

CHINA

- *Rapid growth in China's economy will result in an almost three-fold increase in energy demand through 2030.*
- *Over the outlook period, China will account for about 42 percent of APEC's overall energy demand growth, 67 percent of coal demand growth, more than 30 percent of oil demand growth, and about 24 percent of natural gas demand growth.*
- *China's oil import dependency will increase from 22 percent in 2002 to 70 percent in 2030.*
- *The investment requirement will amount to between US\$1.9-2.3 trillion, representing 37 percent of the overall APEC investment requirements for the energy sector.*

RECENT ENERGY TRENDS AND ENERGY POLICY

Along with rapid industrialisation and improvement in living standards, China's energy consumption has surged in recent years. Between 2002 and 2004, total primary energy consumption grew by 38 percent – the fastest pace that China has experienced over the past decade. Because of the expanding needs for electricity generation and industrial production, coal consumption increased substantially, accounting for 89 percent of the total energy consumption growth in 2002 to 2004. Rising vehicle ownership and industrial development resulted in a greater increase in oil consumption, accounting for 11 percent of the total energy consumption growth over the same period.

To meet the substantial energy consumption growth, China is intensifying the production of all types of energy. Coal production increased from 1.95 billion tonnes in 2004 to 2.19 billion tonnes in 2005, the highest recorded production in the last three decades. Chinese oil companies have been intensifying western and offshore oil production to make up for the decline in Daqing oil field. Natural gas production increased from 41.5 BCM in 2004 to 50 BCM in 2005. With the annual additions of 60 GW, installed electricity generation capacity reached 441 GW in 2004 from 355 GW in 2002.

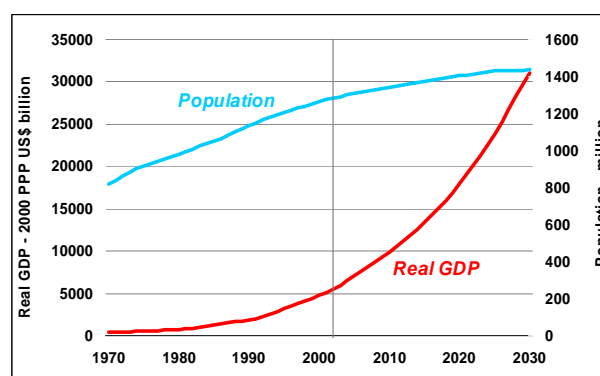
Much of the growth in domestic energy consumption, especially for crude oil and products, has recently been met by imports. The growth of domestic crude oil production and expansion of refinery capacity has not been fast enough to keep pace with the rapid increase in consumption for diesel and gasoline. In 2005, China imported 2.54 million b/d of crude oil – a 3.5 percent increase over 2004. The repercussions of the increase in Chinese oil imports to the global oil market have been felt significantly, creating a tight balance between demand and supply.

Given the rising energy demand and constraints over energy supply, China places energy security as the top priority of its energy policy goals. The 11th five-year plan delineates measures for the enhancement of energy security, with a strong emphasis on efficient energy use. By 2010, China aims to improve energy intensity by 20 percent compared with the 2005 level. To achieve the target, a number of measures have been implemented: 1) modernisation of energy industries with the closure of small coal mines, power plants, refineries, and iron and steel production plants, and 2) introduction of efficient technologies throughout the energy supply chain – from production, transportation to consumption.

ENERGY DEMAND DRIVERS

China's economy is expected to grow robustly, with an annual growth rate of 6.4 percent over the outlook period, which is the fastest rate in the APEC region. The robust growth is led by continued investment activities, expanding domestic demand and exports. In addition, China's accession to the WTO will make the economy more attractive to foreign investors, with the opening of its market.

Figure 25 GDP and Population



Source: Global Insights (2005)

Despite the economy's potential growth, there are risks surrounding the development of China. In the short to medium term, restructuring of state-

owned enterprises (SOEs) remains one of the major tasks to be undertaken by the central government. However local governments have been strongly opposing the closure of inefficient operations, for fear of a rise in unemployment. Based on the World Bank estimates, China may have to provide about 8-9 million re-employment opportunities annually for workers laid-off during the restructuring process.

