CHINA

- *Over the outlook period, rapid economic growth coupled with its efforts in energy efficiency and conservation will drive the moderate annual growth rate of 2.3% for China's final energy demand. This is compared with a GDP growth rate of 6.6% over the same period.*
- *The total primary energy supply is projected to grow 2.1% annually over the period. This includes average annual growth rates of 0.8% for coal, 2.7% for oil and about 7.7% for natural gas.*
- *The contribution of non-fossil fuels in the fuel mix for power generation will rise to 37% by 2035, up from 19% in 2009. This increase will be key to China limiting its CO_2 emissions over the outlook period.*
- *The increase in the gas share of power generation, from 1% in 2009 to 11% by 2035, also reflects China's efforts to limit its CO_2 emissions.*

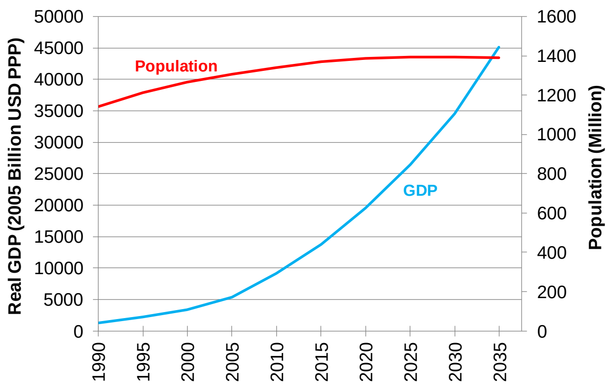
ECONOMY

China is the fourth-largest economy in geographic size in the world, after Russia, Canada, and the United States (US). Its land area covers 9.6 million square kilometres, and features a range of landscape types, including mountains, deserts and river basins. China has by far the largest population of any economy in the world. The economy's population growth will be restrained during the outlook period, growing 0.15% per year compared with the average annual growth rate of 0.82% from 1990 to 2009. The total population is expected to increase to about 1.39 billion by 2035, an increase of about 4.3% from the 2009 figure.

China is the third-largest economy in the world after the US and Japan with a real GDP of USD 8.26 trillion (in 2005 USD PPP) in 2009. It has sustained high rates of economic growth since the early 1990s; the average annual growth rate for the period 1990–2009 was 10.5%. It is projected the high economic growth rate will slow down as China's economy matures. The projected average annual growth rate is about 6.6% during the outlook period (2010–2035). This is similar to the target set in China's 12th Five-Year Plan (2011–2015) for a GDP growth rate of 7% during those five years (APCO Worldwide, 2010).

However, China's development so far has mostly focused on its coastal area due to the access it gives to the global market and the convenience it offers to communicate with foreign economies. Another concern is that the income of many citizens has not kept pace with the fast economic growth over the past decade. To eliminate imbalances and to share the wealth around the economy, China is putting considerable effort into encouraging investment in its western area (such as land credits, lower taxes and subsidies for manufacturers, etc.) and speeding up the construction of transport systems (such as high-speed rail, airports, highways, etc.) for both people and products. The goal is to try to balance the development around China's big territory.

Figure PRC1: GDP and Population



Sources: Global Insight (2012) and APERC Analysis (2012)

Economic development has created increasing demands for air-conditioning, heating, lighting, other appliances, motorcycles, and vehicles to improve people's quality of life. This will boost the future requirements for energy infrastructure and energy consumption. The big challenge for China in the future will be to slow down the growth of energy consumption to protect the environment and to ensure the proper use of limited resources. In China's 12th Five-Year Plan for Energy Development, the projected primary energy consumption shows an annual growth rate of about 4.3% from 2011 to 2015. This represents a slowdown, compared with the 6.6% annual growth rate during the period 2005-2010 (SCC, 2013).

China is seeking to move away from its traditional role as the 'world's workshop' to being a centre of high-tech and high-value added industry. In China's 12th Five-Year Plan for National Economic and Social Development, the focus is on developing seven so-called 'strategic emerging industries' (SEIs). The aim is to increase the SEI's contribution from approximately 5% of GDP in 2009 to 8% by 2015 and 15% by 2020 (NPC, 2011). It is hoped these industries will become the backbone of China's economy over the next decade. These seven industries are biotechnology, new energy, high-end equipment manufacturing, energy conservation and environmental protection, new-energy vehicles, new materials, and next-generation IT. Four of the industries relate to low-carbon technology for a clean environment and sustainable development. China can therefore be expected to become a leader in the low-carbon energy field.

To reduce the dependence of its economy on exports, China is expected to strongly emphasize the importance of shifting to consumption-driven growth, with domestic consumption expected to rise from 35% of GDP in 2009 to around 50–55% of GDP by 2015. Another effort will be to enhance the contribution of service industries; they are expected to account for 47% of GDP by 2015, up 4% from the 2010 level. Other policies stressed in the 12th Five-Year Plan for National Economic and Social Development include raising the minimum wage, expanding the government-funded social welfare and health care system, and reducing the gap in the quality of life between the urban and rural areas. The urban population is expected to reach 51.5% by 2015, up 4% from 2010 (NPC, 2011).

In the past, China's energy demand was driven mainly by the rapid growth of industry. In 2009, industry as a whole accounted for 48% of final energy consumption. The main area of growth was in the rise of heavy industry and energy-intensive industry after 2001. Within this sector, energy use was dominated by iron and steel (29% of all industrial energy used in 2009), followed by non-metallic minerals including the cement industry (23%). However, with the economy's efforts to re-structure the industry sector and to introduce the SEIs in the 12th Five-Year Plan, it is expected the energy intensity and carbon emission levels for the industry sector will be significantly reduced.

The domestic transport sector accounted for around 11% of final energy consumption in 2009; this increased at 7.8% annually from 2000 to 2009. This growth in demand was driven mainly by road transport, which consumed 76% of this sector's energy use in 2009. Passenger vehicle numbers, including civil and private, grew at an average annual rate of 20% from 2000 to 2009. Private vehicle ownership is expected to continue to rise rapidly in the future (NBSC, 2012). Fast growth in the truck and domestic marine fleet is also expected.

