

SECTOR ASSESSMENT (SUMMARY): ENERGY

Sector Road Map

A. Sector Performance, Problems, and Opportunities

1. **Reduction in energy intensity.** The People's Republic of China (PRC) has emerged as the largest energy consumer in the world in 2009, and in 2013 the PRC accounted for 21% of global energy consumption. However, 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.¹ The PRC's energy intensity declined by 19.0% during the 11th Five-Year Plan (2006–2010) and the government has set a target of further energy intensity reduction of 16.0% during the 12th Five-Year Plan (2011–2015). The energy intensity reduced by 4.9% in 2014 and energy intensity reduction during 2011–2014 was 13.4%.

2. **Declining share of coal in the energy mix and slowing greenhouse gas emissions.** The PRC's energy sector is heavily dominated by coal and the share of coal in the PRC's primary energy consumption remained at more than 70% for several decades. The Government of the PRC has set a target to reduce the share of coal in primary energy consumption to 62% by 2020. The cleaning of the PRC's energy sector is mainly attributed to increase in the use of nonfossil energy such as hydro, wind, and nuclear and an increase in the use of less carbon-intensive natural gas. Although total energy consumption in the PRC increased by 2.2% in 2014 compared to 2013, coal consumption declined by 2.9%. This is the first time coal consumption has declined in absolute terms since 1995. The slowing energy demand and reduction in the use of coal has slowed the annual increase in greenhouse gases to 0.7% in 2014. The carbon intensity of the PRC economy declined by 15.8% in 2014 compared to 2010 as against the target of 17.0% reduction by 2015 compared to 2010.²

3. **Improving energy efficiency in the industry sector.** The government has initiated mandatory programs to promote energy conservation in energy-intensive industries such as iron and steel, cement, chemicals, and nonferrous metals. These include phasing out obsolete inefficient industrial plants, energy assessment of new fixed-asset investments to ensure deployment of state-of-the-art energy efficient technologies, and setting enforceable targets for energy efficiency improvement in large industrial plants. The government has also set industry-specific targets for energy consumption per unit output and set the minimum efficiency levels for high energy-consuming industrial equipment such as blast furnaces. The industry sector is expected to achieve energy intensity improvement of 21% by 2015 compared to 2010 and the 10,000 Key Enterprise Program enterprises are expected to realize energy savings of 250 million tons of coal equivalent (tce) per annum by 2015.³

4. **New investments in energy assets.** Despite slowing growth in energy consumption, the PRC continued to invest in energy infrastructure including fossil-fuel-based power plants;⁴ low-carbon fossil fuel resources such as natural gas; and renewable energy such as hydro power, solar photovoltaic, wind power, and biomass; and nuclear power. While rationalizing and

¹ Energy intensity is the ratio between energy consumption and gross domestic product (GDP) measured at constant prices.

² Carbon intensity is the ratio between greenhouse gas emissions and GDP measured at constant prices.

³ This program covered the enterprises consuming more than 5,000 tce. The number of enterprises included in this program exceeded 15,000 as some of the provinces used a lower threshold.

⁴ The newly installed coal power plants use highly efficient ultra-super critical technology, and older and relatively inefficient coal-fired power plants have been decommissioned.

consolidating the coal mining industry in the context of declining demand for coal, the PRC has made investments to sustain the production levels of conventional oil and gas fields and exploited unconventional oil and gas resources including shale gas resources and coal mine methane and coal bed methane. While the development of the fossil fuel industry is mainly driven by concerns about energy security and increasing self-sufficiency of energy resources, the thrust on promoting renewable energy is prompted by the concerns about the environmental sustainability of the current energy supply mix of the PRC, and the PRC's contribution to global warming as the largest greenhouse gas emitter.