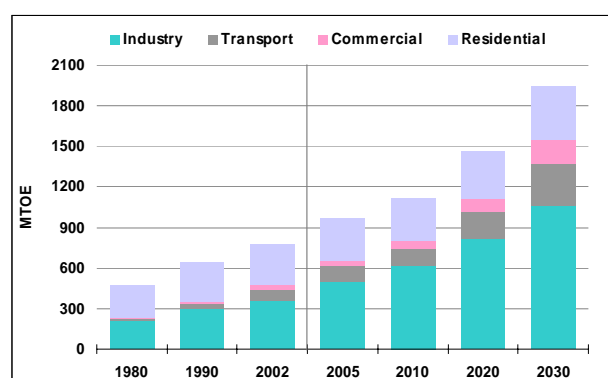
Population growth is projected to be restrained at 0.4 percent per year over the outlook period, compared with the previous three decades of 1.4 percent growth per year. Despite its modest growth, by 2020 China's population will reach over 1.4 billion, comprising 20 percent of the total world population. Economic growth continues to transfer labour and other inputs from agriculture to the industrial and services sectors of urban areas. UN Habitat projects that the share of China's urban population will reach 60 percent in 2030 from 38 percent in 2002. Urban dwellers will seek greater use of automobiles for their mobility and electric appliances for their living, which will in turn result in substantial growth of commercial sources of energy.

OUTLOOK

FINAL ENERGY DEMAND

Over the outlook period, final energy demand is projected to grow at 3.3 percent per year, slightly higher compared with annual growth in the previous two decades of 2.3 percent. The industry sector will maintain the largest share at 56 percent, followed by residential (20 percent), transport (16 percent) and commercial (8 percent).

Figure 26 Final Energy Demand



Source: APERC Analysis (2006)

Industry

China's industrial energy demand is projected to grow at an average annual rate of 3.9 percent until 2030, faster than its average annual growth of 2.6 percent over the past two decades. More than two-thirds of the energy required in the industrial sector

will be used by heavy industry such as chemicals, metals, non-metallic minerals, mining and quarrying. China's output of intermediate industrial products such as steel, cement and fertilizer is projected to grow at an average annual rate of more than 6.0 percent. Over the outlook period, energy intensity in the industrial sector is expected to decline at an average annual rate of 2.5 percent, reaching 77 toe per US\$ million in 2030 from 158 toe per US\$ million in 2002.³³

Coal has been the major source of energy in China's industrial sector, although other fuels such as oil and electricity have nibbled at its share.³⁴ Over the outlook period, coal's share of total industrial energy demand is expected to decline, and will reach 32 percent by 2030 from 48 percent in 2002. Coal is mainly used in the production of crude steel, cement, and chemicals.

By contrast, petroleum products are projected to grow robustly at 4.0 percent per year, accounting for 21 percent of the total industrial energy demand in 2030. Demand for naphtha as a feedstock for ethylene is projected to lead the growth in industrial oil demand. Capacity additions of ethylene plants are under way, and production is expected to increase from the current 5.4 million tonnes to 12.8 million tonnes by 2010, then to 38.8 million tonnes in 2030.³⁵ Diesel demand for mining and quarrying, construction, agriculture and the fishing industry is also projected to contribute to the growth in industrial oil demand.

Natural gas is projected to grow at 5.1 percent per year, compared with 3.5 percent in the previous two decades. Despite its relatively fast growth, the share of natural gas to total industrial energy demand will reach only 5 percent in 2030. Currently, industrial gas use is limited to fertiliser production, which is heavily subsidised.³⁶ In view of the future reform of natural gas pricing - removing subsidies for industrial users - industrial natural gas penetration is expected to only be modest.

³³ Since 1980, China's energy intensity for industrial sector has been improved remarkably at an average annual rate of 6.1 percent, the highest pace in the APEC region.

³⁴ The share of coal in the industrial sector stood at 70 percent in 1980, 67 percent in 1990, and 48 percent in 2002.

³⁵ Industrial naphtha consumption will increase at an annual rate of 5.6 percent until 2030. Despite the expansion of ethylene production capacity, domestic production will not meet China's total demand.

³⁶ In Sichuan the well-head price of natural gas for fertiliser use is 0.59 Chinese Yuan per m³, while natural gas price is 0.73 Yuan for industrial use, 0.77 Yuan for residential use, and 1.01 Yuan for commercial use.

Over the outlook period, electricity is projected to represent the fastest growth, at an annual rate of 5.8 percent. Its demand will surpass that of coal as the leading fuel, accounting for 35 percent of industrial energy demand in 2030. Manufacturing would account for the largest proportion of growth for electricity demand in the industry sector.

