and Opportunities

60. Substantial investment at national, provincial, and local levels has led to substantial improvements in the coverage and quality of transport infrastructure in the PRC. Since 1990, private motor vehicle use has increased from 8.16 million to 141 million in 2015. In 2013, road transport contributed 83.32% of the total passenger transport volume and 75.43 % of the total freight transport volume.

61. Investments in the transport sector have contributed to the PRC's impressive economic growth, but also resulted in challenges such as increased air pollution, congestion, and accidents. The sector is a large contributor of GHG emissions. In 2012, it produced 8% of the country's CO<sub>2</sub> emissions and is set to account for 13% of CO<sub>2</sub> emissions by 2040. Within the PRC, GHG emissions by private passenger vehicles, business passenger vehicles, and taxis accounted for 79% of total GHG emissions from transport sector.

### 2. Government's Sector Strategy

62. The Government of the PRC is committed to developing a low-carbon transport sector. It has issued many policies including the promotion of public transport, providing subsidies, phasing out yellow label vehicles,<sup>35</sup> promoting the development and use of efficient and clean vehicles, and limiting fuel consumption for passenger vehicles.

63. Gaps in the enabling environment may slow down the development of a low-carbon transport sector. Several relevant policies need to be amended and the following considered and strengthened:

- (i) **Structure adjustment.** Priorities should be given to promotion of public transport. There is a big gap in share of public transport between the PRC and developed countries and regions. The share of public transport in London is 44%, 67%, 51%, 81%, 63%, and 25.7% for Paris, Tokyo, Hong Kong, Seoul, and Hangzhou, respectively. This suggests that the PRC should move towards a structural change in the transport sector with promotion of the public transport.
- (ii) **Strengthening Management and Planning and Optimizing Intermodal Connection.** A well designed and managed intermodal transport transfer system in large cities is extremely important. The PRC should strengthen its management and planning in public transport and optimize its connection therefore promote public and non-motorized transport.
- (iii) **Promoting New Energies.** (a) Improving fuel economy could effectively reduce the carbon emission.<sup>36</sup> It is necessary for the PRC to improve its standards on fuel economy; (b) There are barriers for the PRC to develop new energy vehicles such

<sup>35</sup> Yellow label vehicles are the high emitting vehicles that cannot meet National I standard for gasoline vehicles and National III standard for diesel vehicles.

<sup>36</sup> PRC announced the mandatory "Standard on Fuel Consumption Limit of Passenger Cars" (GB19578—2004) on July 1, 2005, and remarkable achievements have been seen henceforth on the energy conservation of passenger cars. By the end of 2006, China had saved 1.18 million tons of gasoline in total, leading to more than CNY7 billion of direct economic benefits. After the successful implementation of the "Standard on Fuel Consumption Limit of Passenger Cars", the NDRC announced on its website the "Standard on Fuel Consumption Limit of Light Commercial Cars" (GB20997—2007, hereafter referred as "The Standard") on Dec. 13, 2007, which would take effect on Dec. 1, 2008. By implementing "The Standard", China's law and regulation system of vehicle energy saving standards could be improved.

as (1) slower pace of supporting infrastructure, (2) low fuel quality, and (3) different standards for different authorities and complicated management structure. Those need to be overcome to promote new energy vehicles; (c) government subsidy policy for purchasing low emission vehicles should be strengthened. Currently, there are two subsidies to the public transport including direct and indirect subsidies. Most cities in the PRC are directly subsidized by the government for their losses; and (c) Carbon tax policy should be in place to optimize vehicle management and resource allocation to stop the unreasonable fuel consumption and bring up the economic benefit.

