6.14 People's Republic of China

- *Rapid economic growth in the People's Republic of China will drive an annual growth rate of 2.4% in final energy demand (2005–2030).*
- *Total primary energy demand is projected to grow at 2.6% annually. Coal will account for the bulk of the primary energy mix, at 53.4% in 2030, although it represents a reduced share compared with the 2005 level of 63.2%.*
- *The increasing amount of oil demand will have to be met by imports, with oil import dependency increasing from 43.6% in 2005 to 71.9% in 2030.*
- *Nuclear power will play a key role to slow carbon dioxide emissions; its growth rate will be about 11.9% (2005–2030).*

Recent Energy Trends and Energy Policy

The People's Republic of China's (PRC) energy demand rose gradually from 1990 to 1996, moderated for a few years, and then accelerated rapidly from 2000 with sustained and very fast economic expansion. Over this period, total primary energy demand grew from 863.2 million tons of oil equivalent (MTOE) in 1990 to 1,878.7 MTOE in 2006, an average annual rate of 5.0%. The total final energy demand growth was slower at 3.8%. Per capita primary energy demand grew rapidly from 0.75 tons of oil equivalent (TOE) to 1.42 TOE, still well below its neighbors and the East Asia group's 2006 average of 1.59 TOE per capita. Primary energy intensity, conversely, fell from 1,942 TOE/$ million to 896 TOE/$ million, an average annual rate of –4.7%. This rate was a much faster decline than the East Asia group's rate of –2.7%, but as a developing country, the PRC's absolute economic energy intensity was still quite high for the region.

The PRC is geographically the largest among Asian Development Bank members in Asia and the Pacific. It has the world's largest population, one that is rapidly urbanizing and concentrated mostly along its eastern coastline, and it is among the top global producers and consumers of energy. A robustly developing major global manufacturing and production base, the PRC's industry sector currently dominates energy demand; despite sustained growth, however, it is gradually yielding share to the "others" sector, including transport. From 1990 to 2006, the share of final energy demand attributed to the industry sector rose from 36.3% to 43.8%. The "others" sector, which includes residential, commercial, agricultural, and other energy uses, fell from 51.7% to 37.4% in the same period. The transport sector's share grew quickly, from 5.6% to 10.5%, driven by demand for freight and personal road transport as well as air travel.

Coal remains the major fuel, although oil and electricity are increasingly important. From 1990 to 2006, coal's share of primary energy demand grew from 61.2% to a dominant 64.2%. Used primarily in the power and industry sectors, oil grew from 12.8% to 18.3%, and natural gas grew from 1.5% to 2.5%. The PRC also has significant hydropower production, and nuclear power was introduced in the 1990s. However, overall shares for both remain small; hydropower rose from 1.3% to 2.0% from 1990 to 2006, and nuclear power reached 0.8% in 2006. Over the same period, coal's share of final energy demand fell dramatically, from 47.5% to 32.7%, whereas the share for oil rose from 12.6% to 24.6% with electricity's rise. Gas rose from 1.5% to 3.1%. PRC electricity production grew 10.0% annually between 1990 and 2006 and an even higher 13.3% between 2000 and 2006, driven largely by industrial demand. Generation continues to rely

heavily on coal, an abundant and cheap domestic resource, followed by hydropower.

In more recent years, the PRC's overall energy demand growth accelerated significantly, following a 1996–2000 slowdown. Average annual primary energy demand growth increased from 2.5% in 1990–2000 to 9.2% in 2000–2006. Recent total economic growth was similar to that of the 1990s, actually having fallen slightly from 10.4% annual growth in 1990–2000 to 9.8% growth in 2000–2006. Much of the dramatic increase in primary energy demand can be attributed to a resurgence of energy-intensive heavy industries such as the iron and steel, aluminium, and cement subsectors.

The PRC energy resources are abundant, but rapid growth in energy demand outpaces growth in energy production. Estimates put recoverable coal reserves at 115 billion tons,[125] proven gas reserves at 80.0 trillion cubic feet, and proven oil reserves at 16 billion barrels.[126] From 1990 to 2006 energy import dependency gradually grew from –4.1% to 7.2%, reflecting the PRC's 1997 shift from net energy exporter to importer. Despite significant domestic production of oil, marginal growth in demand for crude and petroleum products destined for the transport and industry sectors drives increasing energy imports. Non-fossil natural energy resources in the PRC are plentiful as well; hydropower resource potential is estimated to be among the highest globally, and renewable resources, particularly those for wind, hold extremely good potential for continued rapid development such as that experienced in recent years.