Transport

China's transportation energy demand is projected to grow at 4.9 percent annually (2002-2030), the second fastest rate in the APEC region, after Viet Nam. Despite the rapid growth, per capita transportation energy demand will remain small at around 0.2 toe per person in 2030, compared with the APEC average of 0.67 toe per person in the same period.

Throughout the outlook period, road transport is projected to maintain the largest share in total transportation energy demand. It will grow from 62 percent in 2002 to 70 percent in 2030. By fuel type, gasoline, a main fuel for passenger vehicles, will account for a three-fold increase, while diesel for trucks and farm vehicles, is expected to grow five-fold. Continued income growth will increase passenger vehicle ownership. Following the commitment to the WTO, China has been gradually lowering the tariffs on imported cars and parts, and will completely remove them in 2007, thereby making cars more affordable to the general public. To cope with the rising demand for freight traffic and ease congestion, China plans to invest US\$ 240 billion over the next 30 years to extend highway road networks. As a result, it is projected that 3.6 million passenger vehicles will be added every year, leading to a four-fold increase in road transportation energy demand.

The air transport sub-sector is expected to grow the fastest among all the transportation sub-sectors, increasing at an annual growth rate of 6.9 percent over the outlook period. The air transport sub-sector energy demand is projected to surpass that of rail sometime in 2020 and attain the second largest position in total transport energy demand. China's increasing integration to the global economy and rapid growth of personal income will expand the need for international travel, as well as long-distance travel within the economy. In view of the 2008 Olympic Games in Beijing and the expected rise in passenger and freight traffic, Beijing has been developing a new airport which can accommodate 60 million passengers per year by 2015 – more than doubling the capacity from that of 27.5 million in 2002.

Rail transport sub-sector constitutes an important component of freight transport since China depends on rail for transporting coal, mineral products and oil. In 2002, coal accounted for the largest share of rail freight volume, at about 45 percent. Over the outlook period, however, China is expected to reduce reliance on rail for coal transportation; as the economy plans to locate power plants close to coal mines, and deliver electricity through transmission lines to the end user. Likewise, pipeline will replace rail as a means for transporting oil and oil products. With the replacement of rail by other modes of transport, energy demand for rail will grow moderately at 1.7 percent per year up to 2030.

Similar to the rail transport sub-sector, which serves as a means to transport coal, oil and minerals, energy demand for the marine transport sub-sector, excluding international maritime, is projected to grow by 3.8 percent per year (2002-2015) and 3.1 percent per year (2015-2030). The projected decline in growth of marine transport energy demand is mainly due to a shift of modes of transporting coal and oil into other means of transport such as wire, pipeline and trucks during the second half of the outlook period.

Residential and Commercial

Over the outlook period, energy demand in the residential sector is projected to increase at an annual rate of 1.0 percent – a slower pace compared with 1.5 percent annual growth rate over the previous three decades. Along with income growth and infrastructure development, commercial energy sources will replace biomass, which accounted for 71 percent of the residential demand in 2002. Natural gas is expected to grow at the fastest annual growth rate of 7.8 percent. Electricity demand is projected to grow at an annual rate of 6.0 percent, raising the share of electricity in total residential energy demand from 6 percent in 2002 to 22 percent in 2030. Demand for oil products in the residential sector is projected to grow at an annual rate of 5.5 percent.

Energy demand in the commercial sector is projected to grow by 6.4 percent per year. Natural gas demand is expected to grow at the fastest rate of 16.9 percent per year as it continues to replace coal, and oil products for environmental reasons. Demand for electricity, the main fuel for commercial sector, is expected to increase at 9.9 percent per year with the increase in demand for cooling and lighting in commercial buildings.³⁷ Heat demand is projected to

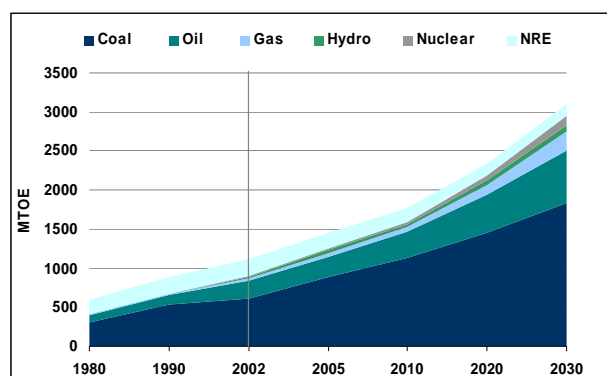
³⁷ Energy Research Institute under National Development and Reform Commission of China projects that the total floor space of commercial building will reach 26.8 billion km² by 2020 from 8.7 billion km² in 2000.

grow at the fast rate of 8.3 percent per year, while its share in total commercial energy demand will remain at 3 percent in 2030.

