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China's Coal Market:

Can Beijing Tame 'King Coal'?

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About the author

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Contents

Structure of the report

This report analyzes the radical transformation of the Chinese coal sector, driven by market trends and policy developments. Its objective is to assess the impact of key changes in China's coal demand, supply, and logistics on China's coal imports and more generally on China's coal trade policy.

The first chapter is an introduction explaining the key role of China on the international steam coal market, while chapter 2 sums up the main orientation of the new energy policy. The next two chapters are devoted to coal demand. Chapter 3 reviews the main drivers leading to a reduction in coal demand, mainly in East China, while chapter 4 assesses the factors that still drive a rise in coal demand and includes a section (Section 4.5) summarizing both trends and highlighting key areas of uncertainty. Chapter 5 analyzes major trends in the coal mining sector, its ongoing restructuring, efforts to resolve the current oversupply, and future trends. Chapter 6 looks at investment in coal ports and new coal-dedicated railway capacity, chapter 7 reviews the evolution of Chinese coal prices and pricing, while chapter 8 provides an assessment of coal imports and coal trade policy in the short and medium/long term. Some concluding remarks are then given in chapter 9.

Executive summary

Chinese coal imports have grown at a dramatic rate since 2009, when the country became a net importer. In 2011, China became the world's largest coal importer, outpacing Japan, while in 2013 China imported 327 million tons (Mt) of steam and coking coal and accounted for about a quarter of global steam coal imports. This reliance on international trade mainly stemmed from logistical constraints and commercial considerations. At the end of the last decade, the rapid growth in coal demand led to recurrent shortages, aggravated by transportation bottlenecks, which in turn led consumers in southeast coastal regions to turn to imports to secure their coal supply. Above all, however, Chinese coal imports have been driven by coal price arbitrage between domestic and international coal prices. As the world's largest coal producer, China has become the 'swing *buyer' of the coal market,* buying on the international market when international prices are lower than domestic prices and largely relying on domestic coal when imports are unattractive. China's domestic steam coal prices therefore set a price cap for international steam coal prices. For almost all of the past four years, imported coal has been cheaper than domestic supplies, burdened by high transportation costs and heavy taxes. Imports of all types of coal surged, but particularly lignite (low-calorific value coal) sold at a discount on other types of coal.

Given its dual role as the largest importer and the 'swing buyer', China has a considerable power on the international steam coal trade and a change in Beijing's energy and climate policy is set to create waves in the global coal market. A review of the coal supply chain and market trends in China shows that Beijing is working towards eliminating all logistical constraints that led to the surge in coal imports. Short, medium- and long-term market and policy developments, however, have different impacts on international steam coal trade.

Short-term: the key priority is to resolve the domestic oversupply issue

China's coal industry has been in crisis since 2012, with demand growth significantly weakened by the economic slowdown, the fight against air pollution, and the increasingly large role being played by clean energy sources. In fact, coal demand decreased in the first three quarters of 2014, its first decline since 1998. Growing imports and the expansion of coal production has turned the domestic market from tightness to oversupply and exerted downward pressure on domestic coal prices. Fierce competition has developed between foreign and domestic suppliers, leading to a downward spiral of coal prices. After a 16 per cent drop in 2012/2013, domestic steam coal prices at Qinhuangdao, the largest port in China, fell a further 16 per cent in the first half of 2014, reaching a six-year low. Weak prices have a detrimental effect on Chinese miners: in the first half of 2014, over 70 per cent of China's coal companies were reported to be making losses and more than half of them to be having difficulties in paying worker wages. This led the government to intervene to resolve the oversupply situation.

The government has implemented a series of measures on production, trade, taxes, and regulation aimed at stabilizing the coal industry. Key producing regions have been instructed to reduce their production and large mining groups are cutting their output of the second half of 2014. Shenhua Energy Group, China's largest coal mining company, has announced its intention to cut production by 50 Mt or about 10 per cent of its original target for 2014. Other large mining groups, such as China Coal Group and Datong Coal Mine Group, have followed suit. The announced reductions, added to the closure of small mines, mean a significant reduction in coal output, exceeding 200 Mt from original targets for 2014, although this remains modest considering that China produced 3.7 billion tons (Gt) in 2013. Nevertheless, 2014 is expected to be marked by the first reduction in China's coal production since 1998. Solving the overcapacity issue, however, requires strict discipline among producers.

Furthermore, leading power groups have to reduce their coal imports in the last four months of 2014. The sudden reduction in Chinese imports, estimated at 50 Mt for 2014, comes at a time when the international coal market is still oversupplied despite cuts in production in several exporting countries.

Coal exporters to China have difficulties in finding another buyer. This further depresses international steam coal prices, although prices are so low that they cannot fall much further.

In addition, since 15 October 2014, China has reintroduced a duty on coal imports, which makes domestic coal cheaper than international supplies. Furthermore, the ban on the production, imports, and sales of low-quality coal with high sulfur and high ash contents, under discussion since early 2013, will become effective on 1 January 2015. It is expected to have limited impact on international markets although interpretation of the regulation is not yet fully clear. For coal suppliers to China, these sudden changes highlight increasing uncertainty and risks.

On the Chinese market, in contrast, domestic prices are rising, but the increase will be limited as long as the overcapacity is not eliminated. With inventories of around 300 Mt across the country, China's supply needs to fall 7-8 per cent to restore market balance. The instruction given to major Chinese producers to cut their production should speed up the process.

Medium/long-term: a major restructuring and transformation of the coal sector

Beyond the short-term reshuffle, China's coal sector is in the midst of a radical transformation that will have far-reaching implications for the international coal trade. The ongoing restructuring and consolidation of the mining sector, structural changes in energy and coal markets, and massive investments in transportation and trading, all have the potential to change how coal is produced, traded, and consumed in China.

Re-orientation of the energy policy

The serious aggravation of local pollution and persistent smog in major cities since the beginning of 2013 have contributed to reinforce environmental policies aimed at fighting local pollution and one of its major causes: coal burning. Since the middle of 2013, the central government has introduced new measures and initiatives to re-orient the nation's energy policy. The priority is to reduce the contribution of coal in the energy mix and combat air pollution and climate change. Alongside the overriding objective of guaranteeing secure energy supply, the new energy strategy aims at reforming energy production and consumption patterns, restructuring the energy mix towards cleaner energy sources, driving energy sector reforms, diversifying power sector energy sources, and cutting emissions from coal plants.

Coal demand to peak, move westwards, and be increasingly used in the power sector

The slowdown in economic activity and the rebalancing of the economy towards a more balanced and sustainable growth path have already moderated the increase in energy and coal consumption. While coal consumption has grown so far in absolute terms, this growth has decelerated significantly and even stopped in 2014. The new energy development strategic action plan (2014-2020), issued by the State Council in November 2014, caps coal consumption at 4.2 Gt by 2020 and the share of coal in the energy mix at 62 per cent. The cap in coal consumption is needed to achieve the recent pledge by China to peak CO_2 emissions around 2030, with the intention to try to peak earlier.

The Chinese government has adopted a series of new policy measures that led to an eventual peak in coal demand. These include efforts to combat air pollution, the acceleration of the development of clean energy sources, the implementation of pilot carbon trading schemes, and the reform of the coal resource tax. In September 2013, the State Council released a plan to curb air pollution mainly by capping coal consumption in the most polluted eastern regions, accelerating the development of low- or non-carbon energy sources, raising energy efficiency standards in key industrial sectors, and limiting the number of vehicles. The plan introduces stricter emission performance standards for coal-fired power plants and moves to eliminate use of small-scale coal boilers. Six provinces have pledged to reduce their coal consumption by increasing their power imports from other regions, natural gas supply, and the use of non-fossil fuels. The number of provinces capping their coal use is growing alongside rapidly rising public concern about air quality, extension of stringent air pollution reduction targets to more provinces, and as enforcement rules are becoming stricter. Total coal consumption now covered by strict air pollution regulation amounts to half of total coal consumption, mainly in East China.

Coal will also see a significant reduction in its share of the national energy and electricity mix following the acceleration of the development of non- or low-carbon energy sources. China is the world's leading investor in clean energy and also in the building of nuclear power plants. The country is also accelerating the development of its gas supplies with the signing of mega contracts with neighboring countries such as Russia and global LNG suppliers, and by further developing its domestic supplies, including shale gas, coal bed methane, and SNG (synthetic natural gas).

However, coal will continue to play a dominant role in the energy mix for many years, despite its decreasing contribution in the energy and electricity mix. Industrialization in Western China and urbanization of the country still require large amounts of energy and electricity, spurring China's overall energy demand, although total energy demand is controlled at 4.8 billion tons coal equivalent by 2020. Moreover, two developments will increase coal use in Western China.

Nine large-scale coal-power bases are being developed, alongside major transmission power lines to deliver electricity to the east. The government expects that the efficient development and the centralized management in the coal-power bases will reduce pollution and emissions and bring down the total environmental cost for the whole country. To reconcile the use of coal and environmental issues, China promotes the use of advanced clean coal technologies and stricter environmental admittance criteria for coal-fired power plants.

China is also building advanced coal conversion plants (coal-to-gas, or CTG; coal-to-chemicals, or CTC; and coal-to-liquids, or CTL) which are a source of potentially large demand growth. Most of the projects are located in northwest water-scarce regions (Inner Mongolia in particular), which has stirred great controversy about the water and carbon footprint of these projects. Following numerous projects announced at local level, the central government is to control the development of this new industry and has imposed stricter environmental conditions on the projects. Furthermore, the government has given priority to the use of coal by the power sector, making the removal of air pollutants easier.

Coal production moves westwards and becomes more efficient and sustainable

China's coal mining industry is still developing, but the development model is changing, with the sector being restructured into large-scale production bases dominated by major state-owned energy groups. Fourteen large modern coal bases are being built, integrating the in-situ conversion of coal into lucrative value-added products: electricity, SNG, CTL and CTC. Production is increased in northwestern regions while it is restricted in other regions. The development of Xinjiang coal resources, in particular, is the focus of future expansion. The Autonomous Region holds 40 per cent of China's coal resources, is also well-endowed with other energy sources, and intends to become a strategic energy base for the rest of the country. At the same time, China continues to close thousands of small, unsafe, or unprofitable coal mines. Production is also more concentrated, as integration between coal mining groups, as well as between coal and power, is promoted to create large-scale global energy groups, such as Shenhua Energy Group, with strong management, financial, and technological capabilities.

This development prepares the foundation of a modern coal industry based on advanced clean coal technologies for both production and use of coal; a prerequisite to the sustainable development of the sector. In this scenario, sustainable criteria are the limiting factor to the growth of coal production and more generally to the development of the sector. In particular, some sectors in the coal industry are highly water intensive, and water shortages are a major barrier to further development.

Transportation bottlenecks to ease

While transportation bottlenecks have been a major driver of coal imports, rail tension is easing gradually, with the opening of major rail projects that link mines in Inner Mongolia and Shanxi to ports in the northeastern Bohai Bay – where capacity is also expanding. As most of these projects are to be completed in 2014/2015, imported coal will soon face fiercer market competition from domestic suppliers. Moreover, China is expected to see a fundamental change in the rail transportation of coal in the future, as new coal-dedicated railways built from north to south and west to east will allow coal to be brought in from more remote provinces, such as Xinjiang.

The decision to build 12 new ultra high voltage (UHV) power lines from west to east is also a key strategic component of the future development of coal and renewables. The power lines will enable the transition from a system based on fossil fuels with clean energy as a supplement to a clean-energy system with fossil energy as backup. As the transmission channels will transport power and not fossil fuels, they will ultimately allow different energy sources to compete on costs, carbon emissions, and dispatchability. Price signals would then determine technology winners.

Coal prices: the fall is over

The decline in coal prices in China has allowed the central government to push forward key reforms in the coal sector, such as the liberalization of the price of coal sold to power companies and the further restructuring of the mining sector. However, the fall has reached a point where it creates concerns about the viability of the sector and economic growth and stability in some mining regions. As such low coal prices do not fit with the environmental policy of the new leadership, nor the need to invest in clean energy sources (including clean coal), we can expect current efforts to stabilize the market to continue. The objective of the new policy is to reach parity between coal and wind prices in the power sector by 2020, which will require massive development of wind to decrease costs or an increase in coal prices. Reform of the coal resource tax and the implementation of a national carbon trading scheme will reduce the price gap between coal and new energy sources.

Coal imports will decrease, but not vanish

Coal imports will be reduced as coal consumption in the main importing coastal regions is expected to weaken, but they will not vanish as the government encourages the import of high-quality coal. As long as foreign coal meets the new quality standards, and as soon as the domestic market rebalances, the arbitrage between domestic and international prices will again play a key determining role. Furthermore, Chinese companies are encouraged to invest in mines overseas to secure coal supplies. After a pause in China’s investment abroad, the low price of coal has allowed Chinese companies to restart their buying spree in overseas coal mines. Large coal mine development projects are planned in a growing number of coal-producing countries, such as Australia and Indonesia. Major coal contracts signed recently with Mongolia and Russia indicate the increasing role of neighboring countries in China’s future coal supply.

Concluding remarks

Another key change is at work: increasing Chinese exports. The government is expected to adapt its export policy in a timely manner with domestic and international market circumstances. Considering the dramatic changes that take place on the domestic market, China may again become an important exporter in the Pacific Basin, not only selling its surplus production, but also as a global trading player from its portfolio of overseas mines.

These moves signal a more market-based approach to coal trading in China, with an optimization of resources taking into account not only domestic coal but also overseas resources (‘the two markets, two resources’ concept). If China’s coal demand peaks sooner than expected – from the viewpoint of China’s producers and foreign coal exporters – ASEAN coal demand still registers a strong growth, offering an opportunity for China's major mining groups to expand their presence overseas and increase their source of revenues. Current massive investment in coal-dedicated railways, expansion of port capacity, improvements in mine productivity, development of coal trading platforms, trading exchanges, and the launch of the first swap contracts priced in renminbi, may well serve this vision.

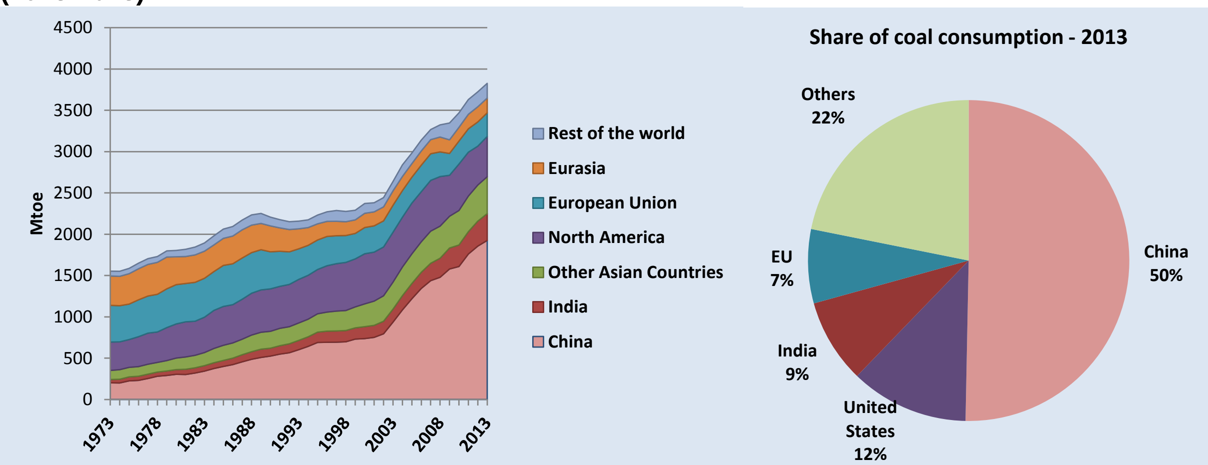
1. Introduction: the key role of China in the international coal market

China's energy market is now in the midst of a radical transformation that will have ramifications across global energy markets. The transformation objective is such that President Xi Jinping called it an energy revolution in the way China consumes and produces energy[1]. In the coal sector, by far the largest energy sector in China, the restructuring and transformation of the coal market has the potential to change how coal is produced, traded, and consumed in China and has major ramifications for the rest of the world, ranging from coal prices, investment decisions on new coal mines in coal-exporting countries, to the price of natural gas and market size for international natural gas trade – not to mention the global climate.

1.1. China accounts for half of global coal demand

Global coal demand has surged in the past 13 years and reached 3,827 million tons oil equivalent (Mtoe) in 2013[2]. Despite rising concerns on its environmental impact, the share of coal has remained almost constant in the past four decades at 30 per cent of global primary energy supply. Coal demand is dominated by a small number of countries/regions, although there are around 100 coal-consuming countries in the world. The four largest consumers (China, the United States, India, and the EU) represented 78 per cent of total coal consumption in 2013, while China alone accounted for half of global coal demand. China's coal consumption has almost tripled in the past decade and reached 1,925 Mtoe in 2013.

Figure 1: Evolution of global coal consumption by major coal-consuming countries/regions (1973-2013)



Source: BP, 2014

1.2. China has driven global coal growth

China has been the driver of global coal growth, accounting for 84 per cent of the growth in world coal consumption since 2000. In the past decade, China's energy policy had been supply-oriented and focused on ensuring energy supply to support economic development. China's energy consumption increased by an average annual growth rate of 8.6 per cent, rising from 980 Mtoe in 2000 to 2,340 Mtoe in 2010, underpinning the growth of the national economy. The country became the world's largest energy consumer in 2010, overtaking the United States, and is also the world's biggest

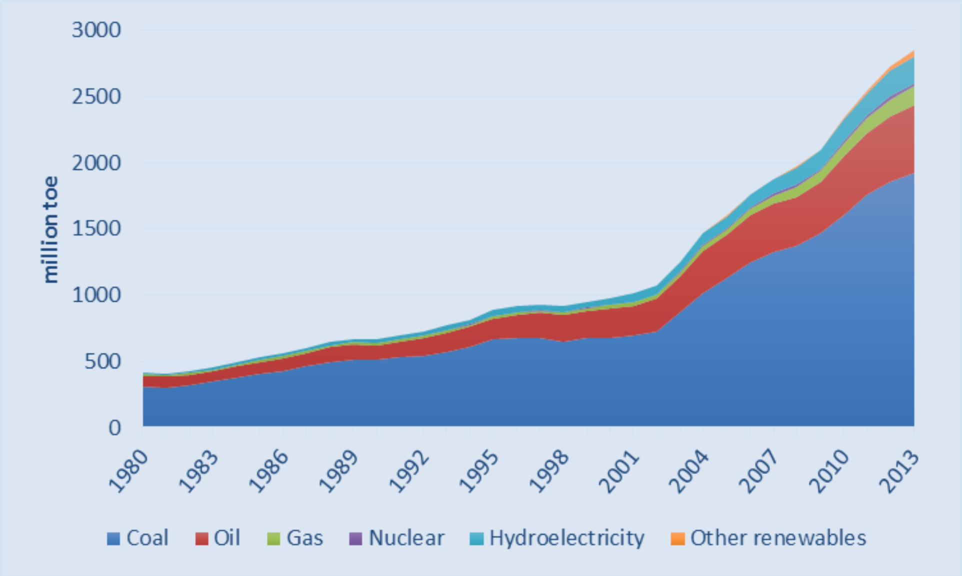
[1] Xinhuanet, Xi stresses efforts to revolutionize energy sector, 13 June 2014 http://news.xinhuanet.com/english/china/2014-06/13/c_133405882.htm

[2] BP (2014), Statistical Review of World Energy, June 2014

CO_2 emitter. Given China's limited oil and gas reserves[3] and abundant coal resources, coal has understandably become the backbone of China's growing economy. Coal has accounted for 70-80 per cent of total primary energy supply in the past three decades, with oil the second-largest source with a share of about 20 per cent. Continued access to vast amounts of cheap, indigenous coal and increasing supplies of imported oil have been decisive factors in the success of China's industrialization and urbanization policies[4].

There has been a marked slowdown in energy consumption growth in the past two years: energy demand increased by 3.9 per cent in 2012 and 3.7 per cent in 2013, in line with the slowdown of economic activity and increasing energy efficiency. In 2013, coal consumption reached 3.7 Gt and accounted for 65.7 per cent of total primary energy consumption (TPES)[5], while oil, with 18 per cent of TPES, was the second-largest primary energy source. Despite their strong expansion over the past three years, wind and solar accounted for only 2 per cent of the energy mix.

Figure 2: Evolution of China's energy consumption (1980-2013)



Source: BP, 2014

1.3. China has become the world's largest coal importer

China, which was still a net coal exporter in 2008, has become a net importer since 2009 and by a large margin. Its imports surged from 41 Mt in 2008 to 127 Mt in 2009. Despite abundant domestic coal resources, several factors contributed to the sudden rise in imports, including the higher cost of domestic coal relative to international prices, bottlenecks in transporting domestic coal, coking coal resource restraints, and environmental and safety concerns. China's imports continued to increase at a spectacular growth rate from 2010 to 2012, growing some 30 per cent each year. In 2011, China overtook Japan and became the world's largest coal importer with imports reaching 327 Mt in 2013 – up some 13.2 per cent from 2012, of which 235 Mt were steam coal[6] (see Annex 1 for a definition of the different types of coal). This relatively low growth, linked with the economic slowdown and

[3] Conventional gas reserves are limited. The inclusion of unconventional gas gives a different picture as China holds the world's largest shale gas resources, though development is still in its infancy. The government expected shale gas production to reach 6.5 bcm by 2015 and 60-100 bcm by 2020. However, shale gas development still faces many challenges and the target for 2020 has been revised to 30 bcm.

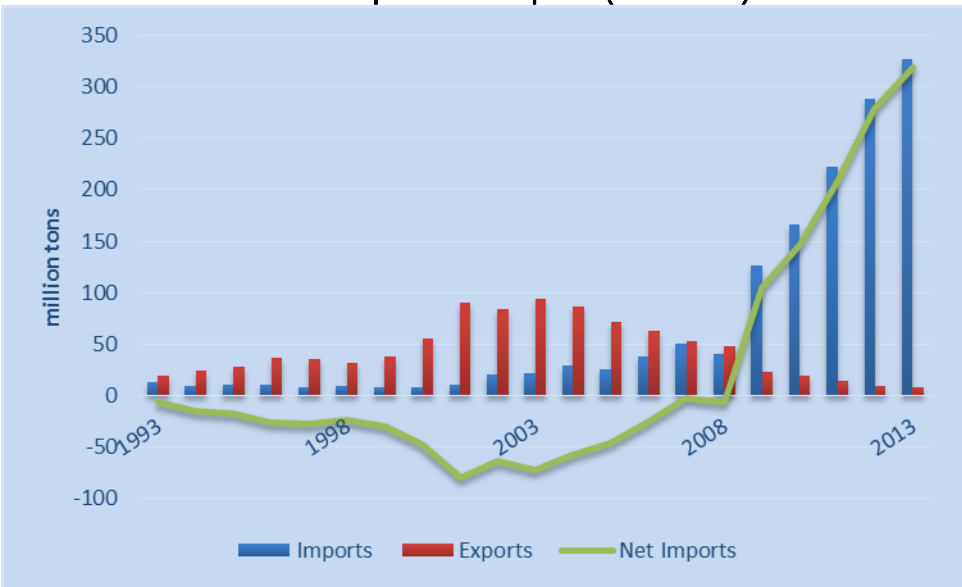
[4] National Energy Administration, 2013

[5] NEA, 2014

[6] China Customs data, 2014

overcapacity in the Chinese coal market, has triggered fears in major coal-exporting countries that China could reverse its position and withdraw from the international coal market.

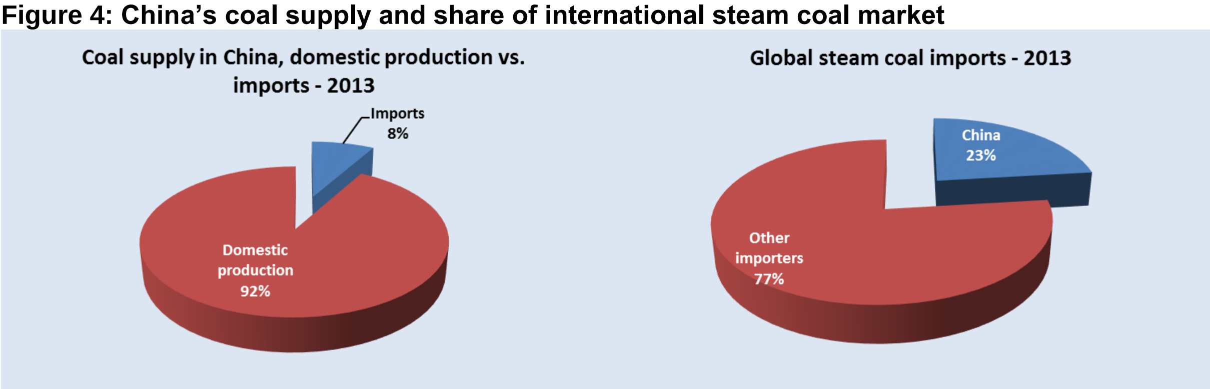
Figure 3: Chinese international coal imports and exports (1993-2013)



Source: IEA, 2013: China Customs data.