Investment in China's transport infrastructure is about CNY 6.2 trillion (USD 976 billion) for the duration of the 12th Five-Year Plan, an increase of 32% over that in the 11th Five-Year Plan. The majority of the funds will be used in highway construction. According to 12th Five-Year Plan, the scale of the economy's highway network will continue to expand. The total road mileage is expected to reach 4.5 million kilometres, and the total mileage of high-speed divided highways is expected to reach 108 000 kilometres. This highway network will connect more than 90% of the towns and cities with populations of over 200,000 people. To slow down the growth in private vehicle use, China is also making massive investments in public transport, including high-speed rail and urban mass transit rail systems. The expansion of the domestic airport and flight fleet is another way the economy is trying to balance development between its eastern and western areas.

Most of the rural areas in China now have electricity; the 2010 electrification figure was 99.4% of households (CEPP, 2010). However, electricity blackouts are still a problem in some of the rural areas. The growth in residential energy demand is mainly due to increasing urbanization (36% in 2000, and expected to reach 71% by 2035) (UN, 2012). The increase in urbanization increases energy demand, as urban residents tend to be more dependent on electricity and commercial fuels than the rural population. The urban population is currently concentrated in the eastern areas due to more industrial development and more employment opportunities. However, it can be expected that more balanced development in the future will mean higher residential energy demand in the western and rural areas.

The 'other' sector, which is mainly residential and commercial use, accounted for 33% of the economy's final energy demand in 2009. Residential energy use dominates (73% of this sector's energy use in 2009), followed by commercial at 12% and agriculture at about 6%. However, the service industry will gradually contribute more to the overall GDP, so the commercial sector is expected to consume more energy in the future.

ENERGY RESOURCES AND INFRASTRUCTURE

China has significant energy resources, particularly coal. In 2010, China was the world's largest producer and consumer of coal, as well as its fifth-largest producer and second-largest consumer of oil (EIA, 2012; BP, 2011). Estimates put China's recoverable coal reserves at around 114.5 billion tonnes in 2010, enough to last 35 years at 2010 production levels; and 14.8 billion barrels of proven oil reserves as of December 2010, enough to last 9.9 years at 2010 production levels (BP, 2011). China's largest and oldest oilfields are located in the northeast region of the economy. China also had 2.8 trillion cubic metres (tcm) of proven natural gas reserves as of December 2010, enough to last 29 years at 2010 production rates (EIA, 2012; BP, 2011).

Investment in the exploration of energy resources was more than USD 17 billion in 2011 alone, 7% higher than in 2010. The potential new areas for oil and gas fields are the western basin area (such as Tarim Basin, etc.) and the offshore area in Bohai Bay (northeast China) (MLR, 2012). China has estimated exploitable shale gas resources of 36.1 tcm, in theory enough to meet China's gas needs for the next two centuries (EIA, 2012). It has launched a five-year plan (2011–2015) for the development of shale gas, aiming for 6.5 billion cubic metres (bcm) of shale gas production by 2015, which is equivalent to 2–3% of projected Chinese gas production in 2015; and more than 60 bcm of shale gas production by 2020. But the geological conditions are complex and will pose great technical and investment challenges.

China's fast economic development saw the economy shift from being a net oil exporter to a net oil importer in 1993. As of 2009, estimates place China as the second-largest net importer of oil. For environmental reasons, China is trying to slow down the growth rate of coal production and to limit coal consumption in the future. In the 12th Five-Year Plan for Energy Development, China will increase the share of gas in the primary energy consumption from 4.6% in 2010 to 7.5% by 2015 (SCC, 2013).

In addition to fossil fuel, China is endowed with 400 gigawatts (GW) of economic hydropower potential, more than any other economy. There is also a potential wind-based generation of 1500 GW, including 500 GW offshore and 1000 GW shore-based (CEC, 2011).

However, coal and oil resources have been used more extensively than natural gas and hydro for power generation and industrial development and this will continue into the near future. Most of the economy's existing power generation is coal based, with coal accounting for 79% of electricity production in 2009. In the 12th Five-Year Plan, China will increase the non-fossil fuel share of power generation from 8% in 2009 to 11.4% by 2015 and to 15% by 2020.

Much of the growth in China's domestic energy demand for crude oil and gas is being met by imports. The expansion of domestic crude oil production and refinery capacity has not been sufficient to match the rapid increase in demand for diesel and gasoline. China's increased energy imports from the global oil market have had a significant impact internationally, tightening the overall balance between demand and supply. Chinese oil companies are also trying to boost overseas investment levels to ensure stable supplies. China is also seeking to increase its gas supply via pipelines from foreign economies, such as Turkmenistan, Kazakhstan, Uzbekistan, Myanmar and Russia. Negotiations with some of these economies are still ongoing. Three liquefied natural gas (LNG) terminals will be operating by the end of 2011 and another six new LNG terminals are in the planning/construction stages (EIA, 2012).

After the enactment of the Renewable Energy Law in 2005, the installation of renewable electricity generating capacity (excluding hydro) has doubled every year, from being almost non-existent before 2005. China's total installed wind turbine capacity (with grid connection) reached 2% (or 17.6 GW) of total electricity generating capacity, with a 1% (or 27.6 TWh) share of total electricity generation in 2009. The share of biomass was 2% (or 14.1 GW) of capacity and 2% (or 64.8 TWh) of electricity generation in 2009 (IEA, 2011). In addition, China has been speeding up its installation of solar photovoltaic power generation: in early 2009, the installed capacity was 300 MW with another 500 MW under construction.

Total solar cell production in China in 2009 was 4011 MW, which accounted for 42% of the world's solar cell shipments. However, at the end of 2009, the accumulated installed capacity in China was only about 300 MW, with another 500 MW under construction. Installed capacity is expected to grow to 21 000 MW by the end of 2015 (SCC, 2013). China launched the Golden Sun program in 2010 encompassing 275 projects with a capacity of 640 MW, which is expected to rise to 1000 MW over the following three years (NEA, 2010).