PRIMARY ENERGY DEMAND

China's total primary energy demand (TPED) is projected to grow at an annual rate of 3.7 percent – at a faster pace than the previous two decades of 2.9 percent per year. Among the fossil fuels, natural gas is projected to grow at the fastest annual growth rate of 7.4 percent followed by oil at 4.1 percent and coal at 4.0 percent over the outlook period.

Figure 27 Primary Energy Demand



Source: APERC Analysis (2006)

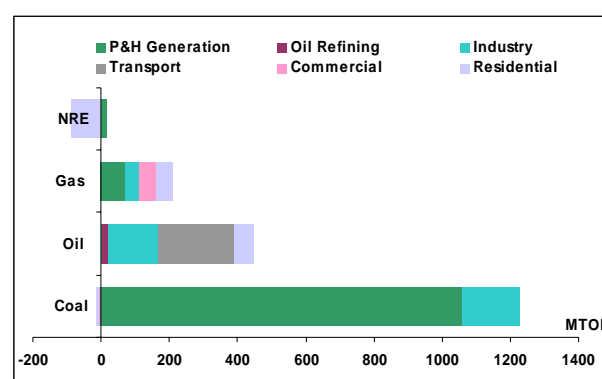
Coal demand will be largely driven by the electricity sector, accounting for more than 85 percent of the total incremental growth. To meet the rising electricity demand, China is expected to continue relying on coal - the most cost competitive option among all fuel types. As a result, installed capacity of coal-fired generation is expected to more than triple from 244GW in 2002 to 769GW in 2030.

The transportation and industry sectors will boost demand for oil by 50 percent and 33 percent of the total oil demand growth respectively. With the rising demand and decline in domestic production, China's net oil import dependency is projected to increase from 22 percent in 2002 to 70 percent in 2030. Recognising its vulnerability to outside shocks, China has been trying to secure oil supply by intensifying its upstream investment activities in Kazakhstan, Venezuela, Sudan, Iraq, Iran and Peru. China is not only making investment in overseas upstream projects. In addition, the first cross border oil pipeline project between China and Kazakhstan started operation in December 2005. To establish long-term relationships for securing oil supply, the Chinese government is extending its political ties with such neighbour economies as Indonesia and Russia.

The Chinese government has set a target to increase the share of natural gas in TPED from the current 2 percent to 10-15 percent in 2020. Although

the target represents less than half of the current natural gas proportion in Europe and the US, there are some impediments to achieving this target. The negotiation with LNG suppliers has not brought positive outcomes since the time of Guangdong and Fujian projects. Amid rising LNG prices, the gap between the proposed sales price and purchase price have not narrowed. In terms of domestic supply, the West-East gas pipeline project started commercial operation in 2004; however, end users' switch from LPG to gas has been relatively slow due to the high initial access fee. Thus the share of natural gas in TPED is expected to only reach 6 percent in 2020, and 8 percent in 2030.

Figure 28 Sectoral Contributions to the Incremental Growth by Source



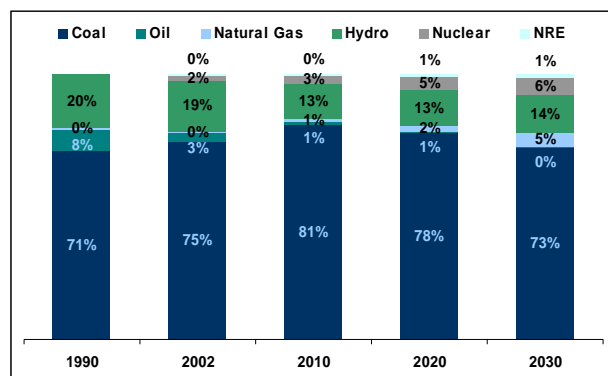
Source: APERC Analysis (2006)

ELECTRICITY

Electricity demand in China will increase by 6.3 percent per year over the outlook period, more than quintupling from the 2002 level. With this fast growth, China's total electricity demand will surpass that of the US sometime around 2025. Despite the substantial growth, per capita electricity demand will reach 5,000 kWh in 2030 – less than two-thirds of the APEC average.