- (iv) **Application of New Technologies.** (a) There are many issues in the PRC for deploying low-carbon transport system including (1) inadequate data collecting and analysis system, (2) road traffic regulations need to be further improved, (3) lack of information provision system for users, and (4) lack of integrated urban planning and transport. The government should establish a coordinated mechanism and enhance the management on low-carbon transport system, and thus create enabling environment for development of low-carbon transport; and (b) Motor vehicle sharing is emerging in the PRC. Vehicle sharing is a good way to reduce energy consumption and emissions, and ease traffic jams.
- (v) **Regional Collaborative Transport Development.** Transport sector in the PRC has been challenged by rapid urbanization and urban agglomeration (or conurbation) trend such as the Yangtze River Delta region, Pearl River Delta region, and the BTH region. Resolving urban mobility needs within and between the cities in urban agglomeration and conurbation area became an urgent task for the governments. Sustainable transport development of urban agglomeration will play an important role for maintain growth momentum. Under the Coordinated Development Plan, Beijing Municipal Commission of Transport announced transport development plan for integrating cities in the BTH region. The plan includes: (a) Developing a suburban rail network: Priority has been placed on developing a 1,000 kilometer (km) suburban rail network. In addition, Beijing Municipality will expand the current subway to 1,000 km from 527 km; (b) Building highways to link unconnected roads in the six-city metropolis: Administrative barriers within the three administrative regions (Beijing Municipality, Tianjin Municipality, and Hebei Province) have left some highways and roads unconnected. The government targets completion by the end of 2017; (c) Implement a “single transport pass” program: Residents in Beijing, Tianjin and the 4 cities of Hebei Province will be able to use a single transport pass for public transport across the 6 cities; and (d) Appoint a committee to oversee the plan: The three governments have established a high-level committee to coordinate the integration of transport facilities in the region. The plan called for the construction of a transport network that would put residents of Beijing, Tianjin and Shijiazhuang, within an hour’s distance; residents of other satellite cities would also be able to reach the major cities within 30 minutes.
- (vi) **Travel Demand Management (TDM).** Implementation of TDM measures for shifting private vehicle users to the public transport and non-motorized transport is still a huge opportunity in the PRC cities. Large cities including Beijing, Shanghai, Shenzhen, and Guangzhou introduced TDM measures restricting vehicle ownership and usage, but more active TDM measures including parking management, road user charging, financial measures and low emission zones, more active public transport priority measures are yet to be introduced to accelerate the public transport and non-motorized transport use.

### 3. Municipal and Provincial Transport Sector

#### 3.1 Beijing Municipality

64. More than 31% of PM<sub>2.5</sub> in Beijing is emitted from the transport sector, making it critical to intervene and address the main emission sources within this sector. By 2030, the number of registered vehicles in Beijing will be capped at 6.76 million, and the public transport ratio in urban areas will be over 41%. Additionally, the energy-saving cars, such as hybrids and electric vehicles, will account for more than 50% of the region's passenger car fleet, and electric vehicles more than 40%.

#### 3.2 Tianjin Municipality

65. More than 20% of PM<sub>2.5</sub> in Tianjin is emitted from transport sector, making it critical to intervene and address its main emission sources. By 2030, the number of registered vehicles in Tianjin should be capped at 4.49 million, and the public transport modal share in urban areas will be over 41%. Additionally, energy-saving cars will account for more than 50%, and electric vehicles more than 35%.

#### 3.3 Hebei Province

66. **Hebei Provincial Government Transport Sector Strategy.** Hebei has 11 prefecture-level cities with population of 3–10 million with a provincial motorization rate of around 11.76 registered passenger vehicles per 100 persons.<sup>37</sup> Hebei's urbanization rate remains 51.33% in 2015, with more than half of the population living in rural areas.<sup>38</sup> Accelerated economic integration, urbanization and increased mobility of people within the BTH region will potentially have a large impact on the transport sector. Although it is still less pronounced, there are clear evidences that a number of private vehicles and associated emission from mobile sources are increasing in Hebei. There is a large room for improvement in urban public transport. In 2013, the length of urban public transport under operation in Hebei was 19,647 km, which is at the same level as Beijing which has 19,688 km. However, the length of public transport per 10,000 people is only 3.1 km in Hebei. The figure is only 74% of the PRC's national average and 30%–32% of Tianjin and Beijing.

67. Hebei's strategy on low-carbon and low pollution policy in transport sector has been mainly focused on replacing high emission vehicles to low emission vehicles and the potential for emissions reduction through travel reduction and shifting to public transport are yet to be implemented. In the provincial CAAP, Hebei Government set target to (i) phase out all 1.05 million yellow label vehicles, (ii) the number of new energy vehicles in the province exceeds 50,000, and (iii) at least 60% of the newly added buses shall use new energy or clean fuel by 2017. Hebei Province introduced public transport development evaluation criteria for the cities in the province and the implementation enforcement and monitoring of the effectiveness of the criteria needs to be evaluated and expended to other cities in the BTH region and beyond.

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<sup>37</sup>The figure is higher than the PRC average of 6.8 vehicles but much lower than that of Beijing (19.7) and Tianjin (14.1).