ENERGY POLICIES

In a context of rising demand and constrained supply, China has made energy security the top priority in its energy policy objectives. The economy's 12th Five-Year Plan for National Economic and Social Development (2011–2015) sets out a program for the enhancement of energy security, with a strong emphasis on clean energy and energy efficiency. By 2015, China aims to have non-fossil fuels account for 11.4% of primary energy consumption, cut energy intensity by 16%, and reduce CO_2 emission per unit GDP by 17% from 2010 levels. By 2020, non-fossil energy will account for 15% of China's total primary energy consumption and CO_2 emission per unit GDP will be 40-45% lower than in 2005 (SCIO, 2012). A number of measures have been implemented to this end. These measures include the promotion of non-fossil fuel as an energy source as well as lower carbon energy sources (especially gas); the modernization of energy industries, with the closure of inefficient small coalmines, power plants, refineries, and iron-and-steel production plants; and the introduction of efficient technologies throughout the energy supply chain, i.e. from production and transport through to consumption.

In the 12th Five-Year Plan for Coal Industry, coal production is capped at 3.9 billion tonnes by 2015. China also introduced regulatory controls to limit environmental degradation, tax evasion, and mine accidents. It aims to reduce the number of coal enterprises from about 11 000 to 4000. Although state-owned coal mines dominate in China's coal industry, non-state-owned coal mines still play an important role. For the state-owned coal mines, ownership is divided between various central, provincial, and local government agencies. About 10 big coal companies are expected to account for nearly 60% of all China's coal production by 2015. Even though coal's share will decrease from 70% in 2010 to 65% in 2015, it will continue to be China's largest energy source and a major contributor to its environmental problems (NDRC, 2012c).

China's three major state-owned oil companies dominate the economy's oil industry, and have been aggressively expanding. China has two vertically integrated firms: the China National Petroleum Corporation (CNPC) and the China Petroleum and Chemical Corporation (Sinopec). The third player is the China National Offshore Oil Corporation (CNOOC). CNPC is the leading upstream player in China and, along with its publicly-listed arm PetroChina, accounts for roughly 60% and 80% of China's total oil and gas output, respectively. Sinopec, on the other hand, has traditionally focused on downstream activities, such as refining and distribution. These sectors have made up nearly 80% of the company's revenues since 2008 and Sinopec is gradually seeking to acquire more upstream assets.

China has been seeking to increase the security of its oil supply by encouraging Chinese companies to become involved in upstream investment activities abroad in cooperation with international or local companies, and by speeding up the build-out of its strategic petroleum reserve (SPR) (Zhang and Wu, 2010). China has traditionally protected its own oil and gas companies by not allowing foreign oil companies to operate in China. However, international oil companies (IOCs) have been granted greater access to offshore oil prospects, mainly through production sharing agreements, and they have made some progress in the Bohai Bay area (CNPC, 2012).

China's oil product prices are regulated by the government. However, it tries to align with the international crude oil market. In December 2008, China launched a fuel tax and reforms of its product pricing mechanism. This was done to tie retail oil product prices more closely to international crude oil markets, to attract downstream investment, to ensure profit margins for refiners, and to reduce energy misallocation caused by distortions in the market pricing.

Similarly, China's natural gas prices are regulated and generally well below international market rates. China has favoured manufacturing and fertilizer gas users by the relatively lower price these sub-sectors pay. To bolster investment in the natural gas sector, particularly by foreign participants, and to make domestic gas competitive with other fuels, the National Development and Reform Commission (NDRC) proposed linking gas prices indirectly to international crude oil prices, effectively raising prices. Industry analysts claim these price modifications are necessary to develop the gas market further. In mid-2010, the NDRC raised the onshore wellhead prices by 25%, and some Chinese cities have raised end-user prices in the industrial and power sectors (EIA, 2012).

Another way China seeks to secure its energy supply is by speeding up its efforts in shale gas exploration. China will seek international cooperation in this area. It will: encourage investment in US companies to learn the technology for exploring for shale gas; provide financial policies and subsidies for shale gas exploration, including price subsidies, preferential tax treatment and land subsidies; and encourage joint-ventures between local and foreign companies to explore for shale gas (NDRC, 2012b).

The 12th Five-Year Plan for Energy Development also specifies targets for the future development of nuclear and hydropower. The power generation capacity of hydropower plants will increase 47% by 2015, based on 2009 capacity. The number of nuclear energy power plants will increase from 11 in 2009 to 25 by 2015 (SCC, 2013).

Following the 2011 Fukushima Nuclear Accident in Japan, China immediately suspended approval of all new nuclear power projects and undertook a comprehensive safety review of existing and under-construction nuclear facilities—these include nuclear power plants, research reactors and fuel-cycle facilities. The safety inspection took over 9 months and concluded that the operating reactors conform to both China's nuclear safety laws and regulations and International Atomic Energy Agency (IAEA) standards. At the same time, several areas for improvement were identified. The Nuclear Power Safety Plan (2011–20) and the Nuclear Power Mid- and Long-Term Plan (2011–20) were developed to address these issues. With the approval of these plans in October 2012 by the State Council, China officially lifted the suspension on new nuclear power plant approvals and at the same time introduced more stringent safety standards and regulations (NDRC, 2012). For example, until 2015, China will reconsider the relocation of nuclear power plant projects proposed for inland provinces to coastal provinces and will re-evaluate the proposed sites in areas that have experienced or are prone to earthquakes (Zeng Ming, et al., 2012). The legal system related to nuclear power will be improved to optimize the nuclear safety management, supervision and inspection systems. An emergency mechanism for nuclear accidents has also been established to enhance the economy's emergency response capability (SCIO, 2012).

China's electricity generation sector is dominated by five major state-owned holding companies. They generate about half of China's electricity. Much of the remainder is generated by independent power producers (IPPs), often in partnership with the privately-listed arms of the state-owned companies. Deregulation and other reforms have opened the electricity sector to foreign investment, although this has so far been limited.