Throughout the outlook period, coal will maintain the dominant share in the generation mix at around 73 percent. China plans to shutdown small-scale coal-fired generation plants near urban areas, and build relatively large-scale coal-fired generation plant, with the unit size 600 MW, near the coal mines. Natural gas-fired generation will account for about 5 percent of the total generation mix. In coastal areas, gas-fired generation will replace coal-fired generation to improve air quality.

Figure 29 Electricity Generation Mix



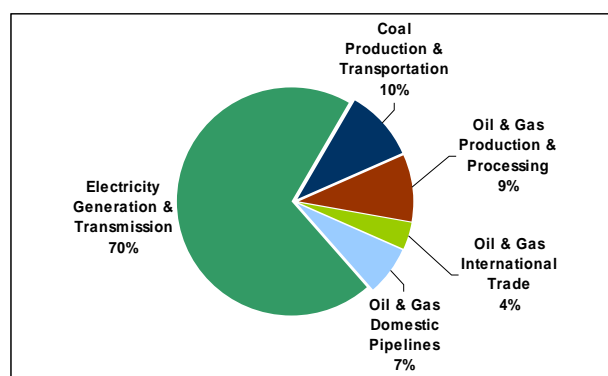
Source: APERC Analysis (2006)

With respect to nuclear, installed capacity will increase substantially from the current 8GW to 30GW in 2020, and further increase to 58GW in 2030. Despite the substantial increase in installed capacity, the share of nuclear in the generation mix will only be about 5 percent in 2030. Hydro will see the major expansion in the near term with the opening of Three Gorges Dam project in 2009. By 2030, hydro capacity is expected to expand to 297GW from 86GW in 2002.

INVESTMENT REQUIREMENTS

China’s high energy demand growth will require new investments of between US\$1.9-2.3 trillion by 2030. A large part, or 70 percent, will come from the construction of additional electricity generation and transmission facilities during the outlook period.

Figure 30 Investment Requirements

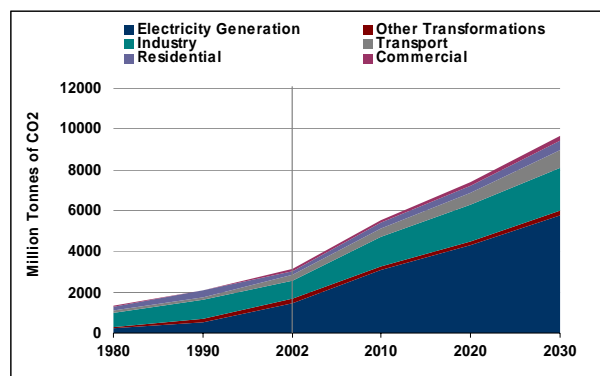


Source: APERC Analysis (2006)

CO₂ EMISSIONS

Over the outlook period China’s total CO₂ emissions from the energy sector is projected to increase from 3,128 million tonnes of CO₂ in 2002 to 9,648 million tonnes of CO₂ by 2030, more than half of which (59 percent) will come from the electricity sector at about 5,764 million tonnes of CO₂ by 2030.

Figure 31 CO₂ Emissions by Sector



Source: APERC Analysis (2006)

MAJOR ISSUES

QUEST FOR OVERSEAS OIL AND GAS

China is richly endowed with energy resources like coal, oil, and hydro. However, the development of these energy sources is not sufficient to meet the economy’s growing demand. As such, net import dependency of oil is projected to increase from 22 percent in 2002 to 70 percent in 2030. The increasing energy imports, combined with depleting domestic resources, have raised concerns over energy supply security.

To ease the tightness between demand and supply of oil, Chinese oil companies are actively investing in overseas exploration and development (E&D) projects. Chinese oil firms’ involvement in overseas oil and gas E&D projects has reached US\$7 billion in 2004 through 65 E&D projects in 30 economies worldwide. In 2004 alone, China sourced 17.5 million tonnes of crude oil from overseas exploration and development projects, accounting for 21 percent of its total imported crude oil.

There are two distinguishing features regarding overseas investment activities by Chinese oil companies. First, they tend to bid aggressively against their rivals and at times they commit high capital investments relative to the size of reserves. Such examples were found in some projects in Venezuela, and Kazakhstan. Second, Chinese oil companies invest in hard-to-reach economies. For example, they invest in oil projects in Sudan and Iran, where oil and gas resources are not fully explored by foreign oil companies.