<sup>38</sup>The urbanization rate of Beijing was 86.4% and Tianjin was 78.3% in 2014.

### 3.4 Shanxi Province

68. **Shanxi Provincial Government Transport Sector Strategy.** Shanxi has a provincial motorization rate of around 10.22 registered passenger vehicles per 100 persons. Shanxi's urbanization rate remains 55.03% in 2015. In 2014, the length of urban public transport under operation in Shanxi was 13176 km. However, the length of public transport per 10,000 people is 3.6 km in Shanxi.

69. Shanxi's strategy on low-carbon and low pollution policy in transport sector has been mainly focused on replacing high emission vehicles to low emission vehicles and the potential for emissions reduction through travel reduction and shifting to public transport are yet to be implemented. In the Provincial CAAP, Shanxi government set target to (i) phase out all 316,000 yellow label vehicles, and (ii) at least 60% of the newly added buses shall use new energy or clean fuel by 2017.

### 3.5 Inner Mongolia Autonomous Region

70. **IMAR Provincial Government Transport Sector Strategy.** IMAR has a provincial motorization rate of around 11.88 registered passenger vehicles per 100 persons. IMAR's urbanization rate remains 60.3% in 2015. In 2015, the length of urban public transport under operation in IMAR was 10,731 km. However, the length of public transport per 10,000 people is 4.3 km in IMAR.

71. IMAR's strategy on low-carbon and low pollution policy in transport sector has been mainly focused on replacing high emission vehicles to low emission vehicles and the potential for emissions reduction through travel reduction and shifting to public transport are yet to be implemented. In the CAAP, IMAR Government set target to (i) phase out all yellow label vehicles, and (ii) at least 90% of the buses and vehicles shall use new energy or clean fuel and 20% of sharing from public transport for city size with more than 1 million population by 2017.

### 3.6 Shandong Province

72. **Shandong Provincial Government's Transport Sector Strategy.** Shandong has a provincial motorization rate of around 12.63 registered passenger vehicles per 100 persons. Shandong has the highest registered passenger vehicles among all the provinces in the PRC. Shandong's urbanization rate remains 52.1% in 2015. In 2014, the length of urban public transport under operation in Shandong was 70,922 km. However, the length of public transport per 10,000 people is only 7.2 km in Shandong.

73. Shandong's strategy on low-carbon and low pollution policy in the transport sector has been mainly focused on replacing high emission vehicles to low emission vehicles and the potential for emissions reduction through travel reduction and shifting to public transport are yet to be implemented. In the CAAP, Shandong Government set target to (i) phase out all 1.16 million yellow label vehicles, (ii) at least 95% of the taxis and buses, and 13.5% of the heavy trucks using liquefied natural gas in the province, and (iii) at least 1,000 compressed natural gas and 400 liquefied natural gas refilling stations will be constructed by 2020.

### 3.7 Liaoning Province

74. **Liaoning Provincial Government Transport Sector Strategy.** Liaoning has a provincial motorization rate of around 9.98 registered passenger vehicles per 100 persons. Liaoning's urbanization rate remains 67.35% in 2015, is the second highest province in the PRC. In 2015, the length of urban public transport under operation in Liaoning was 25,344 km. The length of public transport per 10,000 people is 57.7 km.

75. Liaoning's strategy on low-carbon and low pollution policy in the transport sector has been mainly focused on replacing high emission vehicles to low emission vehicles and the potential for emissions reduction through travel reduction and shifting to public transport are yet to be implemented. In the Provincial CAAP, Liaoning Government set target to phase out all 600,000 yellow label vehicles by 2017.

### 3.8 Henan Province

76. **Henan Provincial Government Transport Sector Strategy.** Henan has a provincial motorization rate of around 8.62 registered passenger vehicles per 100 persons. Henan's urbanization rate remains 46.9 in 2015. In 2015, the length of urban public transport under operation in Henan was 19,697 km. However, the length of public transport per 10,000 people is only 1.83 km in Henan.

77. Henan's strategy on low-carbon and low pollution policy in the transport sector has been mainly focused on replacing high emission vehicles to low emission vehicles and the potential for emissions reduction through travel reduction and shifting to public transport are yet to be implemented. In the provincial CAAP, Henan Government set target to (i) phase out all 282,000 yellow label vehicles by 2017, (ii) the number of new energy vehicles in the province exceeds 72,000 by 2020, and (iii) at least 60% of the newly added buses and trucks shall use new energy or clean fuel by 2017.