In 2002, the State Electricity Regulatory Commission (SERC) was established, which is responsible for the overall regulation of the electricity sector and for improving investment and competition to alleviate power shortages. However, the wholesale and retail electricity prices are determined and capped by the NDRC. The NDRC used to be responsible for determining the annual plan price at which coal companies are obligated to sell large quantities of coal to power producers, but this annual plan price was abolished according to a recent policy issued by the State Council in 2012 (SCC, 2012a). Typically, generators negotiate directly with coal companies for long-term contracts. The NDRC has made small changes to its pricing system and, in 2009, it allowed electricity producers and wholesale end-users such as industrial consumers to negotiate with each other directly. The latest power tariff changes were from June 2010 when the government raised rates for energy-intensive industries by 50–100% to achieve energy efficiency goals for the year (EIA, 2012).

To strengthen coordination and decision-making in the energy sector, China established a high-level body—the National Energy Committee—to be in charge of coordinating China's energy strategy and deliberations on major issues in energy security. In March 2008, the National Energy Administration (NEA) was formed, under the NDRC. The NEA is responsible for developing and implementing energy industry planning, industrial policies and standards, and for administering the energy sector. This responsibility covers coal, oil, natural gas, and electric power including nuclear energy, and new and renewable sources of energy (NRDC, 2012a). In 2009, the National Energy Conservation Centre was formed within the NDRC to provide technical support for the government's energy efficiency and conservation management initiatives.

An amended version of the Renewable Energy Law was endorsed by the Standing Committee of the National People's Congress in December 2009 and came into effect on 1 April 2010. It more clearly defines the responsibilities of power grid and power generation enterprises, and it emphasizes the firm contracts for the purchase of power from renewable energy sources and the establishment of a development fund for renewable energy.

The government has established energy-efficient design standards for both residential buildings and public buildings, and a code for acceptance inspections of energy-efficient building construction. Since 2007, China has issued 46 economy-wide minimum energy performance standards (MEPS). The standards cover home appliances, industrial equipment, and business equipment. By the end of October 2011, China had an energy-efficiency labelling program covering 25 product classes. There is also a voluntary energy-efficiency endorsement label in China, to encourage more enterprises to reach a higher level in energy-efficiency. The government has also promoted high-efficiency illumination products and air conditioners, energy-efficient motors and other energy-efficient products through government subsidies (APERC, 2012).

The government has established its own preferential procurement system for energy-efficient products, released a government procurement list of energy-efficient products, and ordered the mandatory procurement of nine kinds of energy-efficient products, including air conditioners, computers and illumination products. By the end of 2010, the market share of high-efficiency illumination products had reached 67%, and that of high-efficiency air conditioners, 70% (APERC, 2012).

To promote energy conservation activities in the industry sector, the China Government encourages energy service companies (ESCOs) through financial and tax incentives. ESCOs provide a total energy-efficiency solution (finance, technology, operation, maintenance, etc.) for industrial energy users. They generally operate under energy performance contracts which compensate them with a share of the savings they produce for their customers. From 2005–2010, the number of energy service companies increased from 80 to over 800, the number of employees in this sector increased from 16 000 to 180 000, and energy service industry revenues grew from CNY 4.7 billion to CNY 84 billion (USD 740 million to USD 13.2 billion) (APERC, 2012).

In the transport sector, China published its Development Plan for Energy Saving and New Energy Automobile Industry (2012–2020) to introduce more environment-friendly vehicles into the domestic market. The plan will focus on electrically-driven vehicles (EVs and FCVs) and plug-in hybrid vehicles (PHVs) to enhance the competitiveness of the economy's automobile industry, to increase energy efficiency and to reduce carbon emissions. The production and sales of EVs, FCVs and PHVs are expected to total 500 000 units by 2015, and more than 5 million units—with a 2 million unit production capacity—by 2020. Subsidies and tax exemptions are provided for EVs, FCVs and PHVs (SCC, 2012b). China is considering the introduction of a carbon tax in the future, which could provide another incentive. More than 2000 charging stations with 400 000 quick chargers for EVs will be provided by 2015. The economy is harmonizing charging methods to promote electrically-driven vehicles. EVs, FCVs and PHVs will be introduced gradually into the domestic market for both energy conservation and environmental protection (IEEJ, 2012).

China began regulating passenger vehicle fuel consumption in 2004 with the issuance of the National Standard GB 19578-2004 Limits of Fuel Consumption for Passenger Cars (UN, 2011). The standards are based on 16 weight classes and put a limit on fuel consumption by weight. To strengthen vehicle efficiency efforts, a fuel consumption testing and management mechanism was introduced in March 2011. Under this mechanism, China published a list of vehicle models that satisfied the fuel consumption standards in 2011 (CAA, 2011).

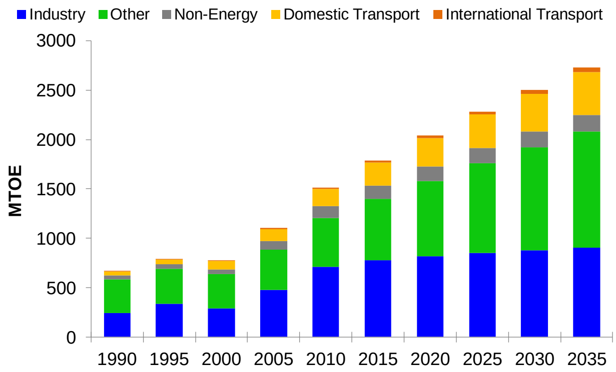
BUSINESS-AS-USUAL OUTLOOK

FINAL ENERGY DEMAND

Over the outlook period (2010–2035), China's final energy demand is projected to grow 2.3% per year, which is a little slower than the average annual growth rate of 4.1% between 1990 and 2009.

The 'other' sector will be the biggest energy user by 2035, with a 43% share of final energy demand, followed by the industry sector (33%) and domestic transport (16%). However, the domestic transport sector has the highest average annual growth rate at 3.7%, followed by the 'other' sector at 3.5% and the industry sector at 0.9%.