5. **Increasing share of renewable energy.** The PRC has made significant progress in increasing the use of renewable energy in its energy mix and has emerged as the world leader in wind power and hydro power generation and 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. Non-fossil-fuel sources contributed 24.7% to electricity generation in 2014, compared to 19.2% in 2010. Although hydropower remains the largest form of non-fossil-fuel energy, wind power and solar power have shown the biggest uptake since 2011.⁵ The installed capacity of hydropower had increased to 301.0 gigawatts (GW) in 2014 from 216.0 GW in 2010, wind power had increased to 96.0 GW from 26.0 GW, and solar power had increased to 29.0 GW from 0.3 GW over the same period. The cumulative additions of renewable electricity generation capacity of 178 GW exceeded the coal power capacity installed during this period (165 GW).

6. **Environmental pollution.** The energy sector in the PRC is a major contributor to the worsening air pollution of the PRC as coal power plants emit particulate material, sulfur dioxide, and nitrogen oxide in addition to carbon dioxide (CO₂) which is contributing to global warming and climate change. Coal is also burnt in northern PRC for heat supply and is also used as an industrial feedstock and energy source for industries. Beijing's average particulate matter of less than 2.5 micrometers in diameter (PM_{2.5}) concentration (123.9 micrograms of particulate matter per cubic meter) is four times higher than World Health Organization standards. The Government of the PRC has initiated an action plan to shut down coal-fired power plants and boilers in urban areas and replace them with cleaner natural-gas-fired combined heat and power plants. Strict pollution control measures will be incorporated into new coal-fired power plants and existing coal-fired power plants will be retrofitted to match the emission levels (i.e., without taking into account CO₂) of natural-gas-fired power plants. In addition to air pollution and coal mining, coal washing is also a major contributor to water pollution, and the cooling water requirements of coal-fired power plants add to water stress in northern and northwestern PRC.

7. **Significant contribution to climate change.** The PRC has emerged as the largest contributor of greenhouse gas emissions with annual emissions of 9.3 billion tons or 29.1% of global emissions in 2014. The energy sector, consisting of electricity and heat production and industries, contributes to more than 70% of the PRC's greenhouse gas emissions. Hence, the decarbonization of the energy sector is critical for climate change mitigation. The recent trends of slowing energy demand, the declining share of coal in the energy supply mix, and the increasing share of non-fossil fuel in the PRC's energy supply mix have underpinned greenhouse gas emissions reduction in 2014. However, it is too early to assess whether this will be sustained in the long term and governments in the PRC have to take sustained efforts to achieve the peaking of greenhouse gas emissions by 2027–2030. Given the predominance of coal in the PRC's

⁵ Electricity generation from wind and solar power increased by more than 3.5 times between 2010 and 2014 (180 terawatt-hours in 2014 compared to 50 terawatt-hours in 2010).

energy supply mix, carbon capture and storage will have to be considered as one of the technologies that need to be mainstreamed in the PRC during 2016–2025.

8. **Energy security concerns.** Although the PRC has sufficient coal reserves, about 10% of its coal demand is met through imports because of production and logistics bottlenecks in the coal supply chain. To reduce the dependence on coal, the PRC is aggressively expanding the use of natural gas. However, this has increased the PRC's dependency on gas imports, which accounted for 30% natural gas consumption in 2014. The natural gas pipelines and Liquefied Natural Gas terminals are being expanded and the PRC is expected to be a major recipient of piped natural gas from Russia and Central Asian countries. The gas transportation network within the PRC needs significant expansion in order to increase gas utilization. Shale gas development offers a significant opportunity to reduce emissions and improve energy security but the early development has been rather slow, primarily because of technology and capacity gaps, water availability concerns, and weak gas infrastructure.

B. Government's Sector Strategy (2016–2020)

9. The government's energy sector strategy is underpinned by the need to ensure energy security in an environmentally sustainable manner and in a way that will also reduce the PRC's contribution to climate change. It is likely that the government will shift support policies and incentives from mandatory targets and subsidies to more market-based instruments such as credit guarantees and tradable instruments such as emission trading. The national emission trading platform is expected to be launched in 2017, taking into account the lessons learnt from the seven pilot emission trading schemes initiated in 2013–2014. The government expects these efforts will cap the total energy consumption at 4.80 billion tce by 2020 compared to 4.26 billion tce in 2014 and the annual average growth rate of energy consumption will be maintained at 2% during 2014–2020.