ELECTRICITY SUPPLY INFRASTRUCTURE DEVELOPMENT AND REGULATORY REFORM

Driven by the fast economic development, China’s electricity demand is projected to experience an almost five-fold increase from 1,416 TWh in 2002

to 7,162 TWh in 2030, and surpass that of the US sometime around 2025 to become the biggest electricity consumer in the APEC region. To meet the growth in electricity demand, China's electricity sector needs to invest up to about US\$1.4-1.6 trillion in electricity generation and transmission facilities, representing the largest electricity sector investment requirements in the APEC region.

A series of measures have been undertaken to enhance electricity supply security and to improve operational efficiency of the electricity industry. Restructuring of the electricity industry has been carried out since 2002 in an attempt to optimise the electricity supply system, to enhance electricity supply security, and to lower electricity price. The government divested the generation and transmission assets of the former State Power Corporation into five generation and two transmission companies. Wholesale market deregulation is also planned for lowering electricity tariffs.

The benefits of electricity industry reform would only be realised after the infrastructure is built. However, the current reform process does not offer incentives, attractive enough to investors, especially to those generators with advanced technologies. Results from a recent trial run on wholesale electricity market exchange in some Chinese provinces showed a wide gap between the bidding prices of generators with old technologies and those with new technologies. Unlike the previous practice, new electricity prices would not guarantee the adequate rate of return for generators, thereby limiting the scope for introduction of generators using new technologies. Efforts are needed to create a regulatory framework that is attractive for investors, through benchmarking price with efficiency level of electricity generation plant.

ENERGY EFFICIENCY IMPROVEMENT

As a result of the recent rise in energy consumption, China's energy intensity (energy consumption required to produce a unit of GDP), has deteriorated. Energy intensity in 2005 was about 10 percent higher than that of 2000. In the future, China's energy intensity is projected to improve, from 204 toe per US\$ million in 2002 to 100 toe per US\$ million in 2030.

Faced with dwindling energy production, and deteriorating environmental conditions, China recognises the importance of efficient use of energy in all sectors. In the 11th five-year plan (2006-2010) China sets a target to improve energy intensity by 20 percent in 2010 compared to that of 2005.

The 11th five-year plan identifies several areas for improving energy efficiency. This includes energy production and processes in electricity, petrochemical iron and steel and coal mines.

Energy intensity of heavy industries in China is significantly higher than the level of developed economies, as their production facilities are small in scale, fragmented, and unproductive. China plans to shutdown antiquated plants and upgrade others to improve operational efficiency of production facilities. For example, China plans to shutdown its 28,000 coal mines, and restructure them into 13 clusters, each of which will have production capacities between 50 million to 100 million tonnes per year. By 2010, China plans to shutdown 64 small-sized power plants with total capacity of 5.35GW.

However, improving performance would require layoffs, which are often impossible without local government support. Sougang Steel – one of the steel companies - employs more than 100,000 people to produce seven million tonnes of steel, while international standards would require only 10,000 to 20,000 to produce the same amount of steel. In other words, the attempt to close small scale operations would face strong opposition from local government as they are the key contributors to local economic growth as well as the last resort to generate employment.

IMPLICATIONS

Rapid growth in China's economy will translate into substantial growth in energy demand. Over the outlook period, China should account for about 42 percent of overall energy demand growth in the APEC region, which by fuel represents 67 percent of coal demand growth, more than 30 percent of oil demand growth, and about 24 percent of natural gas demand growth. With the substantial demand growth, net import of oil is expected to reach 70 percent in 2030 from 22 percent in 2002.

As energy demand is expected to grow far beyond domestic output, China placed energy security as a primary energy policy goal, and identified energy efficiency improvement as an important means for the enhancement of energy security. However, achieving the goal will be a difficult process due to the distinct features of China's energy sector, notably the relationships between central, provincial and local governments. The realignment of different goals among different levels of governments would be needed to attain security of energy supply, and to improve environmental conditions.

Cross-border energy projects will provide an option to enhance energy supply security. China and Russia reached an agreement to develop a natural gas pipeline. For the realisation of these cross-border energy projects, China would need to cooperate with neighbouring economies to establish a framework that can facilitate legislative arrangements, and technical coordination.

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