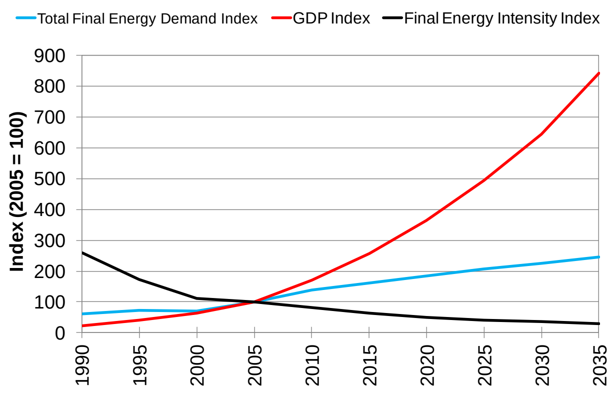
Figure PRC2: BAU Final Energy Demand



Source: APERC Analysis (2012)
Historical Data: *World Energy Statistics 2011* © OECD/IEA 2011

Final energy intensity is expected to decline by about 71% between 2005 and 2035.

Figure PRC3: BAU Final Energy Intensity



Source: APERC Analysis (2012)

Industry

China's industry sector energy demand is projected to grow at an average annual rate of 0.9% during the outlook period. This is significantly slower than its average annual growth rate of 5.6% between 1990 and 2009.

During the outlook period, coal will still be the major source of energy in China's industry sector, although the share of other energy sources such as electricity and gas will increase. Coal's share of total industry energy demand is expected to decline to 46% by 2035, down from 59% in 2009. It is expected electricity will follow coal as the industry sector's most important energy source by 2035, accounting for 34% of China's industry energy demand. Industrial demand for gas is projected to grow very fast, at an average annual rate of 4.9% over the outlook period, but it will still account for only 6% of industry energy demand in 2035.

Within the industry sector, energy use is dominated by the iron and steel industry (25% of all industrial energy used by 2035), followed by the non-metallic minerals industry including cement (17%) and the chemical and petrochemical industry (16%). The projections also show the machinery industry will have the highest growth rate, followed by the pulp, paper and printing industry. Growth in industrial demand is limited by the overall shift from energy-intensive industries to high-value-added industries and by a bigger contribution from the service industry.

Transport

Chinese domestic transport energy demand is expected to grow 3.7% annually over the outlook period. Domestic aviation is projected to grow the fastest with an annual growth rate of 5.8% during the outlook period, followed by domestic shipping at 4.3%, and road transport at 3.6%. Road transport will still use 75% of the transport energy in 2035, due to an increase in the number of private vehicles and the need to transport domestic goods by heavy road vehicles. Light vehicles and heavy vehicles will each use about half of the energy consumed in road transport. Projections to 2035 show the number of light vehicles will grow to about four times the number of light vehicles in 2009, at an average annual growth rate of 5.6%. Vehicle ownership in the economy will begin to approach saturation level around 2020, so the growth in ownership will slow after 2020.

China will continue its efforts to reduce energy consumption in the domestic transport sector, such as promoting clean-energy vehicles, fuel efficiency standards and fuel-efficiency labeling, mass transport systems in urban areas, and high-speed railways for inter-city transportation.

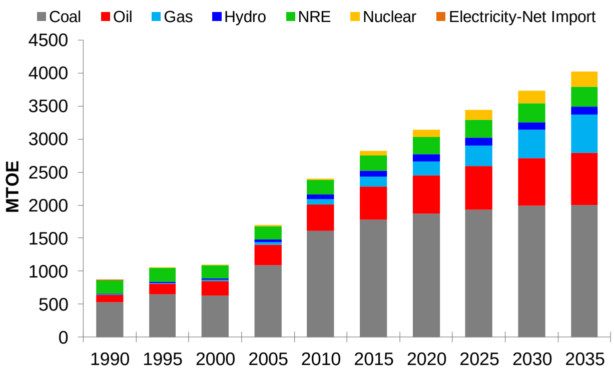
Other

Energy demand in the 'other' sector, which includes residential, commercial, and agricultural demand, is primarily driven by income growth, the improvement in living standards and the expansion of the service industry. China's 'other' sector energy demand is expected to grow at an average annual rate of 3.5% over the outlook period (2010–2035). Electricity is expected to continue to dominate the energy mix, accounting for 37% of 'other' sector energy consumption by 2035, followed by new renewable energy (NRE) at 19% and natural gas at 18%. Energy-efficiency improvements in the building sector (including appliances) are a major force slowing down energy demand growth in the 'other' sector.

PRIMARY ENERGY SUPPLY

China's total primary energy supply is projected to grow at an average annual rate of 2.1% over the outlook period. This is slower than the average annual growth rate of 5.2% from 1990–2009. This is mainly due to a projected slowdown in the GDP growth rate and efforts to improve energy efficiency.

Figure PRC4: BAU Primary Energy Supply

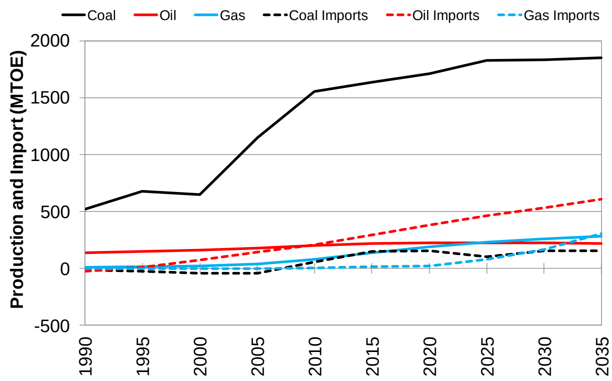


Source: APERC Analysis (2012)
Historical Data: *World Energy Statistics 2011* © OECD/IEA 2011

Among the fossil fuels, natural gas will grow the fastest (8% per year), followed by oil (2.7%) and coal (0.9%). Hydro and nuclear energy are expected to play a key role in reducing China's CO_2 emissions. Projected annual growth rates are 2.3% for hydro and 10% for nuclear over the outlook period, while new renewable energy has a projected annual growth rate of about 1.4%.

If the exploration for shale gas is successful and major progress is made in the future, the share of gas in the primary energy mix will grow faster than the BAU case projection.