10. In parallel with the efforts to contain the energy demand, the government will intensify the efforts to further increase the share of non-fossil-fuel energy in the PRC's energy supply mix and increase the use of low-carbon and cleaner fuels such as natural gas. Natural gas is expected to meet 10.0% of primary energy consumption by 2020 compared to 5.7% in 2014, when natural gas demand was expected to reach 350 billion cubic meters. In addition, the PRC is expected to develop its untapped shale gas resource, the largest in the world. The government is actively promoting the use of natural gas in urban areas for heat supply and cooling using combined heat and power plants and distributed trigeneration combined heat, power, and cooling plants. It will be necessary to introduce an appropriate price for carbon either through a carbon tax or carbon markets to provide financial incentive for stakeholders to shift from high-carbon energy sources such as coal to low-carbon sources such as natural gas and renewable energy.

11. The government is likely to continue offering feed-in tariffs to sustain further development of renewable energy. The installed capacity of hydro power is expected to reach 350 GW (300 GW in 2014), onshore wind 200 GW (96 GW in 2014), and solar photovoltaic 100 GW (26 GW in 2014) by 2020. In addition, the government is promoting other promising renewable energy technologies such as offshore wind and concentrated solar power (CSP) and set targets of 10 GW for offshore and 1 GW for CSP by 2020. The government has announced its intention to launch far-reaching reforms in the electricity subsector. The proposed reforms are also likely to create opportunities for public–private partnership for low-carbon distributed energy supply systems to meet the electricity, heating, and cooling needs of urban areas using smart grid technologies.

C. ADB Sector Experience and Assistance Program

12. The sovereign lending operations of the Asian Development Bank (ADB) during 2010–2015 focused on (i) demonstrating innovative low-carbon energy technologies such as integrated gasification combined cycle and concentrated solar power, (ii) low-carbon solutions to meet the heating demand of urban areas, and (iii) industrial energy efficiency projects to facilitate access to credit for energy efficiency technologies. ADB has approved 10 project loans amounting to \$1.24 billion during this period, and the greenhouse gas savings attributed to these operations are in excess of 21 million tons. In addition, the Private Sector Operations Department of ADB has financed three energy sector projects amounting to \$350 million to support waste-to-energy and expanding natural gas infrastructure in urban areas. The non-lending assistance and knowledge cooperation of ADB supported (i) the establishment of pilot emission trading systems, (ii) capacity building and policy advisory for demonstration of carbon capture and storage technologies and (iii) feasibility studies for increasing renewable energy penetration in selected cities