Energy policy in the PRC was historically guided by successive 5-year plans that emphasized the role of energy security given continually rising demand alongside supply limits. With the philosophy that the energy sector should not impinge on overall economic growth, the PRC energy policy has identified the shared importance of expanding and strengthening energy supply while prioritizing energy efficiency and conservation across all sectors. The most recent *Eleventh 5-year guidelines*, issued in 2006, gave special attention to the role of efficiency, setting targets to improve subsector and technology-specific efficiency metrics with an overarching goal of 20% reduction in economic energy intensity by 2010 (about 4.4% annual reduction). Supporting energy legislation and policies were broad-based and sophisticated, with key measures including the closure of small coal mines to address safety and efficiency concerns; the closure of small, old, and inefficient power generators and deployment of advanced thermal generator technologies; the broad deployment of flue gas desulphurization equipment on coal-fired power generators to help meet sulphur dioxide emission reduction targets; the accelerated development and strengthening of energy infrastructure, including electric grids, gas pipelines, and rail networks; and the promotion of new and clean energy such as natural gas, nuclear, and renewable sources.

In addition to measures that guide energy infrastructure development, recent energy sector reforms also addressed structural reforms. For example, energy policy coordination and strategy was strengthened with the establishment of the National Energy Administration, electricity market reform, and liberalization continued under the State Electricity Regulatory Commission, and tax and pricing reforms were implemented or considered for a variety of fuels. Because the PRC's energy development is heavily influenced by the form of overall economic development, structural characteristics continue to be an important part of government dialogues on energy policy.

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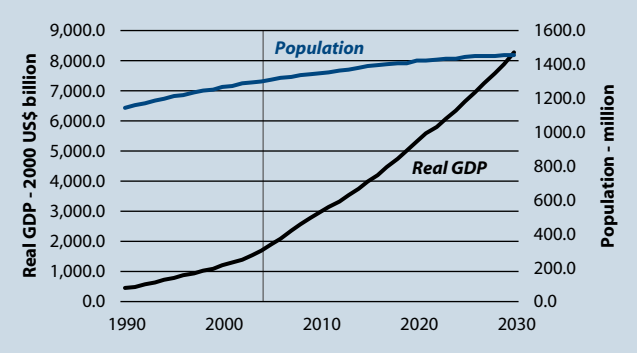
[125] World Energy Council. 2007. *2007 Survey of Energy Resources.* London.

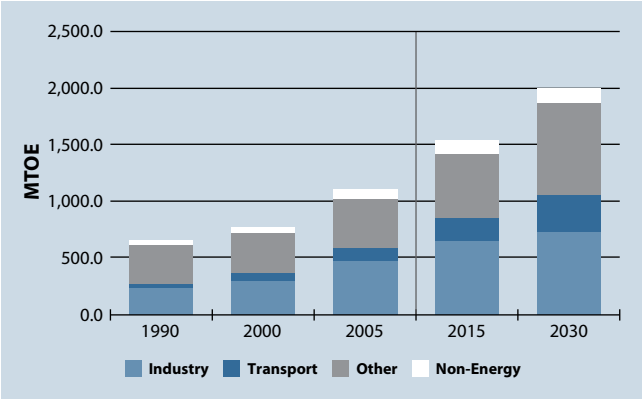
[126] Sandrea, Rafael. 2009. An In-Depth View of Future World Oil and Gas Supply: A Quantitative Model Analysis. *Oil and Gas Journal.* (January). Houston: Pennwell Editors.

Figure 6.14.1: GDP and Population—People's Republic of China



GDP = gross domestic product.
Source: Asia Pacific Energy Research Centre (APERC) (2009).

Figure 6.14.2: Final Energy Demand—People's Republic of China



MTOE = million tons of oil equivalent.
Source: APERC analysis (2009).

Energy Demand Drivers

The PRC per capita gross domestic product (GDP) in 2006 was approximately $1,600 (constant 2000 dollars), lower than ADB East Asia group's average of $2,400, but having grown quickly at 9.2% annually from 1990 to 2006. Electrification rate was 99% as a result of successful rural electrification programs despite a population urbanization level of only 43.9%. Average annual economic growth from 1990 to 2006 was generally stable and very high at 10.1%, although GDP growth is projected to slow to a still-robust annual rate of 6.1% over the 2005 to 2030 outlook period. Economy-wide primary energy intensity is projected to continue to fall over the outlook period (although the rate of decline will likely fall behind its historically fast trend), given expected cross-sector improvements in energy efficiency, a continued transition to higher quality fuels, and a gradual economic structural shift away from the most energy-intensive heavy industries.