Figure PRC5: BAU Energy Production and Net Imports

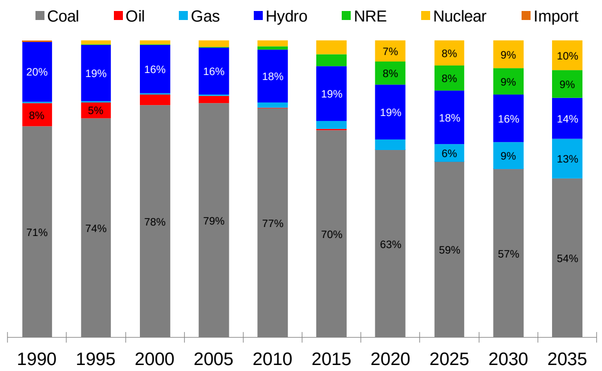


Source: APERC Analysis (2012)
Historical Data: *World Energy Statistics 2011* © OECD/IEA 2011

ELECTRICITY

Electricity generation in China will increase by 3.3% per year over the outlook period. Non-fossil energy (such as NRE, nuclear, and hydro) will gradually increase its share in the fuel mix for power generation from 21% in 2009 to 33% by 2035.

Figure PRC6: BAU Electricity Generation Mix



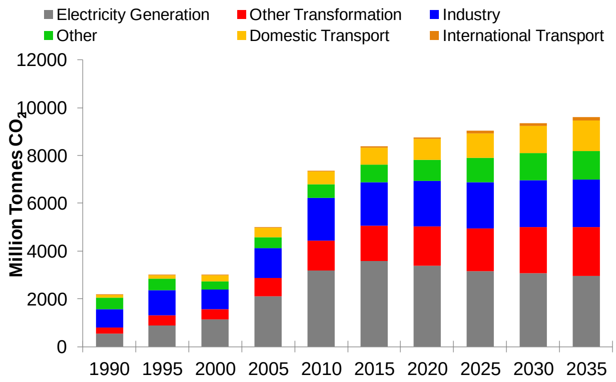
Source: APERC Analysis (2012)
Historical Data: *World Energy Statistics 2011* © OECD/IEA 2011

Throughout the outlook period, coal will maintain its dominant share in the electricity generation mix. It is projected to provide around 54% of generation by 2035, down from 77% in 2010. Generation based on natural gas will provide about 13% of the total generation mix by 2035. In coastal areas, gas-fired generation will replace coal-fired generation, as a result of reforms aimed at reducing carbon emissions and air pollution.

CO_2 EMISSIONS

Over the outlook period, China's total CO_2 emissions are projected to increase from 6870 million tonnes of CO_2 in 2009 to 11 288 million tonnes by 2035. Of the 2035 emissions, 39% will come from the electricity generation sector (about 4145 million tonnes) and 18% from industry (1994 million tonnes).

Figure PRC7: BAU CO_2 Emissions by Sector



Source: APERC Analysis (2012)

The decomposition analysis in Table PRC1 shows that the growth in China's GDP is largely decoupled from energy consumption and CO_2 emissions. Growth in GDP is largely offset by the declining energy intensity of GDP (due mainly to increasing energy efficiency and a shift away from energy-intensive industry) and the declining carbon intensity (due mainly to a declining share of coal in the energy mix).

Table PRC1: Analysis of Reasons for Change in BAU CO_2 Emissions from Fuel Combustion

(Average Annual Percent Change)

	1990-2005	2005-2010	2005-2030	2005-2035	2010-2035
Change in CO_2 Intensity of Energy	1.1%	2.0%	-0.3%	-0.3%	-0.8%
Change in Energy Intensity of GDP	-5.1%	-4.8%	-4.5%	-4.5%	-4.4%
Change in GDP	10.2%	11.2%	7.7%	7.4%	6.6%
Total Change	5.7%	8.0%	2.5%	2.2%	1.1%

Source: APERC Analysis (2012)

CHALLENGES AND IMPLICATIONS OF BAU

China has significant energy resources, particularly coal, oil and hydro. The shale gas potential may play an important role in the future. However, the development of these energy sources is unlikely to meet the economy's growing demand for energy. In particular, net import dependency on oil is projected to increase from 57% in 2009 to 78% by 2035. The economy's growing import dependency, combined with depleting domestic resources, raise concerns about China's energy supply security. Even without significant supply shocks, such a high dependency on imported oil may impede China's economic growth due to the instability of energy prices.

China's new 12th Five-Year Plan and policy initiatives to promote energy efficiency are expected to reduce the economy's energy intensity significantly. However, China's continued economic growth, projected increases in living standards, and high reliance on coal, mean its greenhouse gas emissions are still expected to climb significantly.

Since China is likely to be the world's largest energy consumer in 2035, it will need to be a key player in worldwide efforts to reduce greenhouse gas emissions.

ALTERNATIVE SCENARIOS

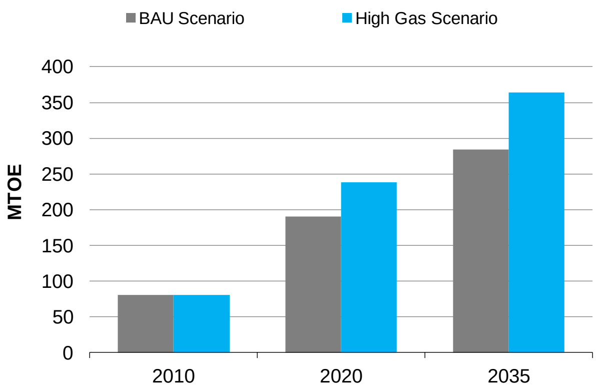
To address the energy security, economic development, and environmental sustainability challenges posed by the business-as-usual (BAU) outcomes, three sets of alternative scenarios were developed for most APEC economies.

HIGH GAS SCENARIO

To understand the impacts higher gas production might have on the energy sector, an alternative 'High Gas Scenario' was developed. The assumptions behind this scenario are discussed in more detail in Volume 1, Chapter 12. The scenario was built around estimates of gas production that might be available at BAU prices or below, if constraints on gas production and trade could be reduced.