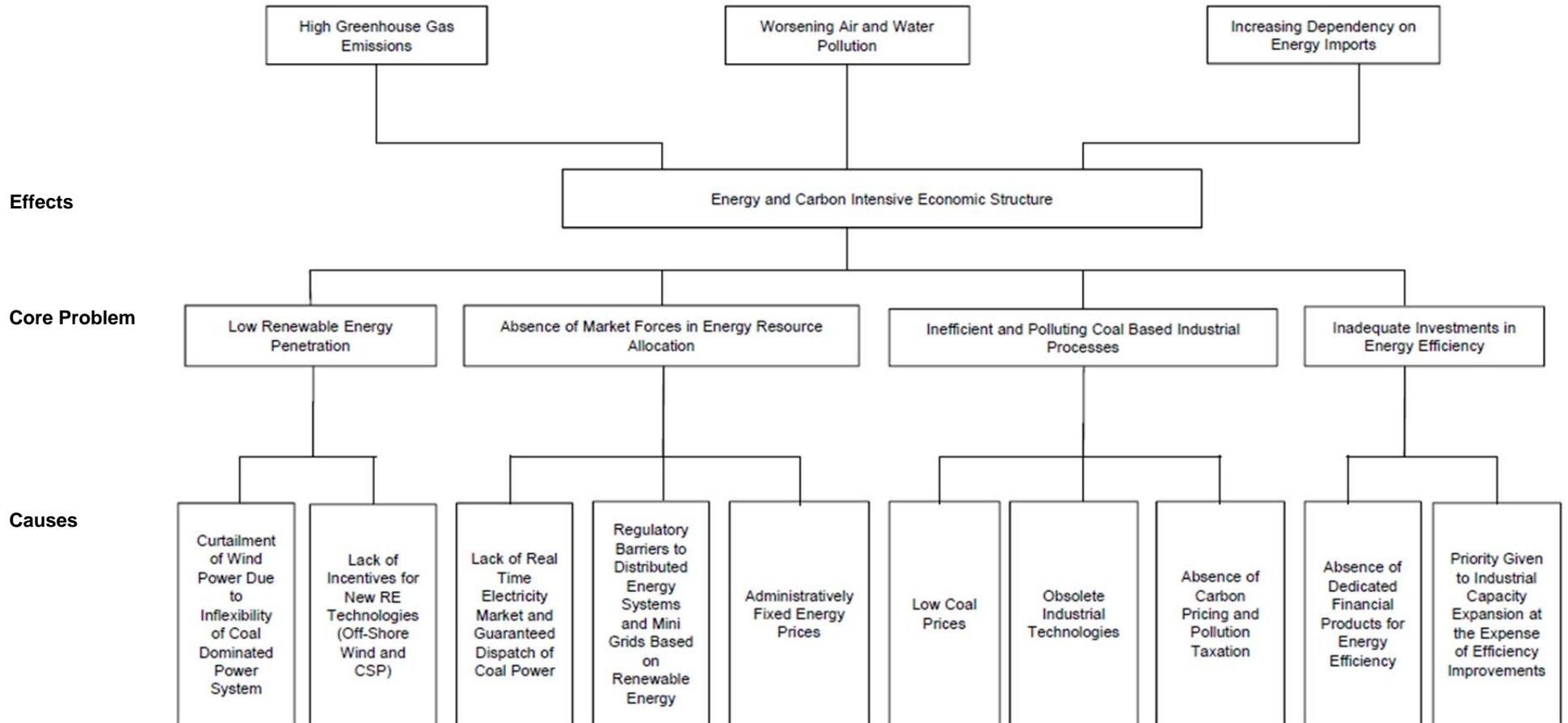
13. **Emission reduction in the industry sector.** ADB will focus on (i) energy efficiency improvement and air pollution control in energy-intensive heavy industries the including power industry, (ii) industrial process conversions from coal-based high-polluting industrial technologies to cleaner technologies, and (iii) financial innovation to facilitate access to finance for energy efficiency investments in small and medium-sized enterprises and to third-party energy efficiency investments undertaken by energy service companies.

14. **Renewable energy development.** ADB will support the development of new forms of renewable energy by financing technologies that are not yet commercially proven or widely used in the PRC. These would include CSP, distributed renewable energy (i.e., solar photovoltaic, solar thermal, shallow ground geothermal, biomass, and solid waste), and offshore wind power.

15. **Advance low-emission fossil fuel technologies.** ADB will support the PRC in reducing the environmental costs and climate change impacts associated with the increased use of coal. This would involve (i) mainstreaming natural-gas-based trigeneration (electricity, heating, and cooling) plants to reduce air pollution in urban areas, and (ii) retrofitting and upgrading coal-fired power plants and carbon-intensive industries to capture and sequester carbon emissions. .

16. **Low-carbon energy-efficient urban energy system.** The continued use of coal-fired boilers for heating is one of the major causes of worsening air pollution during the winter season in northern PRC. ADB will support the transition from centralized coal-based heat supply systems to decentralized urban energy solutions that integrate natural-gas-based heat supply systems with distributed renewable energy sources such as wind, solar thermal, biomass, municipal waste, and shallow ground geothermal as well as waste heat from industry.

Problem Tree for Energy Sector



CSP = concentrated solar thermal power
 Source: Asian Development Bank.