Indeed, despite its growing imports, China remains the world's largest coal producer. Imports account for only a small share of its apparent consumption, 8 per cent in 2013. But on the narrow international coal market (see Annex 2 for an overview of the international market), China now represents 23 per cent of global steam coal imports. It thus has considerable power on the international market, and policy decisions taken in Beijing affect the price of coal delivered to other Asian countries and European buyers.

Figure 4: China's coal supply and share of international steam coal market



Source: China National Bureau of Statistics (NBS), China Customs data and estimates of global steam coal trade.

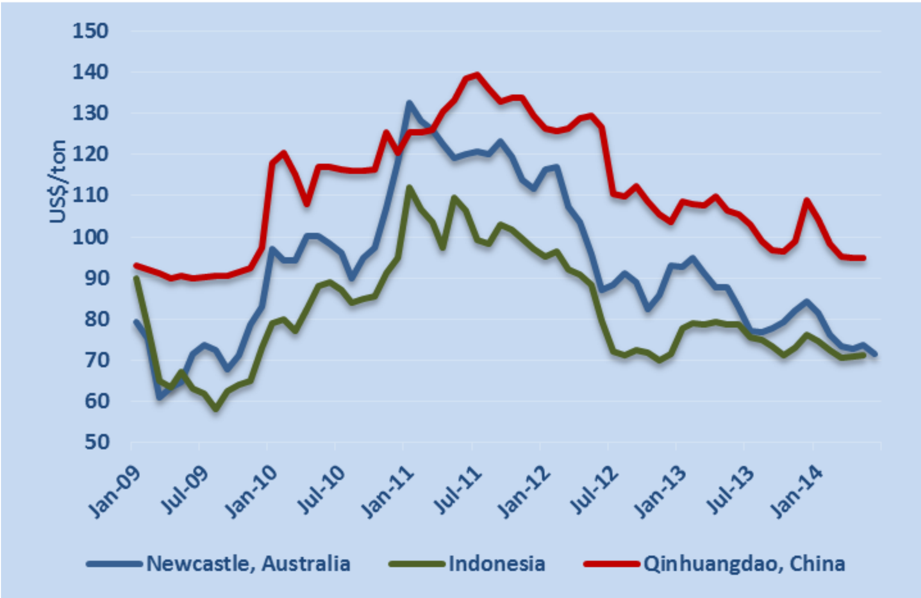
1.4 China is the current price-setting country for steam coal

The shift of China from a net exporter to a net importer has had a tremendous impact on global prices. Since 2011, when China became the largest coal importer, the country has become the price setter for steam coal. The reliance on international trade mainly stems from commercial and logistical considerations. The bulk of China's production comes from the north of the country, while major consumption centers are located in the southeastern provinces. Logistical constraints in this huge country restrict the transportation of coal to centers of consumption (see Section 6). But above all, Chinese coal imports are driven by coal price arbitrage between domestic and international products.

China has become the 'swing buyer' of *the coal market*, buying on the international market when international prices are lower than domestic prices and withdrawing from the market when the reverse occurs. China's domestic coal price therefore sets a price cap for international steam coal prices.

Figure 5 compares prices of domestic coal at Qinhuangdao[7] and export prices from Indonesia and Australia, the two main suppliers of thermal coal to China. As the figure shows, prices of domestic coal at Qinhuangdao were higher than Indonesian and Australian prices for almost all the past four years, leading to the strong growth in China's coal imports experienced during that period. Low maritime freight rates have reinforced the competitiveness of international coal. In early 2011, when Australian coal prices exploded following floods and coal supply cuts in Queensland, China was a net exporter, with Chinese traders reselling their coal cargoes to markets affected by the Australian flooding.

Figure 5: Comparison of coal prices in China (Qinhuangdao) with export prices from Indonesia and Australia



Note: FOB (Free on Board) prices, at 6,000 kcal/kg. China applies a 17 per cent VAT on imported coal.

Source: World Bank, McCloskey

Given its dual role as both the largest importer of steam coal and the swing buyer, China has a considerable power on the international steam coal trade and a change in Beijing's energy and climate policy is set to create waves in the global coal market. Economic, energy, and environmental trends in China are therefore key factors to understand the dynamics of the international coal market.

1.5. China is engaged in a major transformation of its energy system

In the early years of this century, China's main energy challenge was to ensure a sufficient energy supply to support soaring economic growth. Over the last few years two things have changed. First, economic growth has slowed, reducing the pressure on the energy supply chain. Second, air pollution has reached such levels that it has become a major political issue. In response, the government has placed greater emphasis on controlling energy production and consumption and reducing emissions of major pollutants. The priority is to ensure reliable, affordable, and increasingly clean supplies of

[7] Qinhuangdao (QHD) is the largest coal port in China. QHD handled 236 Mt of coal in 2013 for transshipment to southeastern coastal regions. Due to its sheer size of coastal 'exports', QHD serves as a reference for coal prices in northeastern China and is a key benchmark for competing foreign coal suppliers.

energy to fuel growing demands and to secure the country's economic progress, social order and, by extension, political stability.

The transformation of the energy model was first announced in the 12th Five-Year Plan (FYP) for National Economic and Social Development adopted by the National People's Congress (NPC) in March 2011[8]. The plan included a strong focus on addressing climate change and energy challenges with a commitment to achieving low carbon development. The priority is the transformation of the economy from a model based on energy-intensive and export-oriented industries towards a sustainable growth model based on domestic consumption and service-oriented industrial development with the support of capital, scientific development, and innovation. The Chinese government has committed to cutting its CO_2 intensity by between 40-45 per cent by 2020 compared to 2005 levels and increasing the share of non-fossil fuels to 15 per cent by 2020. The 12th FYP formulates key binding intermediate targets to reach these goals:

- A 16 per cent decrease in energy consumption per unit of GDP by the end of 2015
- A 16 per cent decrease in CO_2 emissions per unit of GDP by the end of 2015
- A rise in non-fossil fuels in primary energy consumption to 11.4 per cent by 2015, compared with 8.3 per cent in 2010.

It also targets significant binding reductions in the total emissions of major pollutants:

- Chemical oxygen demand (COD) and sulfur dioxide (SO_2) emissions decrease by 8 per cent by 2015
- Ammonia nitrogen and nitrogen oxides (NO_X) emissions decrease by 10 per cent by 2015.

The serious aggravation of local pollution and persistent smog in major cities since the beginning of 2013 have contributed to a reinforcement of environmental policies aimed at fighting local pollution and one of its major causes: coal burning. In 2013, the government approved 10 key measures to combat local pollution and adopted a comprehensive action plan in September 2013 – the Airborne Pollution Prevention and Control Action Plan, or APPC[9]. The APPC sets regional caps on coal consumption in key eastern coal-consuming provinces to reduce emission of local pollutants and combat air pollution. It also plans to accelerate the diversification of the electricity mix and reduce the coal share in the energy mix. Since then, recent policy decisions and measures have been enacted to accelerate and control the implementation of key energy and environmental targets. They include measures with far-reaching implications for the Chinese coal market and the rest of the world: the government's commitment to control the growth of coal demand and production by 2015; decrease the share of coal in the national energy mix; cap coal use in major eastern provinces by 2017; and ban the sale and import of low-quality coal with high sulfur and ash content.

[8] The 12th FYP for National Economic and Social Development sets overarching national goals and been complemented by specific plans and new policy measures. The White Paper on Energy Policy of October 2012 (http://www.gov.cn/english/official/2012-10/24/content_2250497.htm) and the State Council's Notice on Energy Development in the 12th FYP of January 2013 (hereafter referred as the 12th FYP, http://www.gov.cn/zwgk/2013-01/23/content_2318554.htm), in particular, detail the nation's energy course over the period 2011-2015 and quantify specific objectives for energy production and consumption. Other detailed policy and implementation plans are provided by the 12th FYP for the development of the coal industry (March 2012), as well as several other specific 12th FYP for nuclear, hydropower, wind and solar, energy savings, climate change, etc.

[9] State Council, Airborne Pollution Prevention and Control Action Plan, 10 September 2013, www.cleanairchina.org/file/loadFile/27.html (English translation)

2. New orientation of Chinese energy policy

Since the middle of 2013, the central government has introduced new measures and initiatives to re-orient the nation's energy policy. Given the heavy environmental, social, and economic costs associated with coal burning, the priority is to reduce the contribution of coal in the energy mix and combat air pollution and climate change. Alongside the overriding objective of guaranteeing secure energy supply, the new energy strategy aims at re-orienting the energy mix towards cleaner energy sources, reforming energy production and consumption patterns, driving energy sector reform, diversifying power sector sources, and cutting emissions from coal plants. The long-term strategy is to promote an 'energy production and consumption revolution'[10], as stated by President Xi Jinping on 13 June 2014, while the short-term strategy aims at accelerating the implementation of key initiatives.

The transformation of the energy consumption pattern aims at achieving an 'energy-saving society'. In the short term, it means a strong focus on energy savings and higher energy efficiency, a firm control of total energy consumption to curb 'irrational' energy consumption, and an accelerated adjustment of the industrial structure.

The government also aims at pushing forward reforms of the energy system and building an effective competitive market structure where the price of energy is determined by the market, electricity prices in particular.

On the supply side, the aim is 'the establishment of a multi-supply system', driven diversely by coal, oil, gas, nuclear, new energy, and renewable resources. In the short term, the central government is planning to accelerate the development of gas sources (coal-to-gas, coal bed methane, and shale gas), expedite the construction of new, safer, nuclear plants, and boost the production of green energy[11]. Use of clean coal is also emphasized: clean and efficient use of coal and development of other energy sources are stated as crucial to China's development plans[12].

The reverse distribution of energy resources and economic development and the haze problem in the east have motivated China to implement differentiated policies for eastern, central and western provinces. The policy aims at a more balanced economic development between eastern and western China and a large-scale optimal allocation of energy resources. As pollutants such as PM2.5 and PM10[13] have risen to alarming levels in the central and eastern regions, policy makers are trying to shift the country's energy structure by using greener power and transporting more electricity from the northwestern regions to the east. The key is the optimization of the power structure and layout. Recent policy decisions include the approval of new hydropower plants and wind and solar farms, and the acceleration of the construction of new ultra-high voltage (UHV) transmission lines to move power from western generation sources to eastern consuming provinces. The policy also includes the construction of large-scale integrated coal-power-chemicals bases in the northwestern provinces, which are well endowed with coal resources and the transportation of high value-added products to the east, such as electricity, synthetic natural gas, liquids, and chemicals manufactured from coal. To mitigate the environmental impact of coal, the government emphasizes the further development of advanced clean-coal technologies at all stages of the coal value chain and prioritizes the use of coal by the power sector.

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[10] Xinhuanet, 13 June 2014, op. cit.

[11] Xinhuanet, China to accelerate nuclear power development , 16 June 2014,

http://news.xinhuanet.com/english/china/2014-06/16/c_126627560.htm

[12] Xinhuanet, 13 June 2014, ibid.

[13] PM2.5 consists of all airborne particles less than 2.5 microns in diameter, making them small enough to pass into the gas exchange region of the lungs. PM2.5 poses the greatest risk to human health due to their small size. PM10 are particulates up to 10 microns in size.

The new policy and energy targets reflect an intensification and acceleration of the trend towards ‘higher quality growth’. The targets for the natural gas, nuclear, and renewables industries indicate that the government is pursuing its overriding policy priorities aggressively. The recently-adopted policy measures include a strengthening of energy efficiency, implementation of a national cap on total energy and regional caps on coal consumption, acceleration of the development of clean energy sources, implementation of pilot carbon trading schemes, and reform of the coal resources tax. These new policy measures suggest a drastic reduction in coal demand. On the other hand, the relocation of energy-intensive industries from east to west and the development of large coal bases in the northwestern provinces will lead to growing coal consumption in these provinces. The combined effect of these policies makes medium-term coal demand very uncertain. While coal demand is expected to peak, how and at what pace these two trends develop will be crucial in determining the future role of coal demand in the coming years.

Box 1: Chinese President Xi Jinping's proposals on energy revolution

- Changing energy consumption habits to rein in irrational energy use and control the country's total energy consumption
- Diversifying energy supply to establish a system that encompasses cleaner use of coal and non-coal fuel, including oil, gas, nuclear energy, new energy, and renewable resources
- Innovating energy technologies to forge the industry into a new powerhouse to fuel economic growth. Green and low-carbon energy sourcing are targets of the technology revolution
- Overhauling the energy system to realize faster development. Energy products should be viewed as commodities. A fully competitive market should be established to let the market decide energy prices. Government supervision on the energy sector should be based on the laws
- Engaging in all-round international cooperation to ensure China's energy security. International resources should be fully tapped in the energy production and consumption revolutions

Source: Beijing Review[14]

[14] Beijing Review, Fuel for a Revolution, 3 July 2014, http://www.bjreview.com/quotes/txt/2014-07/31/content_632067_2.htm

3. Towards peak coal demand

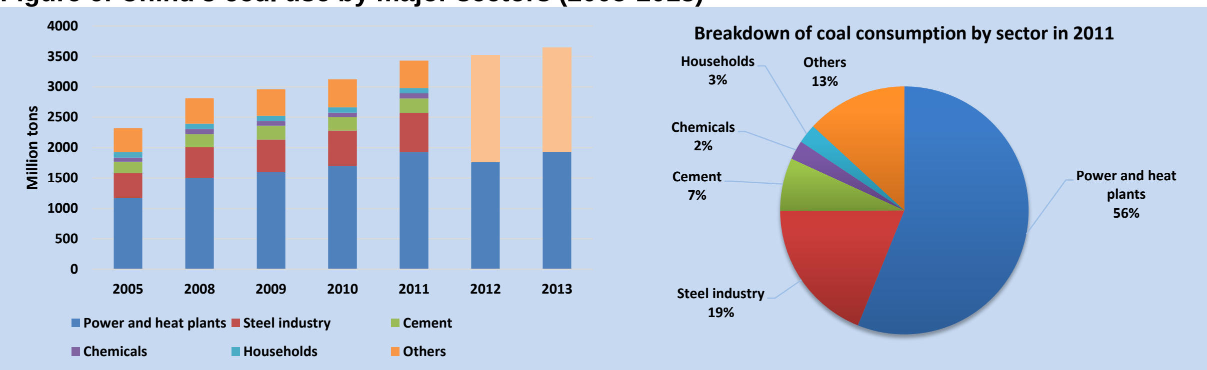
The slowdown in economic activity and the rebalancing of the economy towards a more balanced and sustainable growth path have moderated the increase in energy and coal consumption. In addition, a series of new policy measures suggest a slowdown in coal demand growth and its peak in the short term. These include efforts to combat air pollution, the acceleration of the development of clean energy sources, the implementation of pilot carbon trading schemes and the reform of the coal resource tax.

3.1 The power sector, and therefore industrial demand, dominates coal demand

3.1.1 Main consuming sectors

The power generation sector is the largest coal user, accounting for half of total consumption (53 per cent in 2013, i.e. 1.9 Gt of coal) compared with 80-90 per cent in OECD countries. In contrast with OECD countries, coal demand in China is not only driven by the power sector, but also by industrial demand which still accounts for more than 40 per cent. Industrial consumption is mainly driven by energy-intensive industries, such as the iron and steel, cement, and chemical industries. Household demand has decreased and represented 3 per cent of total coal consumption in 2011.

Figure 6: China's coal use by major sectors (2005-2013)



Source: National Bureau of Statistics (NBS)[15], National Energy Administration (NEA), China Electricity Council (CEC)

The second-largest coal user is the iron and steel industry, which uses coal both as a fuel and raw material (coking coal). The iron and steel industry has expanded significantly in the past few years, reflecting a boom in construction and infrastructure development, as well as strong demand for consumer durables. From 2005 to 2013, crude steel output in China grew from 356 Mt to 779 Mt, at an average growth rate of 10.3 per cent per year. China has become the largest producer of crude steel and accounts for half of global production. The cement industry is the third-largest coal consumer in China, which is the world's largest cement market, producing and consuming about 60 per cent of the world's total[16]. In 2013, China's cement output reached 2.4 Gt and grew at an average rate of 9.3 per cent over 2012[17]. Another large coal consumer is the chemical sector, which has traditionally used coal as its dominant fuel and feedstock instead of oil. The sector is expected to increase its coal consumption significantly as operators develop advanced technologies to produce an array of products based on coal gasification (see Section 4.4.2).

[15] National Bureau of Statistics of China, China Statistical Yearbook 2013, www.stats.gov.cn/tjsj/ndsj/2013/indexeh.htm

[16] Chembureau, 2014

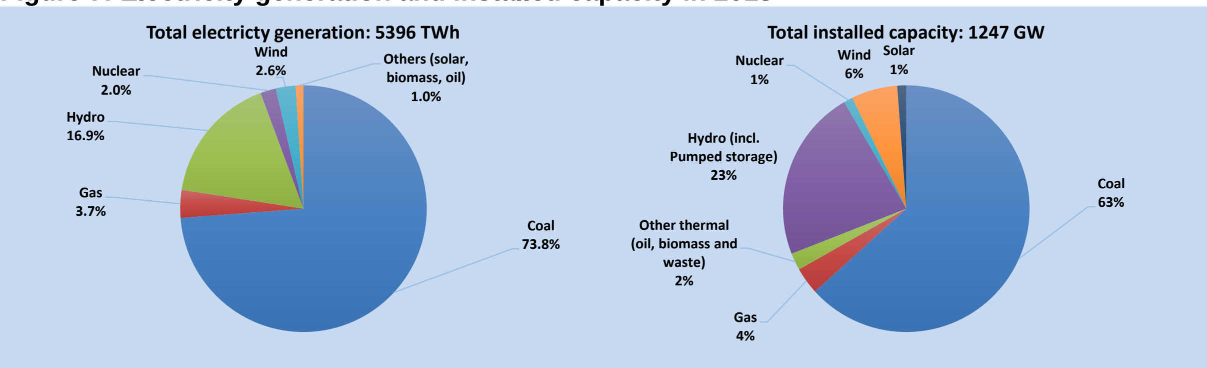
[17] NBS, 2014

3.1.2 Coal accounts for three-quarters of China's electricity generation

China is the world's largest power generator, surpassing the United States in 2011. The growth in electricity demand has been impressive: it has tripled since 2000 from 1,350 TWh to 5,330 TWh in 2013[18]. Electricity demand is highly correlated with industrial activity as over 70 per cent of electricity production in China goes to satisfy industry demands (74 per cent in 2013). In 2012, electricity demand growth fell to 5.9 per cent, its lowest rate since 2008. In contrast, 2013 saw electricity growth rebound to 7.5 per cent thanks to resurgent industrial demand. The high share of industrial demand in both total electricity demand and coal demand means that the industrial sector accounts for above 80 per cent of total coal demand.

The growth in electricity demand has spurred China to triple its generating capacity in the last decade, growing from 315 GW in 2000 to 970 GW in 2010. Capacity has continued to increase quickly in the past three years and reached 1,250 GW at the end of 2013. Coal dominates power capacity, accounting for 63 per cent of total installed capacity.

Figure 7: Electricity generation and installed capacity in 2013



Source: China Electricity Council (CEC), NBS

Despite efforts to diversify power generation, coal still accounted for 74 per cent of power generation in 2013, with hydroelectricity, the second-largest contributor, lagging behind at 17 per cent. Natural gas, nuclear, and renewables so far represent a tiny share of power generation; although this share is expected to increase quickly in the coming years (see Section 3.4).

3.2 Transformation of the economy

3.2.1 Shift in economic structure and slower economic growth

The past decade has seen strong GDP growth accompanied by strong energy and power demand growth. Economic activity rose by an average annual rate of 10.5 per cent between 2000 and 2010, while energy demand rose by an average 8.4 per cent and power demand by 12 per cent[19]. Power demand growth outstripped GDP growth as China continued its rapid investment-led industrialization. However, as the economy rebalances, economic activity growth has started to slowdown. The IMF projects a further moderation as the economy transitions to a more sustainable growth path[20]. Energy and power consumption growth has therefore moderated in 2012 and 2013 and this trend is expected to continue. This transition will help reduce the strain on the environment as economic activity switches from the polluting and coal-centric manufacturing sector to the less resource-intensive service sector. This shift implies a structural change in power consumption, causing power demand growth to fall below GDP growth and thus moderating the growth in coal demand. Likewise,

[18] National Bureau of Statistics of China, February 24, 2014, http://www.stats.gov.cn/english/PressRelease/201402/t20140224_515103.html

[19] IMF database (GDP at constant prices in national currency). Energy: NBS, 2013

[20] IMF, World Economic Outlook, July 2014.

since coal demand is highly correlated to industrial activity, China's economic rebalancing implies a decreasing share of industrial demand in total coal demand. Efficiency gains in major industrial sectors will reinforce this trend.

3.2.2 Rising energy efficiency

Efficiency gains will allow the country to further reduce the increase in energy and coal consumption. The government aims to cut energy intensity by 16 per cent in the five-year period ending 2015, following the remarkable progress achieved during the 11th FYP. In the power sector, for instance, the average thermal efficiency of China's coal fleet improved from 370 gce[21]/kWh in 2005 to 333 gce/kWh in 2010, while most coal power plants built today use state-of-the-art technologies. However, limited progress has been achieved in other sectors and China's energy intensity is still twice that of the world average, mainly because of low industrial energy efficiency. Despite upgrading and promotion of new technologies, coal-burning industrial boilers and kilns in China still have low utilization efficiency and large amount of pollutant discharge, wasting coal resources and causing severe air pollution. Efficiency gains are therefore a challenge for China, but also offer many opportunities.

The urgent desire to reduce air pollution has reinforced the 12th FYP's focus on industrial energy efficiency, particularly in construction, transportation, and public institutions. The plan calls for a 21 per cent reduction in industrial energy intensity by 2015 (from 2010), while the APPC sets an industrial energy intensity reduction target of 20 per cent by 2017 (from 2012).This cut will be achieved mainly by tightening the energy efficiency standards for key industries, eliminating outdated and excess capacities in energy-intensive industries such as steel, aluminum, cement, and flat glasses, and by adopting new efficient technologies and strengthening management of key projects. The policy also focuses on the development of more green buildings. In May 2014, the State Council issued the '2014-2015 energy saving low-carbon development action plan', which accelerates energy saving measures across all sectors[22].

The national target has been divided into strict provincial targets and provincial leaders are accountable for achieving the energy saving targets. Enforcement rules have been reinforced with the promotion prospects of local leaders linked to their realization of performance indicators, which are made public.

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[21] Kgce: kilogram standard coal equivalent

The Chinese government publishes statistics of production and consumption of primary energy in tons of standard coal equivalent (tce). Data on production and consumption of oil, gas, and coal are published in the reference units of each industry: ton oil equivalent (toe) for oil, cubic meters (m^3) for natural gas and metric tons for coal. The conversion factors used in China are based on the lower calorific value.

To convert toe in tce: 1 toe = 1.428 tce (41.87 GJ / toe)

To convert m3 in tce: 1 m^3 = 1.33 kgce (38.98 GJ / 1,000 m^3)

1 tce = 1.4 ton of raw coal (with a calorific value of 5,000 kcal/kg)

[22] State Council, 2014-2015 energy saving low-carbon development action plan, 15 May 2014

http://www.gov.cn/zhengce/content/2014-05/26/content_8824.htm

Box 2: The 'Top-1,000 Enterprises Program' and 'Top-10,000 Enterprises Program'

Launched by the NDRC in 2006, the 'Top-1,000 Enterprises Program' covered the 1,000 enterprises whose energy consumption exceeded 180,000 tce, representing in all one-third of national industrial energy consumption. The NDRC drew up the list of enterprises jointly with provincial governments, which set the targets for each enterprise. These 1,000 enterprises managed to save 150 million tce (Mtce) over the period 2005-2011.

The new 'Top-10,000 Enterprises Program' uses the same principle, with a lower inclusion threshold: annual energy consumption over 10,000 tce. Smaller enterprises, with energy consumption of more than 5,000 tce, may also be included by administrative authorities if they are considered to be 'key units'. The energy consumption of the 'Top-10,000 Enterprises' represents more than 60 per cent of total Chinese energy consumption. In May 2012, the NDRC drew up the list of 'Top-10,000 Enterprises' and the energy savings target for each province based on regional proposals. The target set is for 17,000 enterprises to save 250 Mtce by the end of 2015 compared with 2010 (about 375 Mt of coal). Sectors' share varies among provinces, with the majority taken up by the industrial sector, followed by the transport, service, and retail sectors. Public institutions are also included, as are schools and universities.

3.2.3 China to control energy use to fulfill its energy and carbon intensity targets

To achieve its energy intensity targets, China has implemented a dual control of its total energy consumption and its energy intensity. The central government aims to keep total energy consumption below 4 billion tce (Gtce) by 2015 and electricity consumption below 6,150 TWh (12th FYP). This will require average annual energy consumption growth to be controlled at around 4.3 per cent between 2011 and 2015, lower than the 6.6 per cent annual increase realized between 2006 and 2010. The government has recognized that progress until 2013 fell behind the established targets mainly due to the high growth of energy demand registered in 2011 (7.1 per cent)[23]. The government therefore has intensified its efforts and aims to reduce energy consumption per unit of GDP by 3.9 per cent per year in 2014 and 2015.

China has capped national coal production and consumption at 3.9 Gt in 2015, compared with 3.2 Gt and 3.1 Gt in 2010 respectively (12th FYP). These caps are ambitious: coal consumption increased by an average 6.6 per cent per year over the period 2005-2010, though the average annual growth rate is expected to moderate to 3.5 per cent over the 2011-2015 period. In 2011, the first year of the 12th FYP, it increased by 9.8 per cent, however recent coal market trends show that coal demand growth has decelerated drastically since 2012.

Box 3: Recent trends in energy and coal demand in China: the beginning of the adjustment

Some interesting trends already emerged in 2013 and the first months of 2014. Preliminary data from the National Energy Administration (NEA) show that China consumed a total of 3.75 Gtce in 2013, up 3.7 per cent from 2012, which is the lowest increase rate since 2002. Energy use per 10,000 yuan of GDP dropped 3.7 per cent year-on-year to 0.737 tce, while the share of non-fossil fuels in total energy consumption grew from 9.1 per cent in 2012 to 9.8 per cent in 2013. It is set to grow to 10.7 per cent in 2014.

China's coal demand has already grown at a slower pace. Data from the NEA shows that coal consumption grew by only 2.3 per cent in 2013, a modest figure compared with the average annual growth of 8.3 per cent recorded in the past decade. Coal's share in the energy mix dropped 0.9 percentage points to 65.7 per cent in 2013, and is expected to fall below 65 per cent in 2014. The decline in the contribution of coal (2.7 percentage points in three years) indicates that China's energy mix is being adjusted as a result of the structural adjustments of the energy and electricity mix as well as stronger air pollution controls.

[23] By the end of 2013, China's energy consumption per GDP dropped 9.03 per cent and carbon intensity fell 10.68 per cent from 2010 levels.

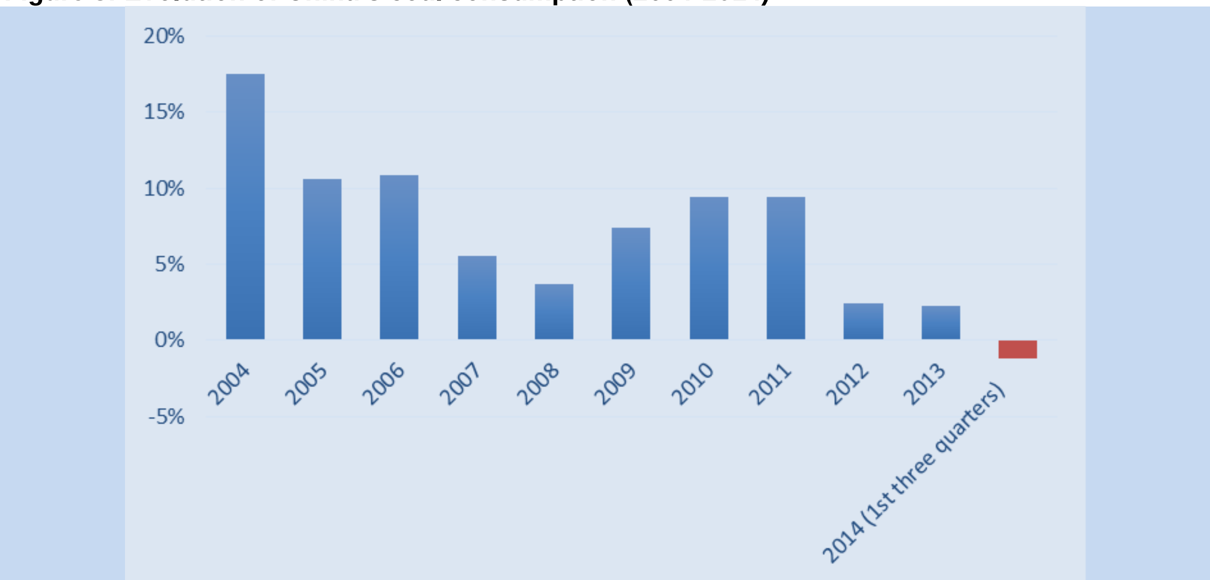
Table 1: Total energy consumption and energy mix (2011-2014)

	Total energy consumption (billion tce)	Total energy consumption by type (%)				Energy consumption decrease/10,000 RMB GDP (%)
		Coal	Oil	Natural gas	Non-fossil fuels	
2011	3.48	68.4	18.6	5	8	2.01
2012	3.62	66.6	18.8	5.2	9.4	3.6
2013	3.75	65.7	18.9	5.5	9.8	3.7
2014 (forecast)	3.88	<65	na	na	10.7	3.9

Source: NEA, 2014

In the first three quaters of 2014 coal demand declined by 1.2 per cent to 3.03 Gt[24], its first decline since 1998. The drop is due to slowing industrial activities and electricity demand, stronger hydropower output, and the government's battle against pollution.

Figure 8: Evolution of China's coal consumption (2004-2014)



Source: BP, NBS, CNCA

3.3 Fighting air pollution

3.3.1 The Airborne Pollution Prevention and Control Action Plan

2013 began with a severe air pollution episode that covered one-sixth of China's territory and affected more than 600 million people in 17 provinces, municipalities, and autonomous regions in most of northern and eastern China. The concentration of PM2.5 in Beijing reached 40 times the World Health Organization (WHO) recommended exposure limit of 25 micrograms/cubic meter per cubic meter (µg/m3). Despite the strict emissions reductions for major pollutants set in the 12th FYP, over the course of 2013 all but two Chinese provinces failed to meet the WHO's least stringent recommendation for PM2.5 levels of 35µg/m^3. The recurrent high levels of air pollution and smog

[24] The Guardian, China's coal use falls for first time this century, analysis suggests, 22 October 2014, http://www.theguardian.com/environment/2014/oct/22/chinas-coal-use-falls-for-first-time-this-century-analysis-suggests

episodes, in Beijing and many major Chinese cities, raised public concern about air quality and created enormous pressure to reduce emissions of major pollutants, such as sulfur dioxide (SO_2), nitrogen oxide (NO_X) and small particulates, and combat the major causes of these emissions: coal burning, intensive industrial activities, and motor vehicle emissions. The coal industry was thrust into the spotlight as the primary culprit, with coal-related emissions reportedly contributing 49 per cent of PM2.5[25]. In addition to the overwhelming role of coal in the power sector, responsible for 17 per cent of PM2.5 emissions, a considerable amount of coal is consumed in industrial boilers, coke ovens, and kilns of the building materials industry, which has exacerbated the pollution in urban areas. Furthermore, a large proportion of coal is still burnt in small coal-fired boilers scattered all over the country. This not only lowers the energy efficiency utilization, but disperses the emissions of pollutants and increases the difficulty and costs of removing them.

Table 2: Pollution emission factor of thermal power plants and small coal-fired boilers in 2010

kg/ton	SO_2	NO_X	PM
Thermal power	4.2	5.5	0.9
Small coal-fired boilers	16	2.9	3.2

Source: Yang J., 2013[26]

Responding to public demands, the State Council, China's top administrative authority, issued an Action Plan for Air Pollution Prevention and Control (APPC) in September 2013, since which time the fight against pollution has become a priority of the central government. At the annual full session of the NPC in March 2014, Premier Li Keqiang 'declared war' on pollution and pledged to fight it with the same determination with which the country battles poverty.

The APPC sets the road map for air pollution prevention and control for the next five years in China with a focus on three key regions with the highest pollution levels: Beijing-Tianjin-Hebei area (Jing-Jin-Ji), the Yangtze River Delta (Shanghai, Jiangsu, and Zhejiang provinces), and the Pearl River Delta (Guangdong Province). The APPC sets a 10 per cent PM10 reduction target nationally by 2017 and varying levels of PM2.5 reduction targets for the three key regions: Beijing and Tianjin (25 per cent), the Yangtze River Delta (20 per cent), and the Pearl River Delta (15 per cent). The average annual concentration of fine particulate matter in Beijing has to be controlled at about 60 $\mu g/m^3$. Measures being employed to achieve the goals include effectively reducing production capacity in many industries and controlling total coal consumption within the regions. The plan sets regional caps on coal consumption in target regions and also requires speeding up the adjustment of energy structure, increasing the supply of clean energy, controlling total coal consumption, and comprehensively replacing the traditional way of energy consumption, characterized by low efficiency and heavy pollution.

[25] Greenpeace International (2013), Tracking back the smog, Source Analysis and Control Strategies for PM2.5 Pollution in Beijing-Tianjin-Hebei, http://www.greenpeace.org/eastasia/Global/eastasia/publications/reports/
climate-energy/2013/Tracing%20Back%20the%20Smog_Executive%20Summary.pdf

[26] Yang J., Air Pollution and total coal consumption control, Chinese Academy for Environmental Planning, November 2013

Box 4: Main themes of the AAPC

The APPC has five main themes: 1) manage air pollution by managing coal; 2) cleaner production; 3) higher fuel quality; 4) clean energy alternatives; and 5) energy efficiency.

1) Manage coal: China will develop a long-term national coal consumption target and reduce coal's share of energy consumption to less than 65 per cent by 2017 (from 66.8 per cent in 2012) as part of the country's efforts to accelerate its energy structure; an objective that the NDRC expects to be achieved already in 2014.
Only target regions (Beijing-Tianjin-Hebei, Yangtze River Delta, Pearl River Delta) are required to reduce absolute levels of coal consumption by 2017 compared with 2012 by increasing imported electricity, natural gas supply and the use of non-fossil energy.
New industrial projects, such as coal power plants and steel mills in key cities and regions, including Beijing and the Yangtze River Delta, are banned. The plan specifies that, except from combined heat and power plant (CHP) projects, the approval of other new coal-fired power plants is prohibited, while according to the 'equal coal offset principle', new coal-fired power generation units with capacity more than 300-MW could be built to replace multiple small units.
Coal-fired boilers are to be phased out in favor of CHP for the chemicals, papermaking, printing, dyeing, leather, and pharmaceuticals industries. For the heavy industries such as coal-fired power generation, iron & steel, oil refining, and non-ferrous metals, the emphasis is on installation of air pollution prevention equipment such as desulfurization, denitrification, and de-dusting facilities. Renovation of coal-fired power plants in the key regions has to be completed by the end of 2015. 50,000 small coal boilers have to be eliminated by the end of 2015[27].
Coal quality has to be improved, with a ban on the sale and import of high-ash, high-sulfur, and low-quality coal envisaged. Coal sales in the target regions have to meet stricter criteria of a maximum 16 per cent ash and 1 per cent sulfur. To address the issue of dust, the washing rate of raw coal must be increased to 70 per cent.

2) Cleaner production: excess and outdated capacity in the 'two highs' – high energy and high polluting – industries (iron & steel, cement, chemicals, petrochemicals, and non-ferrous metals) is to be eliminated. This initiative would also prevent illegal construction projects by giving the relevant ministries more power to enforce. Heavier penalties will be imposed for violations of environmental, energy conservation, and safety requirements, while energy conservation and environmental protection standards will be strictly implemented to support the phasing out of excess production capacity.

3) Higher fuel quality: fuel quality would also be improved in target regions by 2017. The plan calls for technological upgrades at refineries to improve the quality of fuel oil, which affects vehicle emissions. The number of vehicles in major cities is to be controlled. Five million high-polluting 'yellow label' vehicles that were registered before the end of 2005 must be removed from the roads by the end of 2015 in the target regions.

4) Clean energy alternatives: the share of non-fossil fuels will be increased to 13 per cent by 2017. The use of cleaner energy alternatives such as natural gas and coal-to-gas is to be accelerated.
5) Energy efficiency: the APPC sets an industrial energy intensity reduction target of 20 per cent by 2017 from 2012. This is to be achieved mainly by tightening the energy efficiency standards and the development of more green buildings, while other measures include raising electricity prices for high energy consumption industries.

Collectively, China is to invest RMB174 billion in implementing the APPC, of which the investment in industry pollution control takes up 36.7 per cent. Driven by this investment, GDP is expected to increase by RMB2,500 billion, while it is estimated that the industries related to environmental

[27] The new air emission standards for small steam boilers, which took effect for new boilers from 1 July 2014 and all existing boilers from 1 July 2016, requires that all existing coal-fired boilers with capacity of 10 tons per hour or less (approx. 3-MW or less) be upgraded with gas-fired, oil-fired, biomass-fired, higher-quality coal-fired, or centralized heat supply units. China currently has around 276,000 of these small coal-fired boilers.

protection and air pollution control will see an added value of RMB1,600 billion by 2017 providing new jobs for 3.7 million people[28].

3.3.2 Local response: Beijing and other major big cities

In response to the APPC, provincial authorities have set targets to tackle air pollution and curb coal consumption. According to a Greenpeace report published in April 2014[29], 12 of China's 34 provinces (accounting for 44 per cent of China's coal consumption) have pledged to implement absolute coal consumption targets, and six have said they will reduce their coal use by 2017 and replace coal by gradually increasing the proportion of external power transmission, increasing natural gas supply, and enhancing non-fossil fuel utilization intensity, among other measures. Beijing-Tianjin-Hebei and Shandong, for instance, will reduce total coal consumption by 83 Mt. In total, 17 provinces have announced intentions to cap or reduce coal consumption in addition to those 12 who have already pledged control measures[30].

Table 3: China's coal control measures by key regions

Provinces with coal consumption reduction targets by 2017			
		Reduction by 2017 (million tons)	% change (2017/2012)
Jing-Jin-Ji	Beijing	13	-50%
	Tianjin	10	-19%
	Hebei	40	-13%
Pearl River Delta	Guangdong	16	-10%
Other	Shandong	20	-5%
	Chongqing	14	-23%
	Shaanxi	20	-13%
TOTAL		133	
Yangtze River delta	Shanghai, Jiangsu, Zheijiang		Negative growth
Other provinces with coal control measures			
Jilin	<2% growth/year		<2% growth/year
Liaoning	<2% growth/year		<2% growth/year

Source: Greenpeace, 2014

According to Greenpeace, these control measures will mean a reduction in coal consumption of 350 Mt by 2017 compared with business-as-usual growth. By extrapolating the new trajectory of coal consumption in the provinces that have announced coal reductions targets, a reduction of 655 Mt of coal can be expected by 2020 compared to a business-as-usual scenario. This translates into an estimated reduction in CO_2 emissions of about 700 Mt in 2017 and 1,300 Mt in 2020.

Further reductions in coal demand can be expected. In addition to the three key regions targeted by the APPC in September 2013, PM2.5 targets have now been extended to Shandong, Shanxi, and Chongqing. Total coal consumption now covered by PM2.5 regulation amounts to 51 per cent of national coal consumption and can be expected to grow further given stricter enforcement rules and rapidly increasing concern over air pollution[31].

China has adopted new legal tools and revised the Environmental Protection Law in April 2014, with effect from 1 January 2015. The revised law allows governments to fine polluters more heavily and

[28] Greenovation: Hub, A Review of China's Climate Policies and Actions in 2013, G:hub Annual Policy Briefing, April 2014, http://www.ghub.org/cfc_en/wp-content/uploads/sites/2/2014/04/s-Climate-Policies-and-Actions-in-20131.pdf

[29] Greenpeace, 2014. *The End of China's Coal Boom- 6 Facts You Should Now, April 2014*

http://www.greenpeace.org/international/Global/international/briefings/climate/2014/The-End-of-Chinas-Coal-Boom.pdf

[30] Carbon Tracker, ASrIA (2014), The Great Coal Cap, China's energy policies and the financial implications for thermal coal, http://www.carbontracker.org/wp-content/uploads/2014/06/CT_China-Full-Report_web_060614.pdf

[31] Carbon Tracker, ASrIA (2014), op. cit.

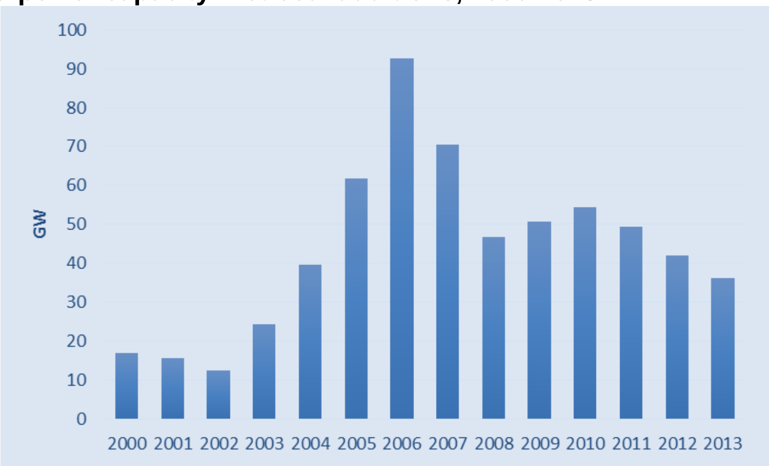
more frequently[32]. In particular, fines for non-compliant enterprises will no longer be one-off demands but will accumulate daily. The revised law also requires that local and regional governments respond to citizen accusations against polluters and clarifies that non-governmental organizations have the right to bring environmental lawsuits[33].

According to new standards for assessing local officials, released in December 2013, the level of government debt and the environment will be key indicators for evaluating their performance; previously it was measured almost solely by GDP growth[34]. The government also intends to revise the air pollution law late this year. The law, adopted in 1987, has been revised twice, in 1995 and 2000.

3.3.3 Impact on the existing coal fleet

The existing coal fleet is large and young, having expanded at an astonishing rate in the past 10 years from 286 GW in 2003 to 790 GW at end 2013. Although its share has dropped, coal still accounts for 63 per cent of total installed capacity. However, the net additions rate (new builds minus closure) has declined (49 GW in 2011, 42 GW in 2012 and an estimated 36 GW in 2013) as power demand growth has moderated and the power mix has shifted away from coal.

Figure 9: Installed power capacity. Net coal additions, 2000-2013



Source: CEC, NEA

The coal fleet is young: 89 per cent of the total operating fleet is younger than 20 years and 69 per cent younger than 10 years. The fleet is also highly efficient: 25 per cent has super- or ultra-supercritical steam parameters and 75.6 per cent has a generation capacity above 300 MW[35]. At the end of 2012, the fleet included 58 GW of ultra-supercritical 1000 MW power plants with efficiency above 46 per cent.

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[32] Chinadaily USA, Harsher air pollution penalties sought, 28 April 2014

http://usa.chinadaily.com.cn/epaper/2014-04/28/content_17470879.htm

[33] Switchboard, New Weapons in the War on Pollution: China's Environmental Protection Law Amendments, 24 April 204 http://switchboard.nrdc.org/blogs/bfinamore/new_weapons_in_the_war_on_poll.html

[34] Xinhuanet, China shifts away from economy-obsessed assessments, 9 December 2013, http://news.xinhuanet.com/english/china/2013-12/09/c_132954111.htm

[35] IEA (2012), CCS Retrofit, Analysis of the globally installed coal-fired power plant fleet, and CEC 2014.

Table 4: Capacity of coal-fired power plants at the end of 2012

Capacity	Number of units	Total installed capacity (GW)
All plants from 24 major power companies in China	1842	623
Unit ≥ 1 000 MW	58	58
600 MWe ≤ unit < 1 000 MW	397	247
300 MWe ≤ unit < 600 MW	740	239
200 MWe ≤ unit < 300 MW	201	42
100 MWe ≤ unit < 200 MW	223	30
60 MWe ≤ unit < 100 MW	223	6

Source: CEC (2013), results based on plants owned by the 24 major power companies, IEA (2012)

The average efficiency of the fleet has greatly improved in the 2000s, from 370 gce/kWh in 2005 to 333 gce/kWh at the end of 2010 and 321 g/kWh at the end of 2013, already reaching the target set for 2015 in the 12th FYP. This improvement has been allowed thanks to a policy of replacing small units (less than 100 MW) with large ones launched by the government in 2006 ('big pressure on the small' replacement policy). While building large-capacity supercritical (SC) and ultra-supercritical (USC) coal-fired units, China has gradually shut their smaller, outdated, and inefficient variants. The initiative was very successful with 77 GW retired during the 11th FYP and 20 GW of closures planned during the 12th FYP. In fact, under the policy of 'big pressure on the small', close to 100 GW of capacity was retired from 2006 to the end of 2012.

The closure rate will be higher than the 20 GW planned in the 12th FYP as the APPC mandates closure of plants which cannot meet new environmental standards and replacement of coal by natural gas or renewables in urban areas of the target regions. At the end of 2012, the thermal installed capacity in Jing-Jin-Ji, Yangtze River Delta, Pearl River Delta, and Shandong totaled 320 GW. Beijing was the first municipality to decide the closure, by the end of 2016, of its four coal-fired power plants (total capacity of 2.7 GW)[36]. More coal-fired capacity may be closed and replaced by natural gas, renewables, or imported electricity.

However, given that most of China's capacity has been built only in the last few years, closures of plants are likely to be limited, targeting the remaining subcritical power plants with a capacity lower than 200 MW, those subcritical plants with higher capacity that cannot achieve new environmental standards and those located inside major cities like Beijing. SC and USC power plants require a high capital investment, making their early retirement unlikely. These power plants have a long technical lifetime (around 40-50 years) and retirement of old plants in Europe and the United States mainly deals with those that have achieved 50 years of operation. Most of the remaining fleet is therefore going to be retrofitted and upgraded to comply with the new environmental standards on SO_2, NO_X, dust, and efficiency.

So the impact of new environmental standards on coal demand by the existing fleet may be relatively limited. Nevertheless, the APPC will greatly improve the emissions performance and thermal intensity of the existing fleet and the ban on new builds will significantly increase the need for cleaner fuels and imported power from other provinces (see Section 4.3.2).

[36] The municipality has also decided to ban the use of coal by 2020. In 2012, it consumed 23 Mt of coal.

Box 5: New air emissions standards and coal power plants

Coal-fired power plants consume more than half of China's annual coal production and emit over 40 per cent of its SO_2 and NO_X pollutants. To reduce power plant emissions, China modified its law on Emission Standard of Air Pollutants for Thermal Power Plants in 2011, replacing standards that had been in effect since 2003, and has adopted some of the strictest SO_2, NO_X, and particulate emissions limitations in the world. The new law, which went into effect on 1 January 2012, requires existing and new coal-fired power plants in smog-affected regions to achieve dust, SO_2, and NO_X emissions limits of 20, 50, and 100 mg/m^3 respectively, with new plants expected to meet the standards from 1 January 2012 and existing plants by 1 July 2014. A limit on mercury and its compounds has been set at a level (0.03 mg/m^3) that represents a core control. This means that providing the power plant operator improves the particulate, SO_2, and NO_X removal systems such that the new standards are achieved, then the mercury standard should be met without the need to introduce an additional capture device[37]. For the regions not affected by air pollution, the limits for SO_2 and NO_X for existing plants are less severe (200 mg/m^3 and 100 mg/m^3 respectively), although current government plans indicate a reinforcement of environmental standards in all regions.

The 12th FYP set mandatory reduction targets for emissions of SO_2 and NO_X of 8 per cent and 10 per cent respectively by 2015 from 2010 levels. This requires that modern, high-efficiency emissions control systems (desulfurization and denitrification facilities) are installed on all new plants and on existing units not scheduled for closure.

During the 11th FYP, SO_2 control equipment was installed on the vast majority of coal-fired power plants. More than 90 per cent of the current installed coal-fired power generating capacity had desulfurization equipment by the end of 2012, a rise from 60 per cent in 2005. NO_X control was added in March 2011 in the 12th FYP. According to CEC, by the end of 2010 (before the requirement came into force) 14 per cent of coal-fired power plants (totally 90 GW) had already installed NO_X control equipment. This percentage increased to 28 per cent at the end of 2012. By 2017, the AAPC requires 100 per cent of coal power plants to install desulfurization and 70 per cent for denitrification units. It also requires the renovation of all coal-fired power plants in the target regions to be completed by the end of 2015.

However, although the emissions standards are quite stringent, enforcement has been very weak thus far. Although desulfurization is installed on almost all the coal fleet, the equipment has been seldom used as it increases costs, and paying the fine of non-compliance was less costly than compliance costs. The AAPC and current policy initiatives make enforcement of the law stricter, with emissions now measured and published and regional policy officials responsible for achieving environmental performance indicators. Fines for non-compliance have also been increased and operations at plants which do not comply are suspended. These measures are expected to significantly decrease emissions from coal-fired power plants.

3.3.4 Impact on coal imports

The APPC will have major impacts on international coal trade and exporting countries. The seven southeast coastal provinces account for 67 per cent of total coal imports. Reductions in coal demand, or limits on its growth, target most of the major importing provinces of this areas, particularly Guangdong, the largest coal-importing province. With the power sector the main importer of coal, this may significantly curb the growth in coal imports. Declining coal consumption in these provinces will intensify competition between imports and domestic coal trans-shipped from northeastern ports. Competition is already fierce due to the oversupply and weak market. The outcome of this competition will depend not only on the relative prices of international and domestic coal, but also on quality

[37] World Resource Institute (WRI), China Adopts World-Class Pollutant Emissions Standards for Coal Power Plants, 15 June, 2012, http://www.chinafaqs.org/files/chinainfo/China%20FAQs%20Emission%20Standards%20v1.4_0.pdf

issues. Coastal power plants in southern provinces require coal with ash content lower than 0.6 per cent to limit air pollution, and as low-sulfur coal from the Tri-West area[38] is limited, imports of low-sulfur coal from abroad may still be required. Low-sulfur coal is blended with higher-sulfur coal at ports or power plants to meet the specific requirements of the plants' boilers. Above all, competition between imports and domestic coal depends on policy decisions, and the government's determination to resolve the oversupply situation may significantly reduce the level of coal imports in 2014 (see Chapter 8).

3.4 Diversification of the electricity mix and acceleration of the development of green energy sources

The targets set in the 12th FYP and the APPC outline future shifts in economic and power sector structures and appear to underline the government's commitment to reducing the share of coal in the energy mix and accelerating the development of renewable and alternative fuels.

According to the 12th FYP, China will increase the share of non-fossil fuels in primary energy consumption to 11.4 per cent (up from 8.3 per cent in 2010) by 2015. The target for 2020 has been set at 15 per cent. Nuclear, hydropower, renewables, and natural gas are expected to increase their share, while the share of coal in the energy mix is expected to decrease to 65 per cent by 2015. Generating capacity is expected to increase from 970 GW to 1490 GW at end 2015, while the share of non-fossil fuels in generating capacity is expected to increase to 30 per cent by 2015 (up from 20 per cent in 2010) to 450 GW (see Table 5). Efforts are focused on the development of hydropower, which allows for more than half of the increase in non-fossil energy consumption, on nuclear, wind power, and solar. Fossil fuel generation would still be dominated by coal. Around 300 GW of coal capacity was planned to be added by the end of 2015, though coal's share in total capacity was expected to fall to 65 per cent by 2015 from 68 per cent in 2010.

The APPC and recent energy initiatives accelerate the development of new energy sources (nuclear, renewables, and natural gas). Non-fossil fuels (including wind, solar, hydro, and nuclear) are expected to supply 13 per cent of the country's energy consumption by 2017, up from a target of 11.4 per cent in 2015 and 9.8 per cent in 2013.

3.4.1 China to speed up the development of renewables

The NDRC is aiming to have 150 GW of installed wind power capacity by 2017, almost doubling the on-grid capacity of 75.5 GW at end 2013, while aiming to more than triple installed solar capacity to 70 GW by 2017[39]**.** Of the electricity supplying the cities of Beijing, Tianjin, and Tangshan, 10 per cent should come from wind by 2015, rising to 15 per cent by 2017. In order to reach the new targets, an annual average of 18.1 GW of wind capacity and 12.5 GW of solar capacity would need to be added in the four years to 2017, representing an acceleration of previous trends. However, power generation from wind and solar PV is restricted by the lack of transmission lines. To solve this issue, the government is accelerating the building of large scale power transmission lines (see Section 4.3.2).

China will also try to reduce the costs of renewable energy, with the aim of cutting tariffs for wind and solar power sold to the grid to the same level as coal-fired power by 2020. Meanwhile, development of domestic hydropower capacity will continue playing a key role in meeting China's national targets, with installed hydropower capacity due to hit 330 GW by 2017.

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[38] The major supplying area of the northeastern ports. It includes Shanxi, west Inner Mongolia, and Shaanxi.

[39] As of the end of 2013, there were 741 PV power-generating stations on grid around China and over 60% of them were located in the northwestern region, mainly Gansu, Qinghai, and Xinjiang Provinces. Digitimes, China faces potential shortage of PV power transmission infrastructure, says NEA, 12 August 2014

Box 6: The surge in wind power

Grid-connected wind capacity has increased dramatically in China in the seven years since the Renewable Energy Law was passed. At the end of 2013, China led the world in cumulative wind installations with 76 GW on-grid capacity, while projects planned or under construction exceeded 56 GW. Despite the lead in capacity, China generated 16 per cent less electricity from wind than the United States, which was a close second in terms of total installations. Reduced capacity factors have been attributed to high amounts of forced curtailment, which reached as high as 50 per cent in some regions. The manifold causes of curtailment include: high penetrations of wind in provinces (mainly in the north and northwest of the country) far from load centers, inflexibility of the coal generation mix, and institutional barriers owing to incomplete power deregulation. To address these shortfalls and other chronic power challenges, China is to accelerate the construction of long-distance ultra-high voltage (UHV) interconnections as well as strengthen inter-provincial and intra-provincial ties.

3.4.2 China to ramp up nuclear power

According to the APPC, China will have 50 GW of installed nuclear power capacity by 2017. To reach the target, the government will launch examination and approval for key nuclear power projects, promote construction along the coastal region, and strengthen protection for inland nuclear power sites. At the beginning of 2014, China had 21 nuclear power units, with a total capacity of 14.74 GW, accounting for less than 2 per cent of the country's generation capacity. In addition, 28 nuclear power units were under construction, with a capacity of 31.66 GW. After the Fukushima nuclear disaster in 2011, nuclear power expansion was halted and safety checks were performed on all nuclear plants. Plans for nuclear power safety and long-term development of nuclear power were passed in October 2012, with approval planned for only a few projects in coastal areas before 2015, and none in inland regions. Only 2.1 GW of new capacity was approved in 2013, though the expansion has since restarted. Nuclear power has become an attractive source of baseload power to help China address its air pollution concern and the energy plan for 2014 calls for an increase of nuclear power installed capacity of 8.64 GW in 2014.

3.4.3 China to accelerate gas development

China will also increase natural gas output and speed up the development of coal-bed methane and shale gas, targeting natural gas supply capacity (domestic and import capacity) of 250 bcm in 2015 and 330 bcm in 2017 (190 bcm in 2013), and up to 420 bcm in 2020. Shifting to coal-to-gas has also emerged as a key policy priority, with China hoping to raise total production capacity to more than 50 bcm by 2020, accounting for up to an eighth of total natural gas supply (see Section 4.4.1). China's drive to develop its shale gas resources has also received a boost. The NDRC is going to open up energy exploration and encourage new forms of investment. The sector is currently dominated by the three national oil companies, but there is a move toward mixed ownership and independent exploration. China is also increasing its gas imports, signing a huge contract with Russia for the supply of 38 bcm per year starting in 2018 and a contract with BP for the supply of LNG. The government plans to build more LNG receiving terminals, emergency peak shaving and gas storage facilities, and also plans to accelerate the construction of the 3rd West-East Gas pipeline, the 4th Shaanxi-Beijing Gas pipeline, the Xinjiang coal-to-gas pipeline, and the 3rd and 4th Daqing-Tieling pipelines. By 2015, the country's newly-increased capacity of transporting natural gas via pipelines will total more than 150 bcm, covering the Beijing-Tianjin-Hebei region and the Yangtze & Pearl River Delta regions.

To solve the air pollution levels in major coastal cities, the government has stepped up its program of switching coal to natural gas, with priority sectors including residential heating, industrial boilers, and power generation in key cities, such as Beijing.

3.4.4 New targets for 2017

Table 5 shows the targets for 2015 as indicated in the 12th FYP and the new targets for green energy sources announced in the APPC. It clearly shows the determination of the government to accelerate the development of new energy sources.

Table 5: China's Energy Five-Year Plan (2011-2015) and new targets for 2017

Category	Indicators	Unit	2010	2015	Annual average growth 2010-2015 (%)	Status	Medium term target (expected)
Energy consumption	**Primary energy consumption**	**billion tons coal equivalent (tce)**	**3.25**	**4**	**4.3%**	**expected**	
	Share of non fossil energy in total primary energy consumption	%	8.6	11.4	(+2.8 points)	**binding**	**13% by 2017 (APPC) 15% by 2020 (12th FYP)**
	Share of coal in total primary energy consumption	%		65%		**expected**	**Below 65% by 2017 (APPC). Below 65% in 2014 (NDRC)**
	Electricity consumption	TWh	4200	6150	8%	expected	
	Energy consumption per unit of GDP	tce per 10,000 RMB of GDP	0.81	0.68	(-16%)	**binding**	
	Energy consumption per KWh	gce/kWh	333	323	-0.6%	expected	
	Electricity losses	%	6.5	6.3	(-0.2 points)	expected	
Energy capacity and production	**Primary energy production**	**billion tce**	**2.97**	**3.66**	**4.3%**	**expected**	
	of which coal	billion tons	3.24	4.1 (a)	4.8%	expected	
	oil	million toe	200	200	0%	expected	
	natural gas	billion cubic meters	94.8	156.5	10.5%	expected	
	non fossil energy sources	million tce	280	470	10.9%	expected	
Electricity	**Installed capacity**	**GW**	**970**	**1490**	**9.0%**	**expected**	
	of which coal		660	960	7.8%	expected	
	hydro		220	290	5.7%	expected	330 GW by 2017 (APPC) 420 GW by 2020 (12th FYP for hydropower)
	nuclear		10.82	40	29.9%	expected	50 GW by 2017 (APPC)
	natural gas		26.42	56	16.2%	expected	
	wind		31	100	26.4%	expected	150 GW by 2017 (APPC) 200 GW by 2020 (12th FYP for wind power)
	solar		0.86	21	89.5%	expected	70 GW by 2017 (APPC)
Environment	**CO2 emissions per unit of GDP**				**(-17%)**	**binding**	
	SOx emissions	g/kWh	2.9	1.5	-12.4%	**binding**	
	NOx emissions	g/kWh	3.4	1.5	-15.1%	**binding**	
Social	**Electricity consumption per capita**	**kWh**	**3800**	**6200**	**10.3%**	**expected**	
	Green energy demonstration counties	Number of projects	108	200	13.1%	expected	
	Access to natural gas	million inhabitants	180	250	6.8%	expected	

(a) Capacity

Source: National Energy Administration, 2013, 2014

By 2017, non-fossil fuel power capacity is expected to reach 600 GW compared with 385 GW at the end of 2013, which will decrease the need for new coal capacity compared with previous plans. Under the 12th FYP, the total installed coal-fired capacity reaches 960 GW by the end of 2015, with 300 GW of new capacity added during the 2011-15 period (see Table 5). Accelerated development of new electricity sources, however, means that the role of coal will be reduced compared to the 12th FYP targets. There has been already a significant slowdown in the growth of new coal builds (gross additions): 58 GW in 2011, 48 GW in 2012, and an estimated 42 GW in 2013. The capacity of the coal fleet reached 790 GW at end 2013 and 30 GW of capacity is expected to be added in 2014.

The high level of coal prices until the middle of 2011 made investment in coal power plants less attractive and led to the postponement of many projects and power utilities delaying final investment decisions. However, project economics for coal-fired plants have greatly improved since 2012 as coal prices collapsed. Several projects which were delayed are now receiving their final approval or being built. For instance, between November 2013 and July 2014, the Shanxi provincial government approved the construction of 24 coal-fired projects based on low-calorific value coal, with a total generating capacity of 20 GW[40]. Also, most of China's new coal capacity is moving westwards in large coal-power bases (see Section 4.1).

3.5 Cap on CO_2 emissions

China is the world's largest emitter of CO_2, accounting for 28 per cent of global CO_2 emissions (7.2tCO_2/capita). In 2013, coal was responsible for more than 80 per cent of China's 8.8 Gt of CO_2 emissions from fossil fuel combustion.

China and the United States signed a landmark agreement on 11 November 2014 to curb carbon emissions by 2030, which could galvanize efforts to negotiate a new global climate agreement by 2015. The agreement includes new targets for carbon emissions reductions by the United States and a first-ever commitment by China to stop its emissions from growing by 2030.

As part of the agreement, China announced targets to peak CO_2 emissions around 2030, with the intention to try to peak earlier, and to increase the share of non-fossil fuels in energy consumption to around 20 per cent by 2030. The US has committed to cut CO_2 emissions by 26 to 28 per cent on 2005 levels by 2025. That is double the pace of reduction it targeted for the period from 2005 to 2020.

China's target to expand total energy consumption coming from zero-emission sources to around 20 per cent by 2030 will require China to deploy an additional 800-1,000 GW of nuclear, wind, solar and other zero emission generation capacity by 2030 – more than all the coal-fired power plants that exist in China today.

In the short term, China has pledged that by 2020 it will reduce its carbon intensity by 40-45 per cent from 2005 levels. CO_2 emissions per unit of GDP had accumulatively dropped 28.56 per cent by 2013 from the levels of 2005, or a reduction of 2.5 Gt, according to the NDRC.

The Chinese government has been experimenting with two methods to help meet the CO_2 emissions reduction target: a market-based carbon trading system and a national carbon tax. China currently has seven pilot programs for carbon trading markets throughout the country with the goal to set up a national market expected to start in 2016[41]. The Ministry of Finance has also been considering introducing a tax on carbon emissions. These measures are likely to be a strong driver for reducing domestic thermal coal consumption.

China began piloting carbon trading in 2011 and approved seven schemes in Beijing, Tianjin, Shanghai, Shenzhen, Chongqing, Guangdong, and Hubei. The latest three were launched recently: Guangdong launched its emissions trading scheme, the world's second biggest after the European Union, in December 2013, Central China's Hubei province in April 2014, and Chongqing, a metropolis of 30 million people on the Yangtze River, in June 2014.

With seven established carbon markets, China's emissions trading schemes cover about 7 per cent of the country's total greenhouse gas emissions. At the moment, allowances are allocated for free and cover 10 different industries, including coal-fired power plants. Under the trading program, companies that produce more than their allocated share of free emission allowances have to buy additional allowances from the market. As of January 2014, carbon prices in China ranged from RMB51 ($8.3) in Beijing, to RMB26 ($4.2) in Tianjin, to RMB31 ($5.0) in Shanghai.

As far as the carbon tax is concerned, China has been planning to introduce such an environmental levy since 2007. As a result of the feared fiscal impact on economic development, this introduction has remained at the discussion stage so far. A great deal of controversy surrounds the basis and rate of the tax, the preferential policy, the start date, etc. The industries affected would be the biggest producers of CO_2 and consumers of coal, oil, and natural gas. The tax rate would begin at RMB10 per ton of CO_2 and progressively increase, possibly to RMB100 per ton of CO_2, although the pace and

[40] China Coal Resource, Shanxi approves 24 low calorific coal-fired power projects, 12 August 2014

[41] Reuters, China aims to launch pollution permit market within 3 years, 24 March 2014

scale of this increase have not been specified. A carbon tax would radically increase the cost of coal generation and encourage non-fossil fuel consumption.

China also has plans to launch a nationwide market to trade pollution permits (SO_2 and NO_X) as part of efforts to tackle its environmental crisis[42]. The ministries of finance and environmental protection have both submitted draft guidelines for a market that would cap emissions of key pollutants from major facilities and force those that exceed their caps to buy permits in the market, thus providing economic incentives for polluters to invest in cleaner technologies.

3.6 Coal resource tax reform

3.5.1 Central and provincial governments fighting against illegal taxes

Despite higher maritime transportation costs, coal imports have been cheaper than domestic coal for most of the past four years. This has pushed the central government to review the cost structure of prices and fight against illegal or unreasonable taxes levied by local authorities. In November 2013, the central government announced a series of initiatives to stabilize the coal mining sector (see section 5.4.4), and said it would chase illegal charges. Government initiatives stated that tax and other administrative charges accounted for 25-35 per cent of coal firms' annual revenue and that some illegal charges levied by local governments would be removed by the end of 2013.

Since then, provincial governments have taken measures to remove illegal taxes on coal producers and reduce tax levies on coal mining. The Shanxi government unveiled '20 Measures' in July 2013, including cutting administrative charges and eliminating illegal fees and taxes among others, which alone would save RMB5 billion for coal miners[43]. Besides Shanxi, which announced additional measures to support the coal sector in 2014, more coal-producing provinces have released supportive measures (Inner Mongolia, Hubei, Fujian). These measures are essential as the government is reforming the coal resource tax.

3.5.2 Coal resource tax

The Chinese authorities are carrying out the reform on the coal resource tax while coal prices remain low, hence the measure will have much less impact on downstream sectors. Currently, the coal resource tax is determined by the level of production rather than the market value, and the tax revenue is owned by provincial government in production provinces rather than the central government[44]. The current resource tax stands at RMB2-8 per ton based on production volumes. Starting from 1 December 2014, China will adopt a new coal resource tax based on the sales value of coal[45]. Local governments will be allowed to set specific rates between 2 and 10 per cent of sales value, and it is expected that the average tax level across the country could be about 5 per cent.

The aim of the reform is to simultaneously increase government revenues, curb excessive production, save resources, and protect the environment. The coal tax reform is a highly sensitive topic. Coal has been, up to now, the main cause of local pollution as well as the main source of carbon emissions in China. The coal price cannot reflect the environmental and ecological degradation during exploitation and consumption, nor the scarcity of coal resources, given the current low and fixed coal tax rate. The new coal tax is set to increase costs for miners. Based on an illustrative tax rate of 5 per cent, the tax would amount to RMB25 per ton at current coal prices (RMB500) and would fluctuate according to the market value of coal. In the current buyer's market, it will be difficult for miners to pass on the new tax burden. While large miners will be able to absorb this new burden, this will not be the case for the smaller ones, which will have to coalesce, integrate with larger mines, or close.

[43] China Coal Resource, A summary of local govts' recent measures to support the coal sector, 3 June 2014

[44] Wang D., 2014, Analysis on conflicts of China's coal tax reform, International Journal of Energy Economics and Policy, Vol. 4, N° 1, 2014, pp. 108-116

[45] China Coal Resource, China sets coal resource tax between 2-10%, within expectations, 13 October 2014

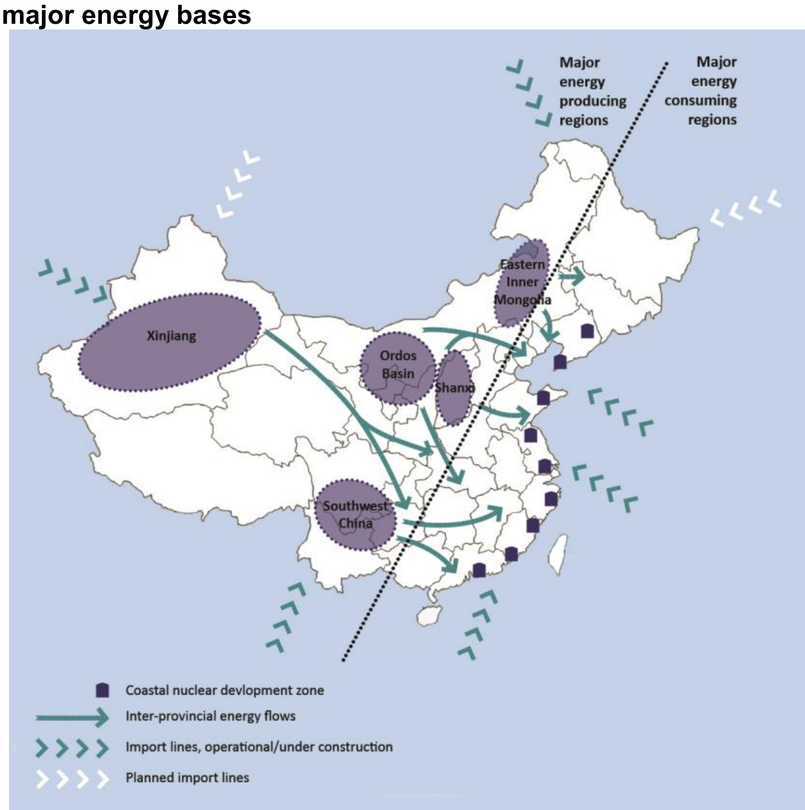
4. Coal demand: the great transformation and migration

Despite new regulatory policies to reduce coal demand in major eastern and southern cities, diversify the electricity mix away from coal, and increase efficiency in energy-intensive industrial sectors, coal demand is expected to remain high as its decreasing share in the electricity mix is within an expanding base. Moreover, two developments may increase total coal consumption at the national level. The first is the relocation of coal-fired power plants and highly energy intensive industries outside of big cities in major coal-power-chemical bases mainly located in northwest China. The second is the new coal demand coming from modern coal conversion projects (coal-to-gas, coal-to-chemicals, and coal-to-liquids). Most of the projects are located in northwest water-scarce regions (Inner Mongolia in particular), which has stirred great controversy about the water footprint of these projects. Likewise, these projects have a high carbon footprint unless carbon capture, use, and storage (CCUS) is developed.

4.1 The development of large coal-power bases

China has embarked on a regional policy to optimize the layout of its energy resources and better balance its economic development between east and west. The policy involves the relocation of energy-intensive industries and power plants to the west, while restricting the use of fossil fuels in the east and re-orienting the eastern economy towards services. While the policy was defined by the former government before the air pollution aggravation, it was confirmed by the new leaders, although there are major changes with the accelerated development of clean energy sources. According to the 12th FYP, five major energy bases are to be developed to reach an energy production capacity of 2.66 Gtce in 2015, accounting for more than 70 per cent of the country's total capacity.

Map 1: China's major energy bases



Source: Adapted and redrawn from the 12th FYP.

The five major energy production areas, and expected production capacity by 2015, are: Shanxi Province (700 Mtce); the Ordos Basin (920 Mtce); Eastern Inner Mongolia (330 Mtce); Southwest

China (420 Mtce); and Xinjiang (300 Mtce)[46]. The five energy bases are planned to export 1.37 Gtce to other provinces, accounting for 90 per cent of national inter-provincial transportation.

While all energy sources were developed in these bases, coal has been the dominant resource in the 12th FYP, during which some 16 major coal-power bases were planned to be built. The potential coal-power capacity of these bases amounted to around 640 GW, of which half is to be exported to other regions by 2020[47]. The acceleration of the development of new cleaner energy sources has reduced the need for new coal capacity, although the potential for new builds is still very significant[48]. The NDRC foresees the development of nine large coal-power bases of minimum 10 GW each, with the building of new coal-fired power plants in the large coal bases of Ordos and Ximeng (Inner Mongolia), Jinbei, Jinzhong, and Jindong (Shanxi), Shanbei (northern Shaanxi), Ningdong (Ningxia East), Hami and Zhundong (Xinjiang)[49]. Preliminary work on the building of 70 GW of new coal power capacity in these bases is to start in 2014. The government also foresees the acceleration of the construction of power transmission channels required to send power from these bases to other provinces.

The plan is designed to support national energy supply availability and the economic development of less prosperous 'inland areas' of China, in line with the government's aim to reduce the nation's socio-economic disparities[50]. The building of such coal-power bases in Western China pursues several key national objectives:

- Moving towards a more balanced economic development: the building of large coal-power bases (and integrated industries) allows regional development of Western China, narrowing the development gap between east and west. At the same time, it allows to re-orient the structure of the economy in the east towards services while decreasing the role of heavy industries. It ensures that the service-based industries developing in eastern China have sufficient resources to continue their growth.
- Moving energy-intensive industries (and power plants) to the west, where energy is abundant and electricity is cheaper, reduces the cost of energy use. This will allow China to remain competitive at a time when the shale gas revolution is driving down energy costs in North America.
- The policy will help to curb pollution in the east by allowing drastic reductions of coal consumption in eastern China, helping to solve the regional haze problem. In the new coal-power bases, the use of advanced clean-coal technologies is emphasized to improve energy efficiency. Environmental admittance criteria for new power plants will be raised, while existing units which do not meet the new environmental criteria will have to be upgraded. The development of integrated coal-power-chemical bases is also aimed at improving production efficiencies through clustering facilities, which can share resources, including CO_2 for CCUS. The centralized development (one large company for each base) aims at driving technology investment and innovation.

[46] State Council, Notice on Energy Developments in the 12th Five-Year Plan, op. cit.

[47] Liu Z., Electric Power and Energy in China, Jons Willey & Sons, Singapore, 2013

[48] Based on a study by the World Resource Institute (WRI), China had 363 proposed coal power plants in 2012, representing a total capacity of 558 GW. Some of these plants will not be built as they are located in regions where the central government has banned the building of new coal-fired power plants. WRI's analysis shows that 15 of the proposed projects fall under this category, accounting for 5% of total proposed capacity (28 GW). In addition, another 48 projects (72 GW) are located in regions where the APPC and the law on thermal plant emissions impose strict emissions standards on new coal-fired plants, reducing their economic attractiveness. Overall, stricter environmental regulation may result in a reduction of the proposed new builds of 100 GW in the eastern provinces. WRI, Global Coal Risk Assessment, November 2012,

http://www.wri.org/sites/default/files/pdf/global_coal_risk_assessment.pdf

[49] NEA (2014), 2014 guidance of energy work, 20 January 2014 http://zfxxgk.nea.gov.cn/auto82/201401/t20140124_1756.htm

[50] see Stanford University, Program on Energy and Sustainable Development (PESD), (2010), Remaking the world's largest coal market: the quest to develop large coal-power bases in China, December 2010, http://pesd.fsi.stanford.edu/publications/remaking_the_worlds_largest_coal_market_the_quest_to_develop_large_coalpower_bases_in_china/

The construction of large coal-power bases with the simultaneous construction of electricity transmission as a component of the official energy policy was reiterated on 13 June 2014 by China's Central Leading Group on Financial and Economic Affairs, the top economic body led by President Xi Jinping[51]. The government expects that the efficient development and the centralized management in the coal-fired power bases will reduce pollution and emissions, and bring down the total environmental cost for the whole country. This expectation is based on the development and use of two key technologies: advanced clean coal technologies (CCT) and UHV (ultra-high voltage) electricity transmission.

This development also prepares a longer-term view of a clean energy economy as advanced technologies, such as polygeneration, allow the use of many fuels, not only coal. The UHV transmission channels transport power which can be generated from coal and all other energy sources, in particular wind – a rapidly growing sector in China.

4.2 Advanced clean coal technologies

Coal, as the only currently abundant domestic energy source in China, is expected to retain a dominant, though receding, role in China's energy and electricity mix for many years.. Within this context, and amid growing environmental concerns, future coal development is being driven by the need to improve efficiency of coal production and use while significantly reducing pollutant emissions. To reduce the environmental footprint of coal production and consumption the central government has adopted CCT as a strategy to realize the sustainable development of the coal industry. CCT in China involves the full value chain of coal, from mining and preparation (washing) to coal conversion into higher value-added products (coal-to gas, to liquids and to chemicals) and recycling of co-products, as well as CCUS.

4.2.1 Clean coal conversion

Faced with a significant increase in oil and gas imports, China has implemented a wide range of measures to secure oil and gas from a diverse range of sources. This has including the development of a modern coal-based conversion industry, based on coal gasification and transformation of the produced syngas into high value-added products (synthetic natural gas, chemicals, and liquid fuels). Coal gasification is not new in China, indeed the coal conversion industry emerged in the 1950s and chemicals production from coal at the commercial scale commenced during the 1990s. However, the syngas produced was used almost entirely in the chemicals industry, mainly for the production of ammonia and methanol. The conversion process, based on traditional gasification of coal, was highly energy-intensive and responsible for heavy pollution. The new policy is to use advanced gasification technologies that first gasify coal and convert it into a wide range of products[52].

The first attempt to develop CCT started in the middle of the 2000s with the promotion of coal-to-liquids (CTL) investments as a way of improving energy security and easing growing dependence on foreign oil. Numerous projects were proposed by state-owned enterprises and private investors without full consideration of efficiency, costs, and supplies of coal and water. This led the government to cancel dozens of projects in 2008 and adopt a more structured program of research, development, and demonstration, leading towards an orderly development of a coal-based conversion industry with a particularly strong emphasis on clean coal conversion. The focus was put on resources of low heating value that were uneconomic for use in power stations.

During the period 2009 to 2012, several demonstration pilot plants and commercial prototypes were built to improve the key technologies and develop China's property technologies. Examples include

[51] Xinhuanet, 13 June 2014, op. cit. and The Economic Observer, Central Government Level Pushes Extra-High Voltage, State Grid Corporation of China Speeds up Arrangement around China, 28 June 2014, http://www.600869.com/en/ArticleShow.asp?ID=2436

[52] Advanced conversion of coal, based on gasification of coal, is a reaction that converts coal into syngas (synthetic gas: CO plus H2), which is then used to produce multiple products, such as diesel/gasoline fuel, derivative chemicals, synthetic natural gas (SNG) and electricity (by integrated gasification combined cycle [IGCC]), and so on.

packaged technologies such as Shenhua's direct coal liquefaction technology, a coal-to-methanol-to-olefin technology (Dalian Institute of Chemical Physics of the Chinese Academy of Sciences), as well as unit technologies such as methanation, coal-to-chemicals catalysts, and large-scale methanol synthesis[53]. Thanks to the successful operation of several conversion demonstration plants that were built during the 2009-2012 period, the development of CTG and CTL conversion projects has, since 2013, been accelerated to supply eastern provinces with new sources of 'clean' energy (see Section 4.4). However, while coal gasification is often portrayed as a CCT, its main claims in this area are is its efficiency for IGCC plants and the concentration of CO_2 emissions, which makes them easier to capture. CCUS is nevertheless needed in order to realize the potential of clean coal conversion.

4.2.2 Clean coal combustion

China has invested significantly in R&D programs, development, and demonstration projects in clean coal combustion technologies for decades. Most of the Chinese plants being built now are highly efficient and state-of-the-art SC or USC coal plants. The first 1 GW USC coal-fired unit (steam temperature of 600 °C) became operational at the end of 2006 at the Zhejiang Yuhuan Power Plant. By the end of 2012, 58 units were operating. China, already a world leader in the number of installed and ordered large-scale (those >1 GW) USC units, is now moving to the next generation of USC plants with R&D on 700°C ultra-supercritical technology. Construction of a 700°C steam temperature demonstration project is expected to begin in 2018, with completion targeted for around 2020[54].

China is also an international leader in technology development for circulating fluidized bed (CFB) combustion for power generation. CFBs have many advantages: fuel adaptability (it can burn coal and many other fuel sources, such as biomass), load following, emissions reductions, and lower operating costs. Currently, the total installed capacity of the CFBs in China is 73 GW. New CFBs are becoming increasingly efficient, larger (600 MW), more reliable, and have decreasing emissions[55].

There is also an increasing trend towards advanced coal gasification, but only one integrated coal gasification plant, or IGCC (integrated gasification combined cycle), has been built so far, the GreenGen project. The project is led by Huaneng, one of China's largest electricity companies, associated with Peabody, Datang, Huadian, and Shenhua. The 250 MW plant, built in Tianjin, came online at the end of 2012, and is expected to also use CCS in a next phase. IGCC enables CO_2, SO_2, and NO_x to be captured far more easily than from the smokestacks of a conventional coal-fired plant due to the highly concentrated stream flow, thus leading to much lower emissions and dust disposal. There are several other IGCC projects in China that have been designed and developed, but none have been approved yet. Despite its many advantages, the technology suffers from high construction and operating costs. It is expected that R&D on IGCC will be promoted in the CCT part of the 13th FYP in order to master the technology and bring down costs.

The development of these advanced combustion technologies means that China is moving to high-efficiency coal use, which is good for the environment but may lock a large part of its future electricity demand into coal dependence. This dependence makes the use of CCUS vital to decarbonize the electricity (and energy) mix.

4.2.3. Carbon capture, use and storage

CCS is ultimately the only technology that can make coal burning 'green' in the sense that it will allow for a dramatic reduction in CO_2 emissions. However, CCS presents high costs, thus China's policies focus on use of CCUS and enhanced oil recovery (EOR) among others. CCUS is still in very early stages of deployment in China and the focus of R&D is on capture and use. The coal-power-chemical

[53] Zhang Y., Clean Coal Conversion: Road to Clean and Efficient Utilization of Coal Resources in China, Cornerstone, 10 October 2013, http://cornerstonemag.net/clean-coal-conversion-road-to-clean-and-efficient-utilization-of-coal-resources-in-china/

[54] Huang Qili, The Development Strategy for Coal-Fired Power Generation in China, Cornerstone, 4 June 2013, http://cornerstonemag.net/the-development-strategy-for-coal-fired-power-generation-in-china/

[55] Huang Qili (2013), ibid.

integrated bases may help this development as emitting plants (power and conversion plants) will be located in the same area as those using CO_2, such as chemical plants.

The Global CCS Institute currently records 12 large-scale CCS projects in China (double the number of projects in 2011) and indicates that this number could increase further in the near-term as additional large-scale projects are being confirmed[56]. Huaneng, Shenhua, and the GreenGen project are all piloting capture technology with both pulverized coal and IGCC plants, while Sinopec is exploring the potential of CCS in EOR projects.

With the progress achieved in the last two years, China is now a world leader in CCS projects, second only to the US. The development of coal conversion with advanced technologies, but without CCS so far, in large-scale industrial bases may at first increases CO_2 emissions. It may also prepare the future development of CCUS and clean coal conversion in China and the commercialization of Chinese CCT to the rest of the world.

Box 7: The longer term: polygeneration as a new technology breakthrough?

China is developing the polygeneration technology using coal for electricity, heat, tar, and gasification, with the aim of maximizing resource utilization and realizing clean production in an optimized way. With this technology, China expects to achieve significant reductions in CO_2 emissions and fully utilize the coal resource and byproducts. Examples of polygeneration development in China include:

IGCC (GreenGen), which allows high efficiency and an easier capture of CO_2 emissions.

Methanol-alkali-ammonia combined process, which utilizes CO from ammonia process to make methanol, uses excess CO_2 to produce alkali, and uses excess H_2 from methanol process to make ammonia. Through this combined process, all the by-products are fully utilized and CO_2 emission control can be achieved.

The ZhongMei Jingbian project, using coal, gas, and oil as raw material; the three processes are combined to balance carbon and hydrogen produced and achieved CO_2 emission reduction.

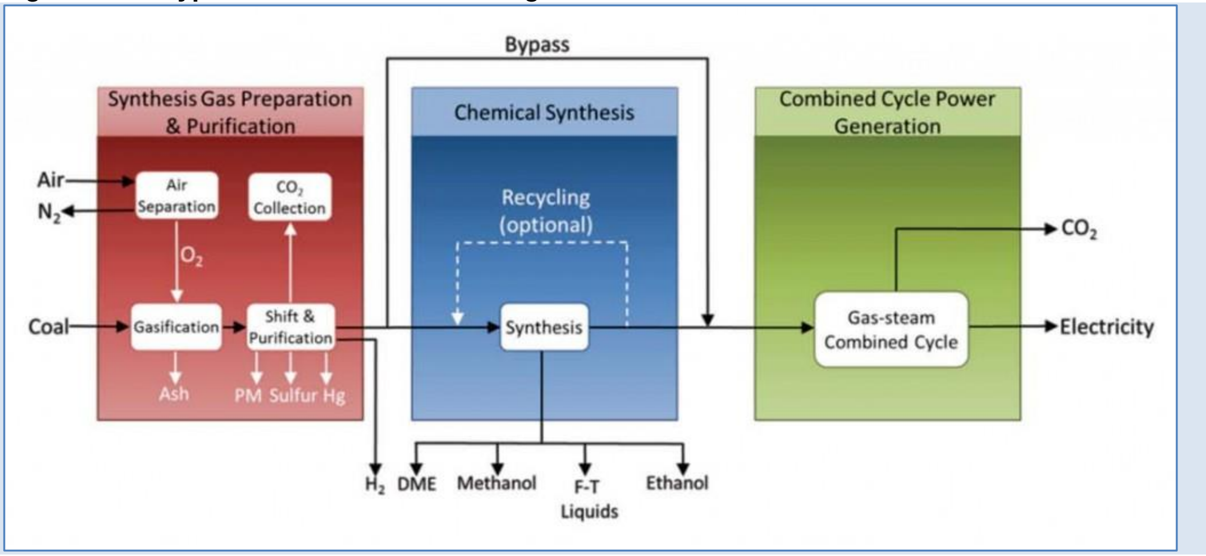
[56]Global CCS instate database, http://www.globalccsinstitute.com/projects/status-ccs-project-database

Table 6: CCUS projects in China

Project Name	Province	Volume CO_2 (mtpa)	Operation Date	Facility Details	Capture Type	Transport Length (km)	Transport Type	Storage Type
PetroChina Jilin Oil Field EOR Project (Phase 2)	Jilin	0.8	2016-17	Natural Gas Processing	Pre-combustion capture (natural gas processing)	35	Pipeline	Enhanced hydrocarbon recovery
Sinopec Qilu Petrochemical CCS Project	Shandong	0.5	2015	Chemical Production	Industrial Separation	75	Pipeline	Enhanced hydrocarbon recovery
Sinopec Shengli Oil Field EOR Project (Phase 2)	Shandong	1.0	2017	Power Generation	Post-combustion capture	80	Pipeline	Enhanced hydrocarbon recovery
Yanchang Integrated Carbon Capture and Storage Demonstration Project	Shaanxi Province	0.4	2016	Chemical Production	Pre-combustion capture (gasification)	150	Pipeline	Enhanced hydrocarbon recovery
Huaneng GreenGen IGCC Project (Phase 2)	Tianjin	2.0	2020	Power Generation	Pre-combustion capture (gasification)	50-100	Pipeline	Enhanced hydrocarbon recovery
Shenhua Ordos CTL Project (Phase 2)	Inner Mongolia	1.0	2020	Coal-to-liquids (CTL)	Pre-combustion capture (gasification)	201-250	Pipeline	Dedicated Geological Storage
China Resources Power (Haifeng) Integrated Carbon Capture and Sequestration Demonstration Project	Guangdong	1.0	2018	Power Generation	Post-combustion capture	150	Pipeline	Not Specified
Datang Daqing CCS Project	Heilongjiang	1.0-1.2	2020	Power Generation	Oxy-fuel combustion capture	Not specified	Pipeline	Dedicated Geological Storage
Dongguan Taiyangzhou IGCC with CCS Project	Guangdong	1.0 - 1.2	2019	Power Generation	Pre-combustion capture (gasification)	200-250	Shipping (e.g. tanker/barge/shuttle)	Dedicated Geological Storage
Shanxi International Energy Group CCUS project	Shanxi Province	2	2020	Power Generation	Oxy-fuel combustion capture	Not specified	Pipeline	Not Specified
Shenhua / Dow Chemicals Yulin Coal to Chemicals Project	Shaanxi	2.0-3.0	2020	Chemical Production	Industrial Separation	<150	Pipeline	Dedicated Geological Storage
Shenhua Ningxia CTL Project	Ningxia	2.0	2020	Coal-to-liquids (CTL)	Pre-combustion capture (gasification)	200-250	Pipeline	Not Specified

Source: Global CCS Institute, August 2014

Figure 10: Polyproduction based on coal gasification



Source: Zhang Y., 2013

Moreover, China is researching energy integration and optimization technologies with the objective of enhancing energy conversion and utilization efficiency. These include: the coupling of shale gas and coal-to-chemicals processing, combining nuclear energy-to-hydrogen and coal polyproduction, combining solar energy-to-hydrogen and coal polyproduction, and combining utilization of coal, waste, and biomass[57].

4.3 Strategic development of long-distance, large-capacity, cross-regional power transmission

4.3.1 A strategic move and a long-term vision

Building long-distance transmission lines is the second condition of moving power generated in the coal-power bases located far from the major consuming provinces. The development of such transmission lines has been on the agenda of the State Grid Corporation of China (SGCC) since the middle of the last decade. Although the building of UHV[58] was included in the 11th FYP, the 12th FYP, and the APPC, its development was slow as there were no consensus about its safety or economics[59]. After a long period of controversy and delayed proposals, the environmental problem in East China has become an important driver for solving this controversy. Premier Li Keqiang, at an April 2014 meeting of the new National Energy Commission to study and discuss the strategic issues and major projects in the development of energy, requested the acceleration of the UHV building program, considered as 'the only way to change energy development pattern, ensure energy security, construct ecological civilization, and serve the economic and social development'[60]. This decision is of key importance as UHV transmission will shape China's power supply for the next half-century and has enormous influence on the direction of China's future energy landscape and power sector

[57] Zhang Y., Prospects of Clean Coal Conversion from High-Carbon Energy to Low-Carbon Energy to near-zero emissions, Cornerstone, 10 October 2013

[58] UHV, defined as voltage of 1,000 kilovolts or above in alternating current (UHVAC) and 800 kilovolts or above in direct current (UHVDC), is designed to deliver large quantities of power over long distances with less power loss than the most commonly used 500-kilovolt line. A single UHV line can carry 10 GW of power. UHV DC lines are frequently used in point-to-point power transmission, while UHV AC technology is preferred in massive grid transmission.

[59] The most debated issues are the security and reliability: with the construction of more and more UHV transmission lines, the nationwide power grid is connected more and more intensively. If an accident (or terror attack) occurs in one line, it is difficult to limit the influence to a small area, thus increasing the chances of a blackout.

[60] SGCC press release, China Enters a Golden Era of Developing UHV, 16 May 2014

development. The aim is to build a backbone UHV grid and establish a unified national electricity market based on the intensive development of large-scale energy bases. UHV grids are aimed at optimizing resource allocation nationwide, resolving the problems of seasonality of hydropower and variability of wind and solar PV (hydro is at its highest level in summer, while wind is more productive in winter), but also greatly improving the exploitation and allocation efficiency of coal and easing the smog problem in the east.

The transmission channels are important for the development of clean energy, in particular wind power produced in the north and west of China. They will enable integration of renewable energy and will reduce curtailment risks by removing the transmission bottleneck that is currently limiting expansion in wind generation capacity. They are also important for the development of the coal industry in northwestern provinces – enabling the shifting of coal power generation to northwestern regions and ensuring supplies to the east. In regions rich in coal and wind/solar resources, such as Inner Mongolia, the bundled export of coal and wind power is planned. In the medium/long term, this development will allow the transition from a system based on fossil fuels with clean energy as a supplement, to a clean-energy system with fossil energy as backup. As the transmission channels will transport power and not fossil fuels, ultimately they will allow different energy sources to compete on costs, carbon emissions, and dispatchability. Price signals would then determine technology winners.

Box 8: Electrification and decarbonization

The UHV strategy is intended to link the country's existing regional grids in a national network, but it is also meant to herald much bigger changes in the way China uses energy[61]. It will allow two transitions: electrification and decarbonization of the energy mix. SGCC has a strategy to shift more energy consumption away from direct use of fossil fuels onto the electricity grid, and then cut emissions from power plants by replacing fossil fuels with more renewables and nuclear power. In a first step, SGCC launched a 'coal-to-electricity' program in 2013 that aims to replace coal- and oil-fired boilers in factories, offices, and district heating systems across northern China with electric heating to cut air pollution. SGCC intends to replace many district heating boilers with large-scale heat pumps and has a program ('oil-to-electricity') to develop the market for electric vehicles, and electric irrigation in rural areas to cut reliance on gasoline and diesel. Much of the electricity for the grid will still be generated from coal, but large central power stations are more efficient than the small, old boilers used in many northern areas to provide winter heating, and they are easier to equip with technology to cut pollution. Shifting from coal to electric heating will also enable China to integrate more clean sources of power into the energy mix.

The 12 recently-approved UHV projects (see below) are also considered important investment measures to stabilize economic growth. The combined investment is estimated by SGCC at RMB800 billion, including RMB210 billion for the construction of the 12 transmission channels, RMB90 billion for electricity equipment, and RMB500 billion needed in the power generating sectors. The UHV technology is very significant for China's industrial policy. After 10 years of development, China has fully mastered the core technology of UHV and now wants to export that expertise to other developing and developed countries looking to build long-distance transmission lines or super-grids. In February 2014, SGCC won the bid for Brazil's Belo Monte Hydropower UHV transmission project to build and operate a 2,000-km, 800kV UHV line from the Belo Monte dam in northern Brazil to the major consumption centers in the southeast.

4.3.2 UHV projects

Currently, there are eight UHV lines in operation and one UHV AC project (Fuzhou to Zhebei) under construction. The eight operating transmission lines include two UHV AC lines, the Jindongnan-Jingmen UHV AC Demonstration Project and its expansion project, and the Huainan-Shanghai UHV AC Demonstration Project delivering electricity from Anhui to East China (see Table 7). According to

[61] Reuters, Super-grid: China masters long-distance power transmission, 19 June 2014

SGCC, these demonstration projects have proved the safety of this new technology with more than five years of safe operation[62].

Table 7: UHV projects in China

Projects	Type	Start province	End provice	Fuel source	Capacity (GW)	Length (km)	Start year	Grid company
Operating								
Jindongnan-Nanyang-Jingmer	AC	Shanxi	Hubei	coal	5	654	2009	SGCC
Huainan-Zhebei-Shanghai der	AC	Anhui	Shanghai	hydropower	8	2X649	2013	SGCC
Yunnan - Guangdong (YG)	DC	Yunnan	Guangdong	hydropower	5	1,373	2010	CSG
Xiangjiaba-Shanghai (XS)	DC	Yunnan	Shanghai	hydropower	6.4	1,907	2010	SGCC
Jinping-Sunan (JS)	DC	Sichuan	Jiangsu	hydropower	7.2	2,095	2012	SGCC
Nuozhadu - Guangdong (NG)	DC	Yunnan	Guangdong	hydropower	5	1,413	2013	CSG
Southern Hami-Zhengzhou	DC	Xinjiang	Henan	coal and wind	10	2,192	Jan-14	SGCC
Xiluodu - Zhejiang (XZ)	DC	Sichuan	Zheijiang	hydropower	7.5	1,680	Jul-14	SGCC
				TOTAL	**54.1**	**12,612**		
Under construction								
Fuzhou - Zhejiang North	AC	Fujian	Zheijiang	Nuclear/Wind	6.8	2X603	Mar-15	SGCC
Approved								
Huainan-Nanjing-Shanghai	AC	Anhui	Shanghai	hydropower			>2015	SGCC
Ximeng-Shandong	AC	Inner Mongolia	Shandong	coal and wind			2017	SGCC
Yu Wang-Shandong	AC	Sichuan	Shandong	hydropower			2017	SGCC
West Inner Mongolia-Tianjin	AC	Inner Mongolia	Tianjin	coal and wind			2017	SGCC
Shanghaimiao-Shandong	DC	Inner Mongolia	Shandong	coal and wind			2017	SGCC
Ximeng-Jiangsu	DC	Inner Mongolia	Jiangsu	coal and wind			2017	SGCC
Ningdong-Zheijiang	DC	Ningxia	Zheijiang	coal and wind			2017	SGCC
Shanxi-Jiangsu	DC	Shanxi	Jiangsu	coal and wind			2017	SGCC
Yunnan - Guangdong	DC	Yunnan	Guangdong	hydropower			2017	CSG

Source: Standard Chartered Research[63], press releases

Since the policy decision taken in April 2014, the development of UHV projects has been accelerated, with 12 trans-regional UHV power transmission lines approved in the first half of 2014[64]. Preliminary work has been started and eight lines are expected to be completed by 2017. These 12 power transmission channels will deliver the power resources in Inner Mongolia, Shanxi, Shaanxi, and Yunnan provinces to Beijing-Tianjin-Hebei, the Yangtze River Delta, and the Pearl River Delta. They will link the coal, wind and solar bases, and hydropower centers in 'inland areas' to the east. According to SGCC, the projects will help cut thermal coal consumption by 200 Mt a year and reduce the density of PM2.5 pollutant particles by 4-5 per cent in the central and eastern regions[65]. When completed, the UHV grid will allow many coal-fired power plants to be retired, as is being done in Beijing city.

SGCC, which supplies electricity to 80 per cent of China's population, will be responsible for building 11 electricity transmission lines, while China Southern Power Grid (CSC) will construct the line distributing power from Yunnan to Guangdong. With a total investment of more than RMB210 billion

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[62] According to SGCC, the two AC and three DC projects of SGCC in operation at the beginning of 2014 have operated safely and delivered over 160 TWh of electricity from their start-up until March 2014. Jindongnan-Jingmen UHV AC Demonstration Project has realized electricity transmission in both ways and fully-loaded voltage with large capacity during its five-year operation, withstanding the test from storm, wind, high temperature, cold and other severe weather. The project, as an important north-south energy transmission channel, has delivered 58.3 TWh of electricity as of March 2014.

[63] Standard Chartered Research (2012), China coal, 20 November 2012

[64] China Coal Resource, China to finish 8 UHV power transmission lines by 2017, 6 June 2014 ; ic.cable cn.com, 2014 Will Be Undoubtedly the 'Spring' for EHV, 4 July 2014

[65] Xinhua, China to build 12 power transmission lines, 14 May 2014

(about $34 billion), the 12 major projects include four UHV alternating current (AC) power transmission lines, five UHV direct current (DC) lines and three conventional 500-kilovolt networks.

Box 9: The importance of UHV for Inner Mongolia

Inner Mongolia consists of the 'Three North' (western Ordos, central Xilingol League, and Hulunbeier League in the northeast). Despite its abundant wind and solar resources and its strategic location close to the eastern region, grid connection and access problems have constrained clean energy power production so far. Four of the 12 power delivery channels approved in the first half of 2014 involve the region and are expected to have a power delivery capacity of 31 GW by 2020. They involve a total investment of RMB63.7 billion ($42.5 billion). According to the plan, 3 GW of electricity will be sent to Beijing-Tianjin-Hebei area and another 6 GW will be sent to Shandong via the Ximeng-Shandong UHV AC Project. This will allow reduction in coal consumption of about 15 Mtce per year in those areas and will reduce CO_2 emissions by 36 Mt per year.

The new transmission channels are expected to allow the intensive development and transmission of wind and solar power to neighboring provinces. Alongside wind power, coal plants will be built to support the bundled export of wind and thermal power. Three large-scale, state-level, coal bases have already been built in the region (Xilingol, Ordos, and Hulunbeier), which aims at ensuring a quota of 30 per cent wind power in the power grid transmission by 2020[66].

Overall, Inner Mongolia plans to build nine energy bases, including two clean coal production bases, three coal-fired power bases, two wind power bases and two coal processing bases.

4.4 Chemical conversion: the 'sleeping giant'

The government attitude toward coal conversion projects has shifted completely from a stance of rigorous control in 2008 to one of promotion of this new industry. This is reflected by the great extent to which the NDRC has accelerated approvals – approving some 15 major coal conversion projects in 2013 after an almost four-year frozen spell from 2009 to 2012**.**

In the meantime, the technology has been successfully proven by demonstration plants and the central government has developed a plan for coal conversion projects with a prerequisite of meeting stringent requirements for environmental protection and preservation of water resources. These include targeted indicators for the approval of new projects based on their energy efficiency (conversion ratio), coal consumption, water consumption, and carbon emissions. The government has also put in place minimum size requirements for coal conversion projects[67] and several conditions for the development of coal-to-gas projects[68]. As a result, the approval process for new projects is stricter and their capital and operating costs higher, which favors big players with large production capacities and advantages in resources, technology, and capital. Stricter approval conditions have not discouraged investors: the coal conversion industry is expanding rapidly in the country, in particular the production of SNG and CTL, reinforced by the recent government policy to reduce air pollution in major cities. The fall in coal prices improves the economics of the projects and also forces coal producers to find new outlets to diversify their source of revenues.

The economics of large-scale projects, however, is uncertain. While such technologies were proven in small-scale pilot projects, not every company succeeded in scaling them up profitably. Shenhua Energy's coal-to-chemicals project in Inner Mongolia posted a net profit of RMB1.26 billion in 2013,

[66] Chinadaily, Inner Mongolia moves towards energy era, 10 July 2014

[67] To curb the blind expansion of CCT projects in local areas, in 2011 the NDRC issued a new policy to standardize the development of the clean-coal industry. The policy lifts the access threshold to clean-coal industry; forbids any CTL project that has an annual capacity of less than 1 mtpa; any CTO project with an annual capacity of less than 0.5 mtpa; any syngas project with an annual capacity of less than 2 bcm; any DME project with an annual capacity of less than 1 mtpa; and any MEG project with an annual capacity of less than 0.2 mtpa.

[68] According to the guidelines on SNG projects published by the NRDC in June 2010, the SNG development shall be planned and deployed in line with the national energy strategy; SNG projects must be initiated only after getting approval from NDRC; SNG projects must secure the pipeline transportation and the available gas market.

but Datang's Duolun project, also in Inner Mongolia, reported big losses in 2013, which led its parent company to sell its coal-to-chemicals and coal-to-natural-gas operations[69].

4.4.1 Coal-to-Gas entering a new stage

The importance of CTG for China's gas sector

In response to increasing pollution, the government has placed greater emphasis on enhancing the use of natural gas. The construction of LNG import terminals is being accelerated and new deals are being struck to import gas by pipeline and LNG from neighboring countries and global suppliers. The government raised gas prices in July 2013 in order to stimulate the extraction of natural gas and has provided additional subsidies for coal-bed methane and shale gas. However, the issue with these supplies is their scale, timing, and cost. The cost of SNG[70] is estimated at between RMB1.5 to 1.8/m^3 ($7 to 8.5/million Btu), while the average price of imported gas stood at $10-13.5/million Btu in 2013. Domestic SNG supplies offer a competitive alternative to costlier imported gas and boost China's bargaining power in negotiations with gas suppliers at a time when gas import needs are rising[71]. SNG also brings additional gas supplies in a short time compared with alternatives, which is an important reason for the government to support CTG development under current natural gas supply constraints. Finally, the technology is more efficient than other coal conversion technologies such as CTL (above 60 per cent for advanced CTG projects compared with 42 per cent for CTL).

From demo to large-scale

China's first two SNG plants started commercial production in December 2013 (Qinghua's plant in Xinjiang, and Datang Power's Keqi plant in Inner Mongolia). These are two of four CTG projects coming online to supply Beijing with more natural gas by 2015[72]. These plants are slated to fulfill China's targeted CTG production of 15-18 bcm by the end of 2015. In addition, the NDRC has approved preliminary work on 20 large-scale CTG projects, while 15 projects received conditional approval in 2013 alone. If all are realized, this would bring total CTG capacity (operating and planned projects) to 83.3 bcm.

[69] South China Morning Post, Datang soars on news of sell-off of unprofitable coal operations, 9 July 2014

[70] CLSA, Converting coal, 15 April 2014, www.clsa.com

[71] China's CNPC signed a mega contract with Gazprom in May 2014 for the import of 38 bcm/year from 2018. The gas price was reported at $350/1,000 m^3, the equivalent of $10/million Btu, a level slightly above the breakeven level of the most expensive domestic SNG supplies.

[72] By 2017, Beijing municipality will consume 24 bcm natural gas annually, and natural gas will account for 35 per cent of Beijing's energy mix while coal share will reduce to 10 per cent from the current 24 per cent.

Table 8: Coal-to-gas projects in China, beginning of 2014

Company	Location (Locality/Region)	Total capacity (bcm/year)	Status
Approved in 2009/10			
Datang International Power Generation	Keqi, Inner Mongolia	4	Operating
Qinghua group	Yili, Xinjiang	5.5	Operating
Datang International Power Generation	Fuxin, Liaoning	4	Under construction
Huineng Coal Chemical Co.	Ordos, Inner Mongolia	1.6 (a)	Under construction
Total 1		15.1	
Approved in 2013/14			
Datong Coal Mine Group, CNOOC	Datong, Shanxi	4	Approved
SDIC Xinji Energy Co	Anhui, Huainan	2.2	Approved
China Power Investment	Huocheng, Xinjiang	6	Approved
Xinwen Mining Group	Yili, Xinjiang	2	Approved
Sinopec, Huaneng Xinjiang Energy Development Co.	Changji, Xinjiang	8	Approved
Henan Energy and Chemical Indusrry	Changji, Xinjiang	4	Approved
Suxin Energy	Changji, Xinjiang	4	Approved
Xinjian Guanghui	Changji, Xinjiang	4	Approved
China Coal	Changji, Xinjiang	4	Approved
Huaneng Group	Changji, Xinjiang	4	Approved
China Huadian	Changji, Xinjiang	6	Approved
Xinmeng Energy	Ordos, Inner Mongolia	4	Approved
Beijing Enterprises Group	Ordos, Inner Mongolia	4	Approved
CNOOC	Ordos, Inner Mongolia	4	Approved
Hebei Construction & Investment	Ordos, Inner Mongolia	4	Approved
China Guodian	Xinganmeng, Inner Mongolia	4	Approved
Total 2		68.2	
TOTAL		**83.3**	

(a) To be increased to 6 bcm.

Source: Platts, China Coal Resource

Pipelines to deliver SNG to the east

One of the conditions to get NDRC's project final approval is the building of pipelines to targeted markets. As most of the new projects are far from the main consuming regions, building the associated infrastructure will be key to the development of the SNG industry. In Xinjiang, where about 60 per cent of CTG capacity is located, progress is being made on major pipelines designed to bring the gas to the east. Sinopec, which recently began construction of China's largest CTG project (design capacity of 8 bcm per year), is building the 'Xinjiang-Guangdong-Zhejiang' coal-to-gas pipeline. The pipeline has a total length of 8,280 km and a design capacity of 30 bcm per year. Sinopec is also planning to build the 4,463-km Xin-Lu pipeline (30 bcm per year), to send SNG from Xinjiang to Henan, Shandong, Hebei, Beijing, Tianjin, Anhui, and Jiangsu regions. The two pipelines are slated for completion in 2015.

The two other major state-owned oil companies, China National Petroleum Corporation (CNPC) and China National Offshore Oil Corporation (CNOOC), are also involved in SNG projects. CNPC is the sole buyer of gas produced from the two plants which entered production in December 2013. The company is transmitting gas offtake from Xinjiang's Yili plant through a branch line of the Third West-to-East Pipeline. For its part, CNOOC plans to build a 4 bcm per year CTG project in Datong, northwestern Shanxi province, with Datong Coal Mine Group. It has also received NDRC approval to build its own 4 bcm per year plant in Ordos, northwest Inner Mongolia.

The NDRC target would increase coal demand by 150-180 Mt by 2020

The NDRC recently indicated that SNG output is to rise to 50 bcm per year by 2020[73], accounting for 12.5 per cent of Chinese gas supply, compared with 2 bcm expected in 2014. Projects amounting to an aggregate annual capacity of more than 80 bcm per year have already received preliminary approval by the NDRC, and many more facilities are in the planning phases. According to data released by China Petroleum and Chemical Industry Federation (CPCIF), coal gasification would top out at 280 bcm if all the planned projects and projects currently under construction became fully operational by 2020[74]. Companies are keen to invest and in some cases receive subsidies from local governments and loans from the Chinese Development Bank, which plans to promote coal gasification projects in Xinjiang by offering loans of more than RMB50 billion in the next three years, targeting four to five projects. Most of the coal resources in Xinjiang, which has 10 operating and approved projects with a capacity close to 50 bcm per year, would be stranded without conversion into gas, power, and chemicals. Furthermore, the region's coal boasts among the country's lowest production costs and pipelines to send gas to the east are under construction.

The NEA target of50 bcm by 2020 would imply additional coal consumption of about 150-180 Mt per year, assuming that 1 bcm of gas requires 3 to 4 Mt of coal. With the plans announced by Xinjiang and other provinces, the national target may be exceeded. However, CTG faces many challenges (see below) that will affect the potential construction of several projects.

4.4.2 Coal-to-chemicals

Increasing need for high-value added chemicals

The basic petrochemicals, such as olefins – the key building block for the production of plastics – are normally produced from crude oil in steam crackers (naphtha cracking mainly in East Asia and Europe) and natural gas (ethane/propane cracking mainly in the Middle East and now in North America based on shale gas liquids). In China, olefins and other derivatives are traditionally produced from crude oil, but coal-to-chemical processes provide another way to produce chemicals in provinces with stranded and low-cost coal assets. China has therefore embarked on a policy of producing chemicals from coal to decrease its dependency on some key petrochemical imports – mainly coal-to-olefins, CTO, coal-to-mono ethylene glycol, CTMEG, coal-to-aromatics, and coal-to-ethanol. Under China's Olefins 12th FYP, the government plans to raise ethylene self-sufficiency to 64 per cent in 2015 from 48 per cent in 2010, while the target for propylene is an increase to 77 per cent from 63 per cent. By 2015, 20 per cent of olefin (including derivatives) capacity, around 10 Mt, should come from alternative feedstock rather than naphtha. As natural gas is not yet an option, China's large oil companies have started implementing new process routes and building chemicals projects based on coal conversion to fulfill the planned target.

New coal-based chemicals projects may add 180 Mt of new coal demand by 2020

Shenhua has been actively exploring in this field and put the first CTO facility into commercial operation in 2010 in Baotou, Inner Mongolia. It was designed with a production capacity of 1.8 Mt for coal-to-methanol and 600,000 tons for methanol-to-olefins, with investment totaling RMB 2.7 billion. The group is expected to double its CTO production capacity upon the completion of the second phase of the project. Shenhua Ningmei started up the world's first coal-to-propylene plant in May 2011 (500,000 tons per year), while Sinopec brought a methanol-to-olefin plant online in October 2011, and Datang International started up a coal-to-propylene plant in January 2012. In total, China has put into commercial operation six coal-to-olefin projects. The capacity of operating plants reached 2.6 Mt of olefins at the beginning of 2014 and several plants are under construction (9.1 Mt of

[73] China Coal Resource, Top coal groups to boost new coal chemicals, 9 May 2014

[74] China Coal Resource, China coal chemical industry is unsustainable, sources, 26 June 2014

capacity)[75] and planned. According to the CPCIF, coal-to-olefin capacities would reach 41 Mt if all the planned projects and projects currently under construction became fully operational by 2020.

Table 9: Operating CTO projects in China, beginning of 2014

Company	Location	Capacity (million tons per year)	Project status
Shenhua Baotou	Inner Mongolia	0.6	Operating
Shenhua Ningmei	Ningxia	0.5	Operating
Ningbo Skyford	Zhejiang	0.4	Operating
Sinopec	Henan	0.3	Operating
Datang	Inner Mongolia	0.5	Operating
Wison Group	Jiangsu	0.3	Operating
TOTAL		2.6	

Source: Standard Chartered, April 2014

In addition to CTO, China is developing other high-value petrochemical products, such as MEG (mono ethylene glycol) and DME (Dimethyl ether). The world's first coal-to-mono ethylene glycol (CTMEG) plant was brought online by GEM Chemical in December 2009, while six other CTMEG plants were started in 2012 and 2013, raising China's total coal-based MEG capacity to 1.1 Mt at the beginning of 2014. The total capacity may exceed 10 Mt by 2020, if projects under construction and planned come on stream.

In 2013 alone, the NDRC approved preliminary work for over 20 new coal-to-chemical projects[76]. Several large groups are developing new coal-to-chemical projects, though most, however, are just in the planning stage and real progress has been quite slow, due to high costs and investments, high technical requirements, and environmental risks. Furthermore, the Chinese government has announced that it aims to cap coal-to-chemical production capacity to avoid over-expansion of the industry and under-utilization of assets. According to the NEA, coal-to-chemical may reach 30 Mt by 2020. Based on an average 6 Mt of coal to produce 1 Mt of olefin, this would represent an additional coal demand of 180 Mt by 2020.

4.4.3 Coal-to-liquids

After the government stopped the investment spree in CTL projects in 2008, investment has restarted after 2013, though based on stricter approval process, with only large-scale projects that comply with stricter environmental rules approved by the NDRC. This policy aims at precluding the disorderly development of CTL projects as occurred in the middle of the 2000s.

Coal liquefaction falls into two categories: direct (DCTL) and indirect liquefaction (ICTL)[77], both of which have been developed and commercialized in China. Shenhua independently developed the Shenhua DCL Process and built a 1.08 Mt per year commercial demonstration plant in Ordos, Inner Mongolia, which was put into commercial operation in January 2011. Three 160–180-ktpa (kilo tons par annum) indirect liquefaction demonstration projects were built during the 2006-2009 period by Shenhua, Yitai, and Lu'an, companies which all have plans for larger-capacity facilities.

The Chinese government recently approved the construction of two large plants based on China's proprietary technology: Shenhua's Ningxia 4-mtpa CTL project at the Ningdong Energy Chemical Industry Base and Yitai's 2-mtpa ICTL project in Inner Mongolia. Several other CTL projects have

[75] Standard Chartered, China Oil & Gas, The turning tide, 17 April 2014

[76] Wison Engineering Services Co, Annual Report, 2013, http://www.hkexnews.hk/listedco/listconews/sehk/2014/0328/LTN201403281661.pdf

[77] CTL is a process of coal liquefaction with the action of a catalyst and includes two types of technologies: direct coal liquefaction, DCLT, which turns coal directly into liquid products; and indirect coal liquefaction, ICLT, or Fischer-Tropsch synthesis (FTS), which gasifies coal into syngas and then produces liquids from the syngas.

been proposed, including Yankuang Group's has a 1-mtpa ICTL project in Yulin, Shaanxi province, and the Lu'an Group is expected to build a 1.5-mtpa ICTL in Changzhi, northern Shanxi province[78]. In April 2014, southwestern Guizhou announced plans to develop a 6-mtpa CTL project, which would be the largest of its kind in China if approved. The Inner Mongolian region expects to developed 10-mtpa capacity in the east.

Table 10: CTL projects in China

Company	Location	Capacity (mtpa)	Status
Shenhua	Ordos, Inner Mongolia	0.18	in operation (2010)
Shenhua	Ordos, Inner Mongolia	1.08	in operation (2009)
Yitai Coal	Ordos, Inner Mongolia	0.16	in operation (2010)
Lu An Group	Changgzhi, Shanxi	0.16	in operation (2010)
Shenhua	Ningxia, Ningmei	4	under construction
Yankuang Group, Yanchang	Yulin, Shaanxi	1	approved
Yitai Coal	Ordos, Inner Mongolia	2	approved
Yitai Coal	Yili, Xinjiang	1	approved
Lu An Group	Changgzhi, Shanxi	1.5	approved
Shenhua	Ordos, Inner Mongolia	4	expansion
Shenhua	Xingjiang	3	proposed
	Eastern Mongolia	10	proposed
	Southwestern Guizhou	6	proposed
	TOTAL	**34.08**	

Source: Companies' annual reports, press releases.

In March 2014, the NDRC released a 'Notification on Issuance of Energy Industry Enhancement of Air Pollution Prevention & Treatment Program', that pushes forward CTL projects in Yulin, Shaanxi, Ordos, Inner Mongolia, and Changzhi, Shanxi. The CTL output is planned to reach 10 mtpa by 2017, to be further expanded to 30 mtpa by 2020[79]. Assuming a consumption of 4 to 5 Mt of coal to produce 1 Mt of CTL (indirect liquefaction), this would represent an additional coal demand of 120 to 150 Mt in 2020.

4.4.4 Coal conversion projects face many challenges that will limit the number of approved projects

China is now moving towards the deployment of large conversion projects. If all projects under construction, approved, and announced were built, the industry's coal consumption would reach 1,026 Mt by 2020[80]. However, several factors will limit the number of projects and coal demand by the sector. The huge capital investment requirement is a first barrier to many projects, as it is estimated that the construction of a 4 bcm per year CTG plant under present conditions costs RMB25-30 billion[81]. Beyond that, large investment is required for long-distance gas pipelines (RMB159 billion for Sinopec's gas line linking Xinjiang to Guangdong), meaning that only large groups backed by government funding will be able to invest in such projects.

[78] Weng Li (2013), The Momentum of Chinese-Developed Indirect Coal-to-Liquids Technologies, Cornerstonemag, 10 October 2013, http://cornerstonemag.net/the-momentum-of-chinese-developed-indirect-coal-to-liquids-technologies and http://dialogue.usaee.org/index.php/coal-to-liquids-why-and-how-it-makes-the-case-in-china

[79] China Coal Resource, Top coal groups to boost new coal chemicals, 9 May 2014

[80] Calculations based on the lowest coal use per unit of output and 80% utilization of the total capacity of all announced projects.

[81] China Chemical Reporter, Coal-to-Gas Enters New Development Stage, 29 August 2013.

But above all, the major issue encountered by coal conversion projects is their environmental footprint. Although coal conversion projects increase the country's energy security and reduce air pollution problems in the east, they suffer from two major problems, as has been pointed out by numerous studies over the past two years[82]. First, with currently available technologies the production of coal-based products requires large amounts of water: in the case of CTG, the most advanced plant of 4 bcm per year will consume around 16 Mt of water a year. Water requirements for CTL and CTO projects are even higher: with ICTL processes, four to eight tons of water is consumed to produce one ton of synthetic fuel; 15-20 tons of water are required to produce one ton of olefins via CTO. This is a key problem as most coal conversion projects are located in the north and northwest of China, which are already water-stressed[83], meaning large-scale production of SNG/CTL would exacerbate existing shortages. Second, the greenhouse gas emissions from the manufacture of SNG/CTL are several times higher than for conventional natural gas or for refined oil products. To produce 1,000 m^3 of synthetic gas, on average 3 tons of CO_2 will be emitted[84]. While SNG and CTL may help to curb pollution in the east, CO_2 emissions on the whole may increase if CCUS is not applied.

These two forms of environmental damage are in direct contradiction with the government's current policy priorities of managing water supplies more effectively and constraining the rise of greenhouse gas emissions. While the CO_2 emissions issue may be tackled through the development of advanced efficient technologies and CCUS, the water risk is the factor that will determine the development of coal conversion projects[85].

The Chinese government recognizes the need to balance its water and energy consumption. In December 2013, the Ministry of Water Resources announced a new policy document called the 'Water Allocation Plan for the Development of Coal Bases', aimed at protecting water resources in large coal bases[86]. The plan specifies water-use efficiency and discharge requirements for existing coal bases and requires all new coal mines to submit a water resources planning study. The guidelines will also push companies to pay for wastewater recycling and wastewater treatment systems.

In addition, in July 2014, China moved again to regulate coal conversion projects after the industry expanded blindly in some areas, causing harm to the environment[87] and earning a rebuke from the NEA, which stated that 'Development of coal conversion projects cannot be stopped but they cannot proceed recklessly,' adding that 'projects should be built with a high conversion rate in areas with abundant water resources'. The NEA urges local authorities to tighten approval of new projects and prohibits small-size projects, with larger projects to be subject to regulatory approval from the State Council. According to the statement, coal conversion projects will be banned in provinces that have a net import of coal (most of the eastern provinces), and the excessive or improper use of water will also be strictly prohibited. The NEA also states that coal should be used first to meet demand for power generation and coal conversion projects should never affect residential and agricultural water use.

Recent guidelines from China's Ministry of Water Resources, regulation of coal conversion projects by the NEA, and stricter approval process by the State Council will limit coal conversion expansion and new coal demand by the sector. Potential competition over coal use for electricity and conversion projects and restrictions on water availability will determine the expansion of the sector. Based on NEA plans by 2020 (CTG: 50 bcm per year, coal-to-chemicals: 30 Mt and CTL: 30 Mt), the new coal demand required to reach these targets would amount to around 450-500 Mt by 2020.

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[82] See Greenpeace: http://www.greenpeace.org/international/en/campaigns/climate-change/coal/Water-impacts/, China water risks http://chinawaterrisk.org/and HSBC Global Research https://www.research.hsbc.com/midas/Res/RDV?p=pdf&key=hhre85hbs8&n=342956.PDF

[83] Li Zheng L., Lingying P. , Pei L; Linwei M., Assessing Water Issues in China's Coal Industry, Cornerstone, Spring 2014

[84] IEA (2014), Medium-term Gas Market Report, IEA/OCDE, May 2014

[85] Li Zheng L., Lingying P. , Pei L; Linwei M (2014), ibid

[86] Waterrisks http://chinawaterrisk.org/notices/mwr-announces-for-coal-plan/

[87] Xinhua, Coal conversion projects face stricter rules, 24 July 2014

Box 10: Water requirement and power production

Most water used in the coal industry is used for coal-fired power plants, many of which are located in arid regions. According to CEC, the average water consumption of thermal power plants in China was 2.34 kg/kWh in 2011 (c2.52 kg/kWh in developed countries). For each coal-fired power plant, most of the water requirements are due to cooling. To reduce water needs, China has turned to dry air cooling, which can reduce power plant efficiency but also offers substantial water savings. China has made major progress employing dry air cooling. In 2013, there was a total of 150 GW of installed thermal power units with dry air cooling, which was 17 per cent of the total thermal power installed capacity. Increased deployment of SC and USC power plants and various water-saving technologies will reduce the average water consumption, which will be extremely important in areas with water scarcity. In these areas, according to the Water Allocation Plan, proposed power plants in major coal bases must apply air cooling technology.

4.5 The peak coal demand debate

There are numerous studies forecasting a peak coal demand in China by 2020/2025 or even earlier[88]. The drivers of change are already at work. In the first three quarters of 2014, China's coal demand registered its first decline since 1998 (down 1.2 per cent), in response to slower economic growth, weak electricity demand (4.9 per cent in the first seven months), efforts to combat local pollution, increased penetration of cleaner energy sources, and strong hydropower generation.

Looking forward, the new energy development strategic action plan (2014-2020), issued by the State Council on 19 November 2014, sets a cap on coal consumption at 4.2 Gt by 2020 (see Box 11). In response to nationwide public concern over air pollution, a growing number of municipalities and provinces, among the largest coal consuming ones, have pledged to reduce or cap their coal use by 2017. The APPC has fixed the contribution of coal in total energy consumption to less than 65 per cent by 2017, a share that the NDRC expects to be achieved already in 2014, and the new energy development strategic action plan sets the share at 62 per cent by 2020. The contribution of non-fossil fuels in the energy mix is planned to increase to 13 per cent by 2017 and to 15 per cent by 2020 as the development of non-coal sources has been accelerated. Investment in renewables, natural gas, and nuclear power is growing fast, while investment in the coal sector is slowing. China intends to peak its CO2 emissions by 2030, and will try to peak earlier. A national carbon trading scheme is expected to begin operating in 2016, while the coal resource tax is being reformed. Last, but not least, the government is determined to change the energy production and consumption patterns and achieve 'safe, green, and efficient' energy systems.

However, the continued development of China's economy, even at a lower rate and on a more balanced and sustainable path, along with industrialization in western China and urbanization trends, mean that energy demand will continue growing for many years. The IEA forecasts that China's energy demand will still grow by almost 50 per cent from 2011 to 2035, although the pace of energy demand growth will slow (IEA/WEO 2013, New Policies Scenario)[89]. The lower share of coal in the energy mix, therefore, will be within an expanding energy base and coal will remain the main source of energy in China for a long time. In the IEA/WEO New Policies Scenario (Figure 13), China's coal demand growth slows before 2020, rising from 2.66 Gtce to 3 Gtce in 2020 (equivalent to 4.2 Gt at 5000kcal/kg), with demand reaching a plateau after 2025 at 3.1 Gtce (equivalent to 4.3 Gt).

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[88] Carbon Tracker, ASrIA (2014), op. cit.

Greenpeace (2014), op. cit.

CITI (2013), The Unimaginable: Peak Coal in China, 4 September 2013.

Deustche Bank (2013), Big bang measures to fight air pollution.

IEA (2013), World Energy Outlook 2013 (IEA/WEO 2013), November 2013

Caldecott B., Tilbury J., Ma Y. (2014), Stranded Down Under? Environment-related factors changing China's demand for coal and what this means for Australian coal assets, SSEE, Oxford University, Stranded Assets Programme.

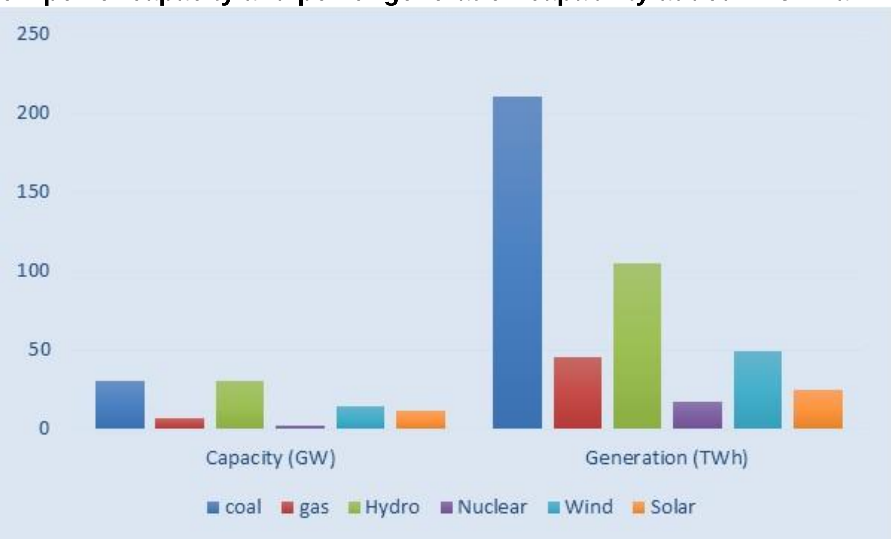
[89] IEA (2013), op. cit.

Coal demand in the non-power sector (excluding new coal conversion projects) is expected to decline significantly thanks to the rebalancing of the economy, structural changes in industry, efficiency gains in the main industrial sectors and substitution policies, closure of excess and outdated capacity in the energy-intensive sectors, and replacement of coal boilers in industrial and heating sectors by natural gas or electricity.

The development of coal conversion projects, however, may offset the decline. If all known and proposed coal conversion projects were realized, demand by the sector would amount to 1 Gt by 2020. This will not be the case as the central government has reiterated its control on the development of this new sector and has prioritized the use of coal by the power sector. However, security of supply objectives and the need for cleaner fuels in East China may lead to a large development of the coal conversion industry.

Despite its decreasing role in the electricity mix, several factors indicate a further growth in coal demand by the power sector[90]. China's power demand is expanding and the share of primary energy devoted to power generation is rising in line with economic development. Power generation rises to around 7,300 TWh by 2020 in the IEA/WEO2013 New Policies Scenario, an increase by 53 per cent compared with 2011 (4.9 per cent per year). China is investing massively in new, cleaner energy sources and by 2017, non-fossil fuel power capacity is expected to reach 600 GW, from 385 GW in 2013. But to reduce coal demand, the rate of new technology deployment and efficiency improvements would have to outpace growth in power demand. The new energy sources, except nuclear and natural gas, have lower capacity factors than coal. For illustration, when adjusted for capacity factors, coal dominated power generation capability added in 2013, although it represented only one third of capacity additions.

Figure 11: New power capacity and power generation capability added in China in 2013



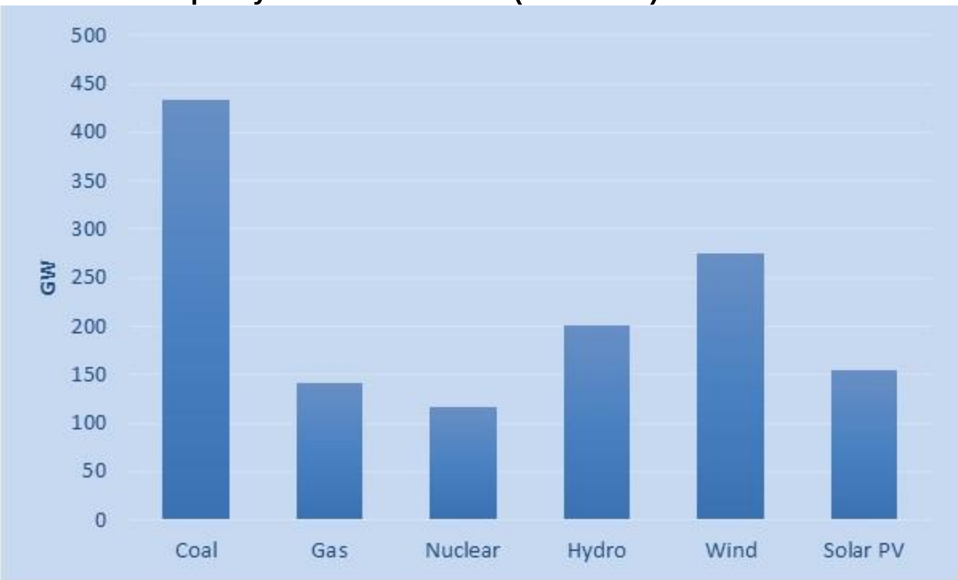
Assumed capacity factors: coal and gas: 80%, hydro: 40%, nuclear: 90%, wind: 40%, solar: 25%

Source: NEA (for added capacity)

While new policy measures lead to a drastic reduction in coal demand in the east, the development of large coal-power bases in northwestern provinces results in the transfer of coal demand to the west. The potential installed capacity in these coal bases is huge: in the IEA/WEO2013 New Policies Scenario, added coal generation capacity over the period 2012-2035 still accounts for one third of total added generation capacity (Figure 12). Coal capacity amounts to 47 per cent of total power capacity in 2035 (63 per cent in 2013).

[90] However, coal demand by the sector may stagnate in 2014 thanks to high hydro production, rising alternative energy sources and limited economic and electricity growth.

Figure 12: Generation capacity additions in China (2012-2035)



Source: IEA/WEO2013

In this development, the costs of renewables and natural gas are two factors of uncertainty with a potentially major impact on Chinese coal demand. The speed of development and integration of new sources adds to these uncertainties. Any delay in the development of renewables or nuclear power will translate into increased use of coal, while on the other hand, cost reductions in wind and solar industries will translate into reduced use of coal. The construction of power transmission corridors from generating regions offers strategic flexibility to adapt the power mix according to technological and economic developments. After 2020, more fuel switching may occur as shale gas production is expected to take off.

As coal will remain the main source of energy in China for many years, the government has stated that clean coal use and the development of new energy sources is crucial to China's development. With the priority given to the use of coal by the power sector, the use of advanced clean-coal technologies is a key policy focus for the future sustainable use of coal in China. CCT, such as ultra-supercritical plants, polygeneration, coal conversion, and CCUS, also represent a huge market for China's equipment suppliers.

Long-term developments in the Chinese energy sector underline the high uncertainty of Chinese coal demand, both upside and downside. This is accentuated by the uncertainty on the pace of rebalancing of the economy, the level of energy savings achieved in all sectors but particularly in major industrial sectors, and acceptance by China's citizens to pay higher energy prices. By 2035, the difference in coal demand of the power sector between the IEA/WEO New Policies Scenario and the 450 Scenario amounts to 1,130 Mtce, two-times the size of the total Pacific Basin steam coal trade. With this in mind, the high risk that players active on this market are exposed to with respect to Chinese coal demand becomes obvious[91]. In all scenarios, coal demand in the major importing coastal provinces is expected to decline. Therefore, the key question is what will be the source covering future (reduced) coal needs in the coastal provinces: imported coal from overseas or domestic coal transported from the north?

[91] IEA (2013), Medium-term Coal Market Report, IEA/OCDE, December 2013

Figure 13: Uncertainty about future demand: IEA/WEO Scenarios

CPS: Current Policies Scenario. NPS: New Policies Scenario

Source: IEA/WEO2013

Box 11: The Energy Development Action Plan (2014-2020) caps coal consumption at 4.2 Gt by 2020

China issued an energy development strategic action plan which caps coal consumption at 4.2 Gt by 2020. The plan was issued by the State Council on 19 November 2014[92], a week after China pledged for the first time to end growth in carbon emissions by 2030. China has also vowed to raise the share of non-fossil fuels in its total energy mix to 20 per cent by the same year. To achieve the targets, China needs to cap coal consumption by 2020.

Under the energy development plan, China is set to limit primary energy consumption at 4.8 Gtce by 2020. China consumed 3.76 Gtce in 2013, which means that the growth of energy consumption has to be controlled at an average annual rate of 3.6 per cent. The share of non-fossil fuels in total energy mix will rise to 15 per cent by 2020, while the contribution of coal will be capped at 62 per cent and that of natural gas is expected to exceed 10 per cent.

To meet the targets, coal consumption at newly-constructed thermal power plants must be lower than 300 g/kWh, and trans-regional ultra-high voltage power transmission lines will be further developed. Through measures like elimination of outdated energy-intensive industrial capacities and expansion of trans-regional power transmission, coal consumption in Beijing, Tianjin, Hebei and Shandong is forecast to drop 100 Mt from 2012 levels. Coal consumption at the Yangtze River Delta and the Pearl River Delta is forecast to register negative growth.

The government will focus on the development of 14 large coal production bases, which are expected to contribute 95 per cent of the nation's total output by 2020. It will also build more power plants near mines in the west and north of the country, and then use long distance transmission lines to carry electricity to the more populated east and south of the country.

The plan also said it boost railway construction, especially the key coal-dedicated rail line from western Inner Mongolia to Jiangxi in central China, aiming to achieve 3 Gt of rail coal capacity by 2020.

[92] State Council, Energy Development Strategic Action Plan (2014-2020), 19 November 2014, http://www.gov.cn/xinwen/2014-11/19/content_2780748.htm

According to CEC[93], China's total installed capacity of coal-fired power generation is expected to reach 1,000 GW in 2020, accounting for 56 per cent of the total installed capacity. The share of coal-fired capacity is projected to further decrease after 2020, down to 45 per cent by 2030 at 1,350 GW. Non-fossil fuel power's share of total installed capacity is forecast to be 39 per cent in 2020, up from 33.1 per cent at the end of 2013.

Clean energy from unconventional sources will be systematically explored and utilized. By 2020, shale gas output is expected to exceed 30 bcm and coalbed methane output to reach 30 bcm.

[93] China Coal Resource, China's coal-fired power capacity to reach 1 TW in 2020, 31 October 2014

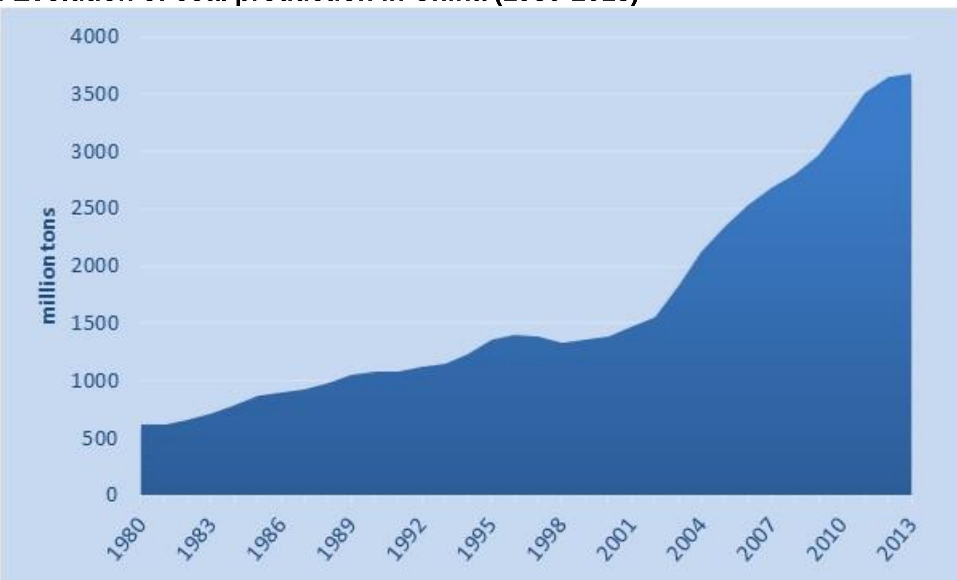
5. Coal supply

After the rapid expansion of coal production in the 1980s and the 2000s, leading to the construction of thousands of small and unsafe town and village coal mines, the central government has initiated a policy of consolidation of the scattered coal mining sector, with three priorities: eliminating outdated capacity and closing smaller mines, encouraging the formation of large state-owned mining groups, and building new large-scale clean-coal bases – mainly in northwest China. Improving mine safety, controlling the extensive mode of production, saving coal resources, and developing environmental awareness have also become leading priorities. After years of extensive production, the government has set a non-binding cap on national coal production for 2015. Restructuring of the coal mining sector has created a temporary mismatch between demand and production, which has led to growing imports since 2009. The influx of foreign coal combined with the expansion of Chinese production has moved the market from tightness to oversupply. Prices have fallen since 2011 to such an extent that 70 per cent of Chinese miners cannot recover their costs[94]. This crisis has pushed the government to intervene to resolve the oversupply situation.

5.1. Coal production has tripled since 2000

China is by far the world's largest coal producer and mined 47 per cent of global coal in 2013. Coal production has increased at a very impressive rate in the past decade, from 1.38 Gt in 2000 to 3.23 Gt in 2010 – an average annual growth of 9 per cent. Production has continued to increase in the past three years, however growth is slowing dramatically. In 2013, production grew to 3.7 Gt, a modest 1.3 per cent increase on 2012. The reasons of the slowdown are twofold: Chinese demand growth has slowed and the relatively low prices in the international seaborne trade have enhanced the attractiveness of imports over domestic coal.

Figure 14: Evolution of coal production in China (1980-2013)



Source: BP

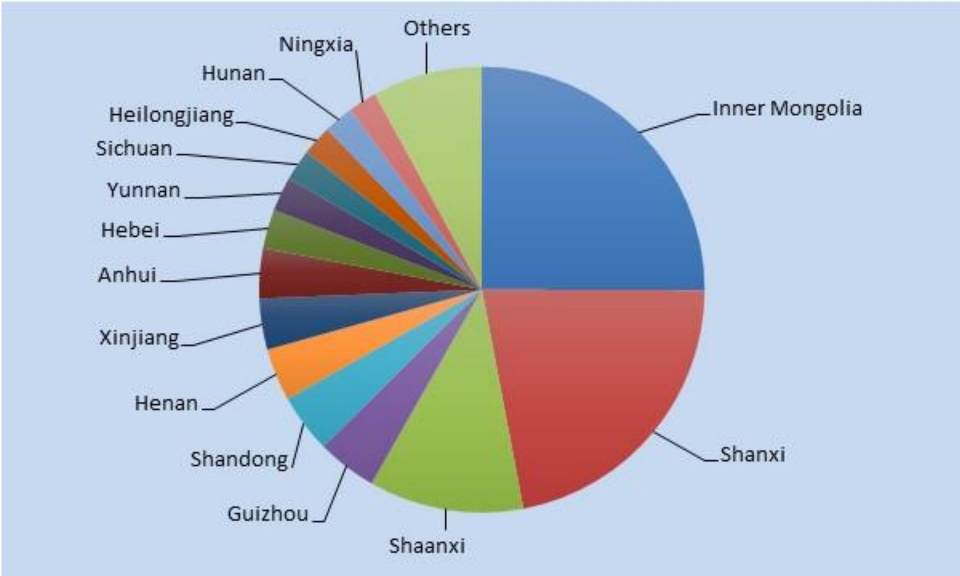
Although there are 27 provinces in China that produce coal, three provinces are responsible for the bulk of production: Inner Mongolia (994 Mt in 2013), Shanxi (964 Mt), and Shaanxi (493 Mt)[95]. Their

[94] Platts, CNCA head calls for production cuts to boost China's ailing coal sector, 25 July 2014

[95] China Coal Resource, Inner Mongolia 2013 coal output down 6.4% YoY, 13 January 2014, Shanxi coal industry performance in 2013, 20 January 2014, Shaanxi 2013 coal output ranks 3rd in China, 6 January 2014

combined output, 2.51 Gt in 2013, represented 68 per cent of China's total production. Inner Mongolia, China's top coal-producing region, accounted for 27 per cent of national output despite a 6.4 per cent decline of its production in 2013.

Figure 15: Coal production by major province in 2012



Source: NBS

5.2. Huge coal resources but unevenly distributed

5.2.1 Huge coal resources, but proven reserves are not well known

According to the World Energy Council (WEC)[96], China held 114.5 Gt of recoverable hard coal reserves at the end of 2011, the third-largest in the world behind the United States and Russia, and equivalent to about 13 per cent of the world total. Reserves were expected to last for 34 years at 2011 level of production and BP reported the same level at the end of 2013[97]. However, proven reserves are not well known. The WEC has not changed the reported reserves data since its 1992 edition despite the fact that China produced 47 Gt during the 1991-2013 period. The WEC justified its reserves estimate by applying an average recovery ratio of 35 per cent to the level of 'ensured reserves' published annually by the NBS (326.1 Gt for 2008, as quoted in the WEC 2013 edition). The NBS estimated 'ensured' coal reserves at 229.9 Gt in 2012[98].

The Chinese Ministry of Land and Resources regularly publishes resources data, however, they are difficult to interpret as they do not state proven economic reserves as defined internationally. As of end-2009, the ministry estimated proven coal reserves at 163.7 Gt[99], a figure much higher than the WEC's estimate. At the beginning of 2014, the ministry estimated total coal resources (within 2,000 meters below ground) at 5,900 Gt at the end of 2013[100], among which 2,020 Gt are discovered resources and the other 3,880 Gt are predicted resources[101].

[96] WEC (2013), World Energy Resources, 2013 Survey

[97] BP (2014), Statistical Review of world energy, June 2014

[98] NBS (2014)

[99] China Coal Resource, China newly proven coal reserves at 57.5 bln tons last yr, 27 February 2012

[100] China Coal Resource, China total coal resources almost 6 tln T by end-2013, 9 January 2014

[101] 'Discovered resources' are the quantity of coal estimated to be contained in known accumulations; 'predicted resources or prognostic resources', which are also called undiscovered resources, are the estimated quantity of coal in accumulations yet to be discovered; 'total coal resources' are the sum of discovered and predicted resources.

Box 12: Peak coal production?

The uncertainties about China's proven reserves led to a lively debate in 2007/2008 about a possible peak in coal production. In 2007, the Energy Watch Group[102] published a report on coal resources and future production which concluded that China would reach maximum production within the next 5–15 years, probably around 2015. Increasing exploration efforts since then have allowed the conversion of potential resources into recoverable reserves. Investment in coal mining boomed at the end of the 2000s to such an extent that it was one of the factors driving the market to overcapacity. Exploration in new regions (Xinjiang in particular) allowed the discovery of large coal resources. Investment to convert these remote resources into synthetic gas and electricity and transport them to central/eastern regions has allowed the government to transform these stranded resources into recoverable reserves.

More recently, a detailed analysis[103] showed that China's ultimate recoverable coal reserves equal 223.6 Gt, and its production could reach its peak by around 2024, with a peak production of approximately 4.1 Gt. Furthermore, the analysis states that actual production may peak earlier and the maximum production may be lower if some other factors are considered, such as water availability, land availability, transportation capacity, and climate change. As the government now caps coal consumption and production at 3.9 Gt by 2015 and is seeking ways to resolve the oversupply situation, the debate on coal supply and peak in coal production has lost relevance in the short term. It demonstrated, however, that despite its significant coal resources, China had to limit its extensive mode of production and save coal resources, which has been an important driver for coal imports. In the medium term, sustainability criteria may limit future coal production (see Section 5.5).

5.2.2 Coal resources are far from consumption centers

Coal deposits are located in most Chinese regions but three-quarters of resources are in the north and northwest of the country, particularly in the provinces of Shanxi, Inner Mongolia, Shaanxi, and Xinjiang, far away from major consumption centers.

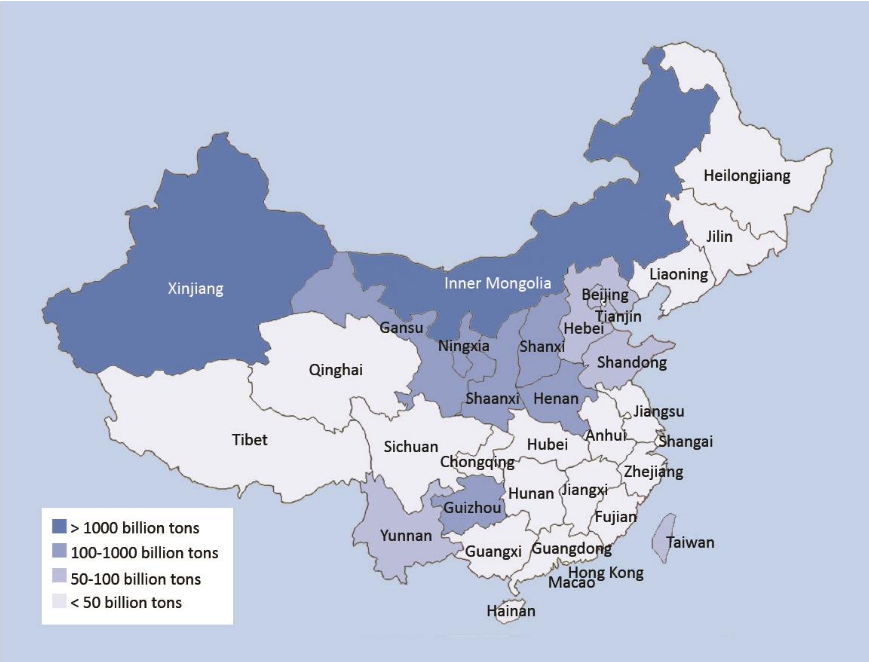
The Xinjiang region is estimated to hold coal resources of 2.19 trillion tons, around 40 per cent of China's total, but its reserves are underdeveloped due to transportation bottlenecks. To overcome this obstacle, new rail infrastructure and UHV lines are being built to transport coal and electricity to neighboring and eastern provinces.

Due to the location of coal mines, transportation bottlenecks have been a recurrent problem leading to serious coal shortages in winter months (see Chapter 6).

[102] Energy Watch Group (2007), Coal: Resources and future production, EWG-Paper No. 1/07, 10 July 2007

[103] Wang J., Feng L., Tverberg G. (2013), An analysis of China's coal supply and its impact on China's future economic growth, Energy Policy 57 (2013), pp. 542–551 and Wang J. Feng L., Davidsson S, Höökand M., Chinese coal supply and future production outlooks, Energy Policy 60 (2013), pp. 204-214

Map 2: China coal resource distribution

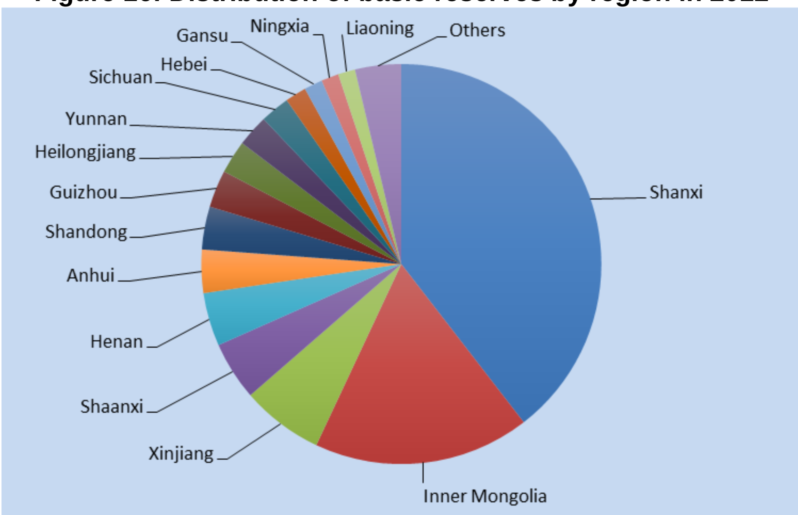


Note: The boundaries and names shown and the designations used on maps included in this publication do not imply official endorsement or acceptance by either the author or the Oxford Institute for Energy Studies

Source: ICIS China, 2014

According to NBS, 62 per cent of basic coal reserves[104] are deposited in the area referred as the 'Tri-West Area' which consists of Shanxi, Western Inner Mongolia, and Shaanxi. Southern coastal areas with the highest GDP growth, such as Guangdong and Fujian, are among China's least coal-abundant provinces.

Figure 16: Distribution of basic reserves by region in 2012



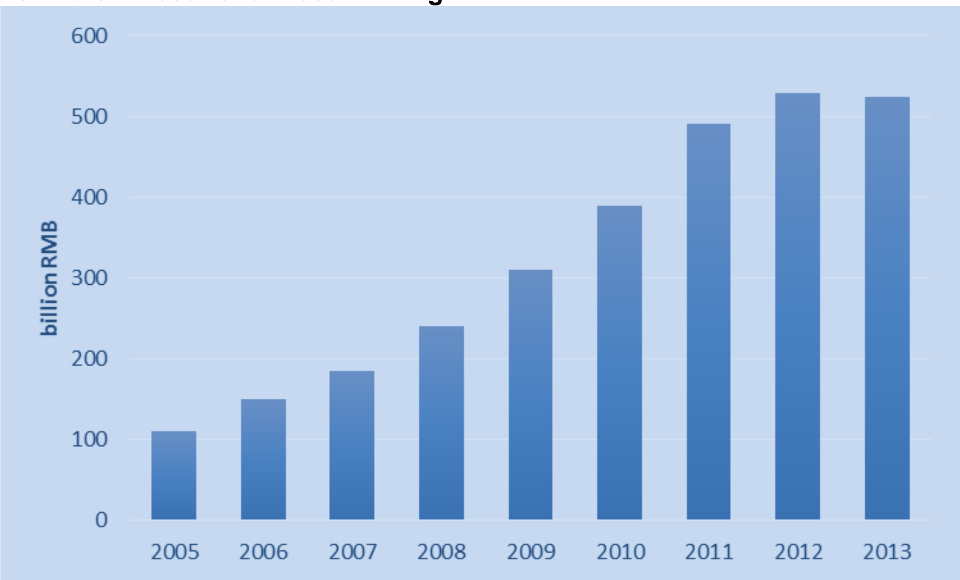
Source: NBS

[104] Basic reserves are a part of total identified coal resources that can satisfy an index including grade, quality, thickness and technical conditions under current mining conditions. The losses associated with designing and mining have not been deducted.

5.2.3 Investment in coal mining is slowing

From 2000 to 2005, investment in the coal sector totaled only RMB200 billion ($32 billion at the 2013 exchange rate). This low figure led to coal shortages on the domestic market, particularly acute in 2008 and 2009. Investment surged to double-digit percentages during the stimulus era of 2009-2011. Even as the economic activity noticeably decelerated, China invested RMB529 billion in 2012 and 523 billion in 2013. The recent massive investment spree has led to a huge supply overcapacity. While coal investment declined slightly between 2012 and 2013, it is bound to slow further, as sluggish demand weighs on the industry and weak coal prices decrease profitability of the sector.

Figure 17: China's investment in coal mining



Source: NBS

5.3 Restructuring and consolidation of the coal industry

The structure of China's coal industry has traditionally reflected the structure of Chinese politics and society. Large state-owned coal companies, such as Shenhua and China Coal, dominate the sector and report to the central government. Beneath them, local state-owned enterprises (SOE) fall under the jurisdiction of provincial governments, while at the bottom end of the production scale are thousands of small mines operating within towns and villages (TVE or town and village enterprises), controlled by agricultural collective economic organizations[105]. Since the middle of the last decade, the central government has initiated a policy of consolidation in the coal industry, closing smaller mines and encouraging the formation of large mining groups, operating large-scale coal bases and integrating power and chemical production[106]. Despite years of consolidation[107], there are still some 12,500 mines, with some 10,000 producing less than 300,000 tons per year.

5.3.1 Closure of small unsafe mines

Local SOE and TVE typically have small production, poor efficiency, lack of access to capital, and poor safety records. Fatalities at TVE mines numbered 4,000-5,000 every year during the 1990s and, while safety has improved, the industry still recorded over 1,000 deaths in 2013 from mining

[105] *World Coal (2013), China's coal conundrum, October 2013*

[106] Xianzheng W. (2014), Advancing China's coal industry, cornerstone, 10 April 2014, http://cornerstonemag.net/advancing-chinas-coal-industry/

[107] During the 11th FYP (2006-2010), the number of coal mines fell 40% to some 15,000.

accidents108. Small mines also suffer from low productivity and low yields. The exploitation rate of TVE mines is typically 10-15 per cent, while that of key state-owned coal mines is generally 50 per cent. Productivity in China therefore remains very low. The coal mining industry employs 5.7 million workers to produce 3.7 Gt, while in the United States, 90,000 employees produced 0.9 Gt in 2013. Small mines also suffer from a low rate of adoption of modern equipment, mechanization, and advanced management techniques. Due to their smaller size and disparate nature, the smaller mines are more difficult for the central government to control and monitor tax evasion, industrial accidents, and environmental degradation.

To address overcapacity, uncontrolled development of coal production, low-quality production, safety, and environmental issues, the Chinese government has stepped up consolidation efforts. China closed 1,200 small-scale mines in 2013, while 1,725 small mines with a 117 million-ton capacity are going to close or integrate into larger mines in 2014. Old and increasingly depleted eastern and southwestern mines are the focus of the closure program.

In November 2013, local governments were ordered to gradually shut all coal mines with annual production of less than 90,000 tons, including mines operating illicitly without safety requirement compliance. In addition, small coal mines with annual capacity below 300,000 tons will not be allowed to be developed, and no approvals will be granted to those with designed annual capacity below 900,000 tons but prone to accidents, such as coal and gas outbursts.

China also aims at further reducing the operating coal mining enterprises to around 4,800 by the end of 2014; down from more than 6,300 at the end of 2013. According to the ‘12th Five-Year Plan of Coal Industry Development’ (the Coal Plan) issued by the NEA in March 2012, the national coal enterprises will be controlled at less than 4,000 by the end of 2015 through mergers and acquisitions, and the average capacity increased to more than 1 Mt per year.

Box 13: Political drive to consolidate bearing fruit

Consolidating the coal industry has long been one of Beijing's strategic industrial policy imperatives, and serves a variety of deeper political imperatives[109]. In addition to increasing safety record of the sector, it rationalizes and stabilizes national coal output, enhances economic interdependencies between regions, and strengthens the central government's position vis-a-vis local governments in traditional coal mining regions.

As long as coal demand and prices were high, as they were for most of the 2000s, efforts to rationalize the sector were unsuccessful. Local governments had a strong incentive to keep small-scale local mines operating, as they generated revenue for the local governments and kept employment high. Now that the economy and coal demand are slowing, coal prices have significantly declined, and as a result, small-scale producers are having difficulties in recovering their operating costs and are having to curb output substantially. The following data on coal output in Inner Mongolia reveal that the pace of consolidation has accelerated significantly since 2013, while production by local SOE and TVE has declined sharply in 2013 as miners made big losses and could no longer sustain operations. According to a report from the China Coal Transport and Distribution Association, as many as 24 per cent of the coal mining companies in Inner Mongolia suffered losses totaling RMB4.06 billion in 2013.

[108] 2,200 deaths in coal mining accidents in 2010. The number of deaths in coal mining accidents fell to 1049 in 2013.

[109] Stratfor (2013), China's Potential Opportunity to Consolidate the Coal Industry, 20 July 2013

Table 11: Coal production in Inner Mongolia, by type of enterprise

	2013 (million tons)	% change/2012	First half 2014 (million tons)	% change/First half 2013
Local SOE	68.89	-18.8%	8.01	-79.2%
TVE	215.46	-51.7%	18.31	-82.0%
Key state-owned SOE	709.95	33.7%	425.14	18.8%

Source: China Coal Resource

Declining coal demand and prices have favored Beijing's industrial consolidation drive by eliminating increasingly unprofitable private coal enterprises and forcing those that survive to amalgamate or be subsumed under state-controlled entities.

5.3.2 Creation of 10 large coal firms

In addition to the closure of small mines, the government promotes mergers and acquisitions in the coal industry to create large groups able to develop economies of scale and apply advanced mining technologies. The Coal Plan foresees the continued consolidation of the industry by forming 10 coal firms, each with at least 100 Mt of annual production capacity (mtpa) by 2015 and another 10 companies with about 50 mtpa of capacity. These 20 companies would then be responsible for 60 per cent of the country's output of coal by 2015.

Although TVE and local SOE in aggregate still account for around a third of total coal output, the pace of consolidation has accelerated. By the end of 2013, China had eight coal enterprises with at least 100 mtpa of production capacity that produced 37 per cent of the 2013 output, including Shenhua (318 Mt in 2013), China Coal (161 Mt), Datong Coal Mine, Shandong Energy, Jizhong Energy, Shaanxi Coal and Chemical Industry, Henan Energy, and Shanxi Coking Coal. The level of concentration, however, is still low compared with other major coal producing countries: in the United States, the top four companies produce 70 per cent of total output.

Integration between coal and power utilities is also promoted to solve the ‘coal-power conflict’[110]. Currently, the combined installed capacity of coal enterprises is more than 130 GW. In addition, coal producers are becoming more involved in midstream and downstream activities, such as logistics, trading, and conversion of coal.

[110] Power prices in China are government regulated, based on the cost plus principle. But prices are controlled by the NDRC. For decades, the price of electricity has been kept low to control inflation. Moreover, power prices are not fully directly linked to coal input price, which is market driven. Hence, only a portion of the coal price increase/decrease may be passed through to the customers. In periods of high coal prices (before 2013) power companies could not recover their full costs and hence accumulated losses, while in low price periods (post-2013) the power business acts like a downside protection for coal miners, compensating the loss on coal sales. Integration of coal and power allows companies to compensate losses in one segment with profits in the other segment.

Box 14: Vertical integration: the business model of Shenhua

Shenhua Energy Group, China's largest coal mining company, has a vertically integrated business model which provides it with competitive advantage over the other domestic producers. Shenhua owns coal-fired power plants with capacity of 65 GW at end 2013 and coal transportation networks including railways, ports, and ships. Its power business provides a stable captive market for its coal production. In 2012, about 80 per cent of the coal consumed by its power business came from its coal operations, which amounted to 17 per cent of its total coal sales volume. Furthermore its railway network connects to its ports, allowing the company to dominate the seaborne trade and achieve steady supply despite the transportation challenge in China.

In 2013, Shenhua produced 318 Mt of commercial coal, sales of which totaled 515 Mt, among which the seaborne sales of self-produced coal and purchasing coal was 225 Mt, representing a third of the northeastern coastal market.

5.3.3 Construction of 14 large coal bases

The Coal Plan of March 2012 emphasizes the need to change the development pattern of the coal industry and focuses on the development of large coal bases and a modern coal industry, guaranteeing a steady energy supply and coordinated growth between resource development, and ecological environment. According to the plan, during the 12th FYP period, China will build 14 large coal bases and annex and restructure 20 coal bases in order to help meet the country's five-year energy-saving goal. The coal industry is expected to be capable of producing 4.1 Gt of coal by the end of 2015, though the Coal Plan calls for capping the output at 3.9 Gt in 2015 to control energy use and reduce carbon emissions.

During the 11th FYP, 13 national coal bases were created and a 14th added, in Xinjiang, in 2010. These large bases are located in Jindong (eastern Shanxi), Jinzhong (central Shanxi), Jinbei (northern Shanxi), northern Shaanxi, Huanglong (Sichuan), Ningdong (eastern Ningxia), Shendong (Shaanxi and Inner Mongolia), Mengdong (eastern Inner Mongolia), Jizhong (central Hebei), Luxi (western Shandong), Henan, Lianghuai (northern and southern Anhui), Yungui (Yunnan & Guizhou), and Xinjiang. Altogether, the 14 large mining bases are expected to account for over 90 per cent of China's coal output by 2015.

The development of the large coal bases is differentiated according to their location. The policy aims at speeding up the construction of coal bases in the northwestern regions (northern Shaanxi, Huanglong, Shendong, Mengdong, Ningdong, Xinjiang), optimizing the development in the center of China (Shanxi Province, Jinzhong, Jindong, Henan, Lianghuai, and the Yunnan-Guizhou coal base resources), and controlling development scale and intensity in the eastern part (Jinzhong and Luxi).

The focus is on the construction of large-scale, clean, and efficient coal bases. The government promotes the transformation of coal to high value-added products (coal-to-liquids, coal-to-olefins, and coal-to-gas), the use of advanced technologies, and the preservation of local environment.

Table 12: Outlook for coal production in the 14 large-scale coal bases

Bases	Province	Planned annual coal mining capacity in 2015 (million tons)	Reserves (billion tons)	Main conversion projects
Shendong	Shaanxi & Inner Mongolia	520	223.6	A number of plants are already operating on the Shendong base, including the Shenhua CTL plants, Shenhua Baotou plant, Yitai Group CTL plant, Datang SNG plant and Rongxin Inner Mongolia Coal to Methanol Plant. There are plans to produce more than 50 bcm of SNG, 800,000 tons of DME and 500,000 tons of coal tar in the base.
Jinbei, Jinzhong, Jindong	Shanxi	735	908	Production of the 3 bases will be 3 million tons of methanol, 600,000 tons of olefin, 300,000 tons of DME, 160,000 tons of CTL and 100,000 tons of maleic anhydride.
Mendong	Eastern Inner Mongolia	520	68.4	The Lu'an Group CTL plant and the Fuxin SNG plant are both operating there. The coal chemical products planned for the base are 400,000 tons of glycol, 10 bcm of SNG, 1.2 million tons of methanol and 460,000 tons of propylene
Lianghuai	Anhui	150	27.1	The planned coal chemical products for this base are 1.7 million tons of methanol and 600,000 tons of olefin.
Yungui	Yunnan and Guizhou	260	43.5	The planned coal chemical products for the base are 500,000 tons of methanol and 600,000 tons of polyolefin.
Jizhong	Hebei	80	6.5	
Luxi	Western Shandong	140	18.6	The Shandong Hai Coal & Chemical Company Coal to Methanol Plant is operating at Luxi
Henan	Henan	215	24.5	The plans for the base include the production of 750,000 tons of methanol, 400,000 tons of ethylene glycol and 1.8 million tons of olefin
Shaanbei	Northern Shaanxi	300	109.8	The Shenhua-Dow Coal to Chemicals Plant was forseen to be built there. The project was stalled in 2014.
Ningdong	Ningxia East	100	32.3	Shenhua hopes to complete the base in 2020. The base is expected to produce 4 million tons of a variety of liquid chemical products. Each year, it will consume 100 million tons of coal from surrounding mines.
Huanglong	Shaanxi & Gansu	145	15.7	The Inner Mongolia Datang International Hexigten SNG plant is operating at Huanglong, where a planned 800,000 tons of methanol plant will be built..
Xinjiang (Turpan-Hami, Junggar, Ili and Kubai)	Xinjiang	420	161	The Xinjiang Guanghui Hami Coal to Methanol Plant is already operating there. A production of 50 bcm of SNG is planned at Xinjiang, as will 800,000 tons of DME and 500,000 tons of coal tar.
	TOTAL	3585		

Source: Greenpeace (2012)[111], author's compilation from various sources

5.4 The coal industry in crisis

The coal industry has been in crisis since 2012 due to weaker demand and strong competition from overseas suppliers, with the arbitrage between domestic and international prices making imports more attractive. Growing imports and the expansion of coal production – although modest – has turned the domestic market from tightness to oversupply and exerted downward pressure on domestic coal prices. The oversupply is reflected in China's coal inventories, which have remained at around 300 Mt since 2012, up from the typical rate of 150-200 Mt. Since then, Chinese miners have suffered from overcapacity, higher production costs, low profits, and competition from imports. No coal operator has been spared the effects of the country's ongoing economic slowdown and weak prices, but China's smaller coal operators have been the hardest hit. They have also suffered from increasingly restricted access to credit.

5.4.1 Weak coal prices

Weaker coal demand due to slowing economic growth and environmental concerns, combined with a flood of cheaper imports, have caused a sharp decline in domestic coal prices. After a 16 per cent drop in 2013, spot prices at Qinhuangdao fell a further 16 per cent in the first half of 2014 to RMB515 per ton at the beginning of July 2014, a six-year low.

[111] Greenpeace (2012), Thirsty coal: a water crisis exacerbated by China's new mega coal power bases, August 2012, http://www.greenpeace.org/eastasia/Global/eastasia/publications/reports/climate-energy/2012/Greenpeace%20Thirsty%20Coal%20Report.pdf

Figure 18: Historical evolution of coal prices at Qinhuangdao

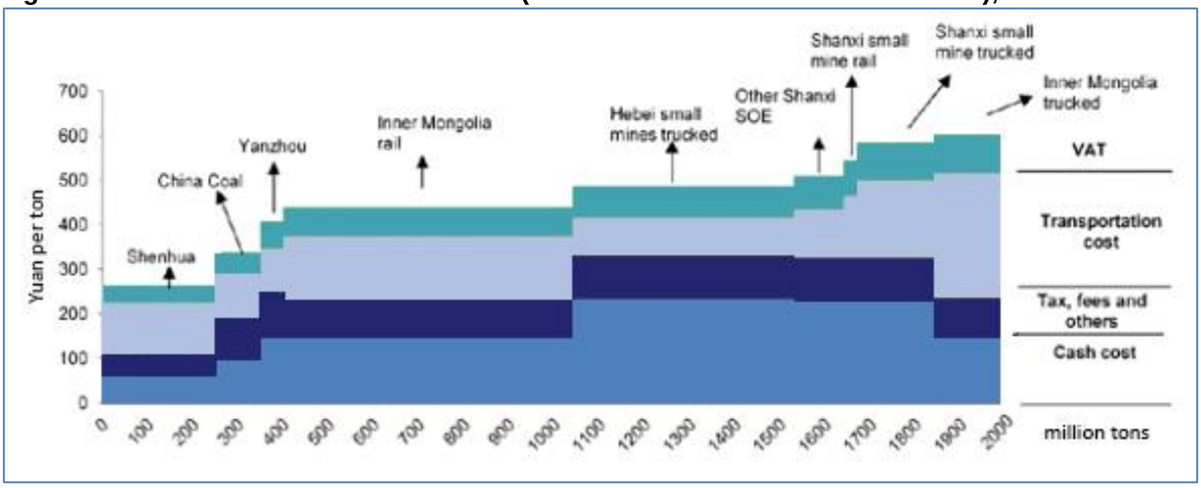
Prices for domestic coal, 5500 kcal/kg, VAT included

Source: Deustche Bank, China Coal Resource

5.4.2 Current prices below operating costs of small miners

While all mining companies are negatively impacted by low domestic prices, the small and medium-sized producers are reported to incur higher production costs than current prices, whereas big companies continue to expand their operations. The level and structure of costs in China differ significantly from one operator to another and largely depend on transportation mode. The following curve illustrates the coal cost curve of steam coal produced in the northwest regions for delivery at Qinhuangdao port, with the price (including 17 per cent VAT) broken down in production cost, taxes, transportation costs, and VAT.

Figure 19: China thermal coal cost curve (coal delivered to northeast of China), end of 2013



Source: Market Realist, from Macquarie Research, 2014[112]

The cost curve suggests marginal costs to deliver thermal coal to customers fell to around RMB550 to 600 per ton in China by end 2013 (equivalent to $88 to 97 per ton), after the government introduced measures to lower fees and levies on coal in November 2013. The graph shows that production costs account for less than half of the delivered price of coal at Qinhuangdao and range from RMB75 to 200

[112] Market Realist, Seaborne coal gluts suggest limited upside for fertilizer stocks, 20 March 2014 http://marketrealist.com/2014/03/seaborne-coal-supply-glut-suggests-limited-upside-for-nitrogen-fertilizers/

($12 to 32/ton). Transportation costs account for another 20-40 per cent, while coal levies and taxes make 15-20 per cent of the delivered price (before VAT), compared with 25-35 per cent before the government decided to track down illicit regional taxes.

Large companies, such as Shenhua and China Coal, enjoy the lowest costs as they benefit from large economies of scale and access to their own transportation railroad. In 2013, Shenhua reported an average production cost of self-produced coal of RMB124.5 per ton. The picture is different for many small coal miners, particularly those in landlocked Inner Mongolia, which is far from coastal buyers, railways, and ports, thus forcing small-scale miners to rely on expensive trucking for delivery. They are also facing shrinking credit issues. Besides traditional banks, coal miners in Inner Mongolia and beyond have relied heavily on China's shadow banks as the government has set minimum production quotas and cut off lending from