The extra gas production for China in the High Gas Scenario comes mainly from the economy's development of its shale gas resources. China is one of the APEC economies possessing a major resource potential for shale gas. However, the development of shale gas in China will pose major technical and policy challenges. In this High Gas Scenario, we assumed China can overcome these challenges. Figure PRC8 shows an increase in gas production of 28% by 2035, compared with the BAU case.

Figure PRC8: High Gas Scenario – Gas Production

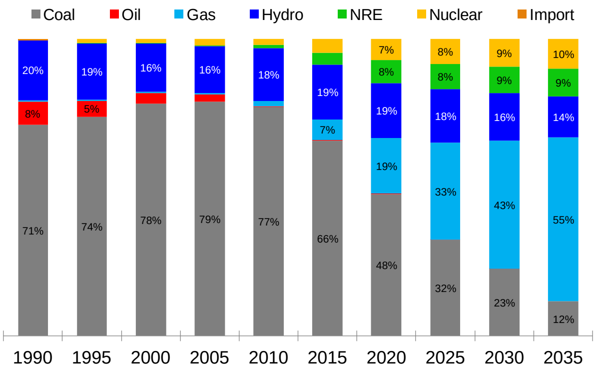


Source: APERC Analysis (2012)

Additional gas consumption in China in the High Gas Scenario will depend on the extra production of shale gas, as well as the LNG and pipeline natural gas imported from other economies. We also assumed all the additional gas would be used to replace coal in electricity generation. The electricity sector relied heavily on coal-fired power plants in the BAU case, so the sector has plenty of opportunity to replace coal by gas.

Figure PRC9 shows the fuel mix for power generation in this High Gas Scenario. This figure may be compared to Figure PRC6 above. The projection shows the share of gas in electricity generation in 2035 has increased by 42%, from 13% in BAU to 55% in the High Gas Scenario. At the same time, coal share has declined by the same amount to 12%.

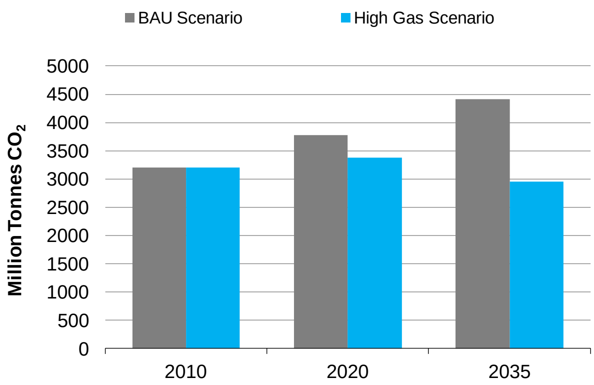
Figure PRC9: High Gas Scenario – Electricity Generation Mix



Source: APERC Analysis (2012)
Historical Data: *World Energy Statistics 2011* © OECD/IEA 2011

Since gas has roughly half the CO_2 emissions of coal per unit of electricity generated, this had the impact of reducing CO_2 emissions in electricity generation by 33% in 2035. Figure PRC10 shows this CO_2 emissions reduction.

Figure PRC10: High Gas Scenario – CO_2 Emissions from Electricity Generation



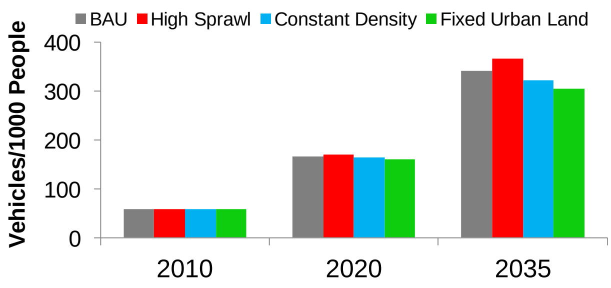
Source: APERC Analysis (2012)

ALTERNATIVE URBAN DEVELOPMENT SCENARIOS

To understand the impact of future urban development on the energy sector, three alternative urban development scenarios were developed: 'High Sprawl', 'Constant Density', and 'Fixed Urban Land'. The assumptions behind these scenarios are discussed in Volume 1, Chapter 5.

Figure PRC11 shows the change in vehicle ownership under BAU and the three alternative urban development scenarios. The difference between the cases is significant. By 2035, vehicle ownership would be about 7% higher in the High Sprawl scenario, compared with the BAU scenario, and about 6% and 11% lower in the Constant Density and Fixed Urban Land scenarios respectively. Given that China is still under a period of fast development, vehicle ownership has a lot of room to increase. This is especially true if sprawling development patterns make it difficult for people to live without a car. The model results suggest that better urban planning could significantly reduce the need for people to own vehicles.

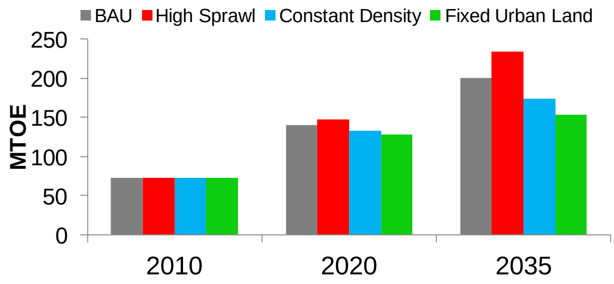
Figure PRC11: Urban Development Scenarios – Vehicle Ownership



Source: APERC Analysis (2012)

Figure PRC12 shows the change in light vehicle oil consumption under BAU and the three alternative urban development scenarios. The impact of better urban planning on light vehicle oil consumption is even more pronounced than on vehicle ownership—more compact cities reduce both the need for vehicles and the distances they must travel. In 2035, light vehicle oil consumption would be 17% higher in the High Sprawl scenario, compared with the BAU scenario, and about 13% and 24% lower in the Constant Density and Fixed Urban Land scenarios respectively.