Between 1990 and 2006, the PRC population grew from 1.14 billion to 1.32 billion, an average annual rate of only 0.9%. Population growth is projected to slow to 0.4% over the outlook period, reaching 1.45 billion in 2030 and reaching its peak soon after as the average age rises. Over the outlook period, this population will become increasingly wealthy, urban, and mobile. This will be reflected in an increased demand for energy services and fuel, switching away from direct use of coal and biomass and toward clean and refined fuels such as electricity and gasoline in the residential, commercial, and transport sectors. Drawing from the developmental experiences of the PRC's East Asia group neighbors, this large demographic shift will over time change the broader structure of the economy itself as domestic demand of goods and services grows (Figure 6.14.1).

Final Energy Demand

Over the forecast period, final energy demand is projected to grow at 2.4% per year, much lower compared with the annual growth rate of 3.5% from 1990 to 2005. In 2030, the other sectors will maintain the largest share at 40.4%, followed by the industry sector at 36.4%, and transport at 16.8% (Figure 6.14.2).

Industry Sector

The PRC's industrial energy demand is projected to grow at an average annual rate of 1.7% until 2030, lower than its average annual growth of 4.7% from 1990 to 2005. 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. 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.[127] Over the outlook period, coal's share to total industrial energy demand is expected to decline and will reach 46% by 2030 (from 59% in 2005). Coal is mainly used in the production of crude steel, cement, and chemicals.

The share of total industrial energy from petroleum products is projected to decrease to 6% of the total industrial energy demand in 2030 from 8% in 2005. Natural gas is projected to grow fast at 6.1% per year, compared with 3.5% from 1990 to 2005. Despite its relatively fast growth, the share of natural gas to total industrial energy demand will reach only 7% in 2030 in comparison with 3% in 2005.

Over the outlook period, electricity is projected to represent the fastest growth at an annual rate of 2.8%. Its demand will account for 32% of industrial energy demand in 2030. Manufacturing would account for the large proportion of growth for electricity demand.

Transport Sector

Over the outlook period, the PRC's transport energy demand will grow by 4.4% annually (2005–2030). By fuel type, gasoline (the main fuel for passenger vehicles) will see a 4.3% growth rate, and diesel for trucks and farm vehicles is expected to grow by 4.5%. Continued income growth would boost the number of passenger vehicles owned. Following the commitment to the World Trade Organization (WTO), the PRC gradually lowered the tariffs on imported cars and parts, and completely removed them in 2007, thereby making cars more affordable for the general public.

Other Sectors

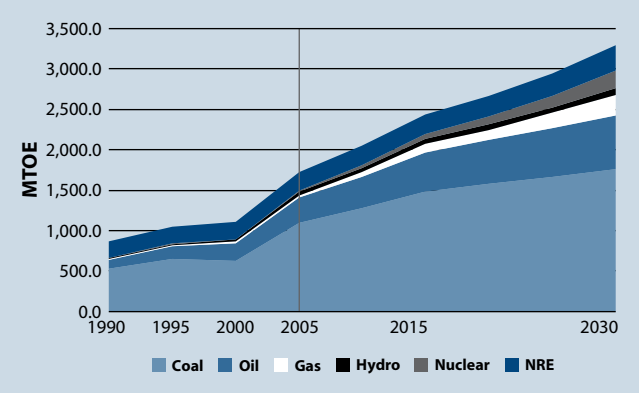
Energy demand in the other sectors, which includes residential, commercial, agricultural, and construction demand, is expected to grow at 2.5% per year over the outlook period. Electricity and biomass are expected to continue to dominate the fuel mix in this sector, accounting for 26% and 28% in 2030, respectively, compared with 7% and 61%, respectively, in 2005. This increase in electricity over biomass can be accounted for by higher living standards and availability of electricity.

Primary Energy Demand

The PRC's total primary energy demand is projected to grow at an annual rate of 2.6%—a slower pace than the 4.7% per annum from 1990 to 2005. Among the fossil fuels, natural gas will grow at the fastest pace of 7.7% per year, followed by oil at 3.1% and coal at 1.9%. Nuclear will play a key role to reduce carbon dioxide emissions, its growth rate will be 11.9%, and new and renewable energy (NRE) will be about 1.0% (from 2005–2030).

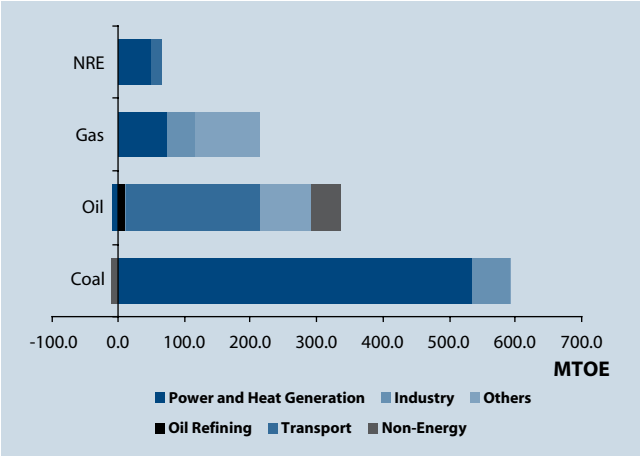
[127] Share of coal in the industrial sector stood at 71% in 1990, 59% in 2000, and 59% in 2005.

Figure 6.14.3: Primary Energy Demand—People's Republic of China



MTOE = million tons of oil equivalent, NRE = new and renewable energy.
Source: APERC analysis (2009).

Figure 6.14.4: Incremental Energy Demand Growth—People's Republic of China (2005–2030)



MTOE = million tons of oil equivalent, NRE = new and renewable energy.
Source: APERC analysis (2009).

Coal demand will be largely driven by the power sector, accounting for about 80% of coal's incremental growth between 2005 and 2030. To meet the rising electricity demand, the PRC will continue to rely on coal because it is the most cost-competitive option among all fuel types, considering that it has significant coal reserves. The installed capacity of coal-fired generation may increase from 381 gigawatts (GW) in 2005 to 762 GW in 2030.

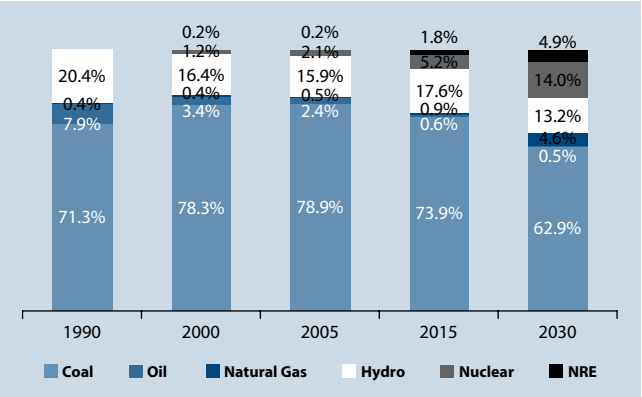
The transport sector will boost demand for oil, accounting for 61.7% of the incremental oil demand growth between 2005 and 2030. With rising demands and inadequate supply increases, the PRC's net oil import dependency is projected to increase from 43.6% in 2005 to 71.9% in 2030.

The share of natural gas in total primary energy demand will increase from 2.3% in 2005 to 7.9% in 2030. Although the share represents less than half of the current natural gas proportion in Europe and the United States, there are some impediments for achieving it. The first West-East Gas Pipeline started commercial operation on 30 December 2004, with the pipeline network covering more than 70 cities, 3,000 large and medium-sized enterprises, 42 billion cubic meters of natural gas sales, and nearly 2 billion people benefiting from its use. The pipeline has also become the main gas source for the PRC's Bohai Sea and the Yangtze River Delta economic circle. On 22 February 2008, the second line of the West-East Gas Pipeline began construction. This gas line, which passes through 14 provinces and municipalities, is a main energy artery with a total length of 9,139 km. Its west point starts in Horgos in Xinjiang, southeast to Guangzhou, and east to Shanghai, connecting the Central Asia Gas Pipeline across three source countries: Kazakhstan, Turkmenistan, and Uzbekistan.[128] The amount of natural gas will be 30 billion cubic meters, and the gas supply will last for more than 30 years. With all these factors taken into account, the share of natural gas in total primary energy supply (TPES) will reach 2.3% in 2015 and 7.7% in 2030.[129]

[128] China Internet Information Center. 2008. *Kazakhstan Starts Work to Send Gas to China.* Available: www.china.org.cn/business/2008-07/10/content_15985103.htm

[129] China Internet Information Center. 2008. *China Lays 2nd West-East Natural Gas Pipeline.* Available: www.china.org.cn/china/photos/2008-07/14/content_16004226.htm

Figure 6.14.5: Power Generation Mix—People's Republic of China



NRE = new and renewable energy.
Source: APERC analysis (2009).

Electricity

Electricity demand in the PRC will increase by 3.9% per year (2005–2030) to an amount that is more than two times higher than the 2005 level. With this fast growth, the PRC's total electricity demand will surpass that of the United States sometime in 2025.

Throughout the outlook period, coal will maintain its dominant share in the generation mix at around 62.9% in 2030. Natural gas–fired generation will take about 4.6% share in total generation mix. In coastal areas, gas-fired generation will replace coal-fired generation to improve air quality. Nuclear installed capacity will increase substantially from the current 8 gigawatts (GW) to 70 GW in 2020, and will further increase to 120 GW in 2030. Despite the increase in installed capacity, the nuclear share in the generation mix will be only 14.0% in 2030. Hydro will see a major expansion in the near term with the opening of Three Gorges Dam in 2009. By 2030, hydro capacity is expected to expand to 320 GW from 117 GW in 2005, and renewable capacity will expand to 139 GW from 3 GW in 2005, mostly from wind.

Energy Policy Issues

Energy Efficiency and Intensity Improvement

Efficient and rational energy use has long been a keystone of the PRC's energy policy goals. And in recent years, as the scale of energy demand and economic activity took on increasingly global proportions, the prioritization of economic energy efficiency has carried a new sense of urgency.

As a developing country, the PRC's absolute efficiency levels in many of the most energy-intensive subsectors, such as aluminium and glass production, still lag behind demonstrated "international advanced level" potentials. At the same time, many of these inefficient industries in recent years have also been the fastest growing. To address this, policy responses, both national and subnational, have been broad and strong. More importantly, they have helped achieve significant progress. For example, the 2007 *Top 1,000 Enterprise Energy Efficiency Action Plan*, which targeted industries responsible for about 30% of total PRC energy demand, anticipated 50 MTOE in total energy savings by 2010. Similarly, the 2004 *Medium-and Long-Term Energy Conservation Plan* developed targets and strategies so that energy demand in the production and operation of major industrial, commercial, and residential products in 2010 will reach the international level of the early 1990s and approach the advanced international level by 2020 or sooner.[130]

Similar continued policy efforts that can build on these successes will help ensure that the PRC's economic energy efficiency performance becomes an asset to future energy security global competitiveness.

[130] APERC. 2008b. *Understanding Energy in China*. Tokyo.

Energy Supply Security and Investment

With rising energy demand, continued aggressive energy sector investment will help reduce the likelihood and severity of energy supply disruptions. For example, ongoing infrastructure improvements such as strengthening and optimizing the operation of domestic rail networks and electricity grids are expected to relieve pressure on the balance of supply and demand often experienced during periods of stress such as natural disasters or severe market fluctuations. Concerted upstream efforts by major PRC petroleum companies to extend the life of mature domestic oil fields, to invest and improve expertise in the production of clean domestic fossil resources such as natural gas, and to engage in broadening exploration and development with overseas partners all contribute to energy security by improving diversity in the fuel supply mix, markets, and geography. Over the outlook period, an attractive investment environment in the PRC's energy sector will encourage continued progress in these and other key areas.

Global Energy Cooperation

As its energy sector evolves and matures over the outlook period, the PRC will strengthen its role as a key international energy economy. Regional and global exchange on issues of energy production and demand, trade, technology, investment, conservation, efficiency, and environmental impact will become increasingly important. On some issues, such as minimization of local air and water pollution from energy production and demand, or power generation technology, the PRC will likely benefit from considerable international experience. But other issues—such as climate change, new and renewable energies, and global energy trade and investment—present novel challenges for all parties and will define an evolving shared international experience. Moreover, although the PRC has historically been engaged in international energy cooperation with many of the most developed global economies—relationships that will continue to strengthen—it will increasingly become a valuable partner for other developing countries that want to learn from the considerable and unprecedented energy development experience being created in the PRC today.

Policy Implications

Throughout the outlook period, the growth in the PRC's energy demand and its energy supply choice will affect the dynamics of global energy demand and supply. In particular, the PRC's expected oil import dependency at 72% in 2030 may imply the PRC's further need to find overseas resources and make efforts toward energy efficiency improvements across the sector. In this regard, the PRC's implementation of the vehicle efficiency standards, promotion of small vehicles, and development of urban transport systems in the major cities may be further strengthened in the future. Cooperation with the ADB regional member countries in sharing the policy information and know-how will benefit the implementation. And cooperation within the regional member countries on oil resources development may bring mutually beneficial outcomes for the PRC's energy security enhancement and host countries' economic development.

The projected carbon dioxide emissions growth trends offer a slower rate during the second half of the outlook period. This results from the combination of slower energy demand growth, mainly in the productivity improvement of the industry sector, efficiency improvement in coal-fired generation, and application of zero emissions power generation technologies such as

wind and nuclear. The pathway to reach this trend has to be supported by policy making and implementation at central and local levels. Clear direction and practical ways to integrate the long-term policy direction to support a low-carbon economy with the PRC's economic development goals will lead to further success in the PRC's development as well as region-wide prosperity.

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