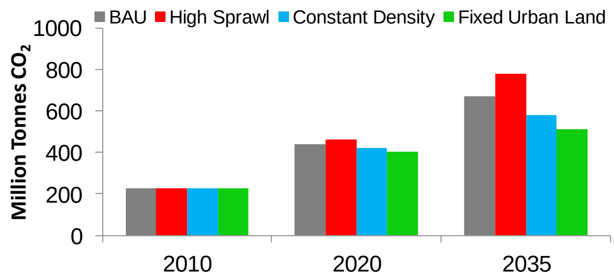
Figure PRC12: Urban Development Scenarios – Light Vehicle Oil Consumption



Source: APERC Analysis (2012)

Figure PRC13 shows the change in light vehicle CO_2 emissions under BAU and the three alternative urban development scenarios. The impact of urban planning on CO_2 emissions is similar to the impact of urban planning on energy use, since there is no significant change in the mix of fuels used under any of these cases. In 2035, light vehicle CO_2 emissions would be 17% higher in the High Sprawl scenario, compared with the BAU scenario, and about 13% and 24% lower in the Constant Density and Fixed Urban Land scenarios respectively.

Figure PRC13: Urban Development Scenarios – Light Vehicle Tank-to-Wheel CO_2 Emissions



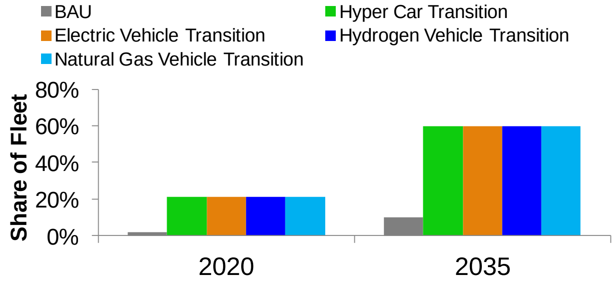
Source: APERC Analysis (2012)

VIRTUAL CLEAN CAR RACE

To understand the impact of vehicle technology on the energy sector, four alternative vehicle scenarios were developed: 'Hyper Car Transition' (ultra-light conventionally-powered vehicles), 'Electric Vehicle Transition', 'Hydrogen Vehicle Transition', and 'Natural Gas Vehicle Transition'. The assumptions behind these scenarios are discussed in Volume 1, Chapter 5.

Figure PRC14 shows the evolution of the vehicle fleet under BAU and the four 'Virtual Clean Car Race' scenarios. By 2035 the share of the alternative vehicles in the fleet reaches around 60% compared to about 10% in the BAU scenario. The share of conventional vehicles in the fleet is thus only about 40%, compared to about 90% in the BAU scenario.

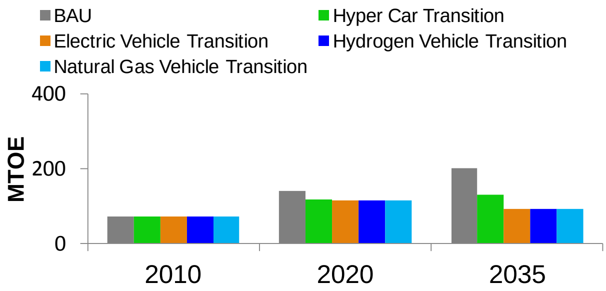
Figure PRC14: Virtual Clean Car Race – Share of Alternative Vehicles in the Light Vehicle Fleet



Source: APERC Analysis (2012)

Figure PRC15 shows the change in light vehicle oil consumption under BAU and the four alternative vehicle scenarios. Oil consumption drops by 54% in the Electric Vehicle Transition, Hydrogen Vehicle Transition, and Natural Gas Vehicle Transition scenarios compared to BAU by 2035. The drop is large as these alternative vehicles use no oil. Oil demand in the Hyper Car Transition scenario is also significantly reduced compared to BAU—down 36% by 2035—even though these highly-efficient vehicles still use oil.

Figure PRC15: Virtual Clean Car Race – Light Vehicle Oil Consumption



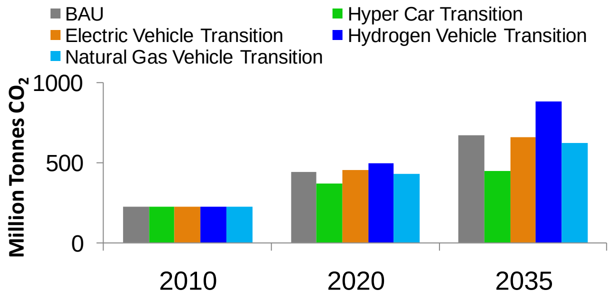
Source: APERC Analysis (2012)

Figure PRC16 shows the change in light vehicle CO_2 emissions under BAU and the four alternative vehicle scenarios. To allow for consistent comparisons, in the Electric Vehicle Transition and Hydrogen Vehicle Transition scenarios the change in CO_2 emissions is defined as the change in emissions from electricity and hydrogen generation. The emissions impacts of each scenario may differ significantly from their oil consumption impacts, since each alternative vehicle type uses a different fuel with a different level of emissions per unit of energy.

In China, the Hyper Car Transition scenario is the clear winner in terms of CO_2 emissions reductions, with an emissions reduction of 33% compared with BAU in 2035. The Electric Vehicle Transition scenario offers an emissions reduction of about 2% and the Natural Gas Vehicle Transition scenario a reduction of about 7% compared with BAU in 2035. The limited reduction in the Electric Vehicle Transition scenario is principally because the marginal source for the added electricity demand is mainly coal, which is more carbon-intensive than oil. However, if introduction of electric vehicles were combined with a re-structuring of the fuel mix for the power sector, China could achieve a bigger emissions reduction.

The result for the Hydrogen Vehicle Transition scenario shows an increase of CO_2 emissions of 31% by 2035. This is mainly due to the way hydrogen is produced—from steam methane reforming of gas, a process which involves significant CO_2 emissions. However, the results would be more favourable if the hydrogen could be produced from a renewable or low-carbon energy source.

Figure PRC16: Virtual Clean Car Race – Light Vehicle CO_2 Emissions



Source: APERC Analysis (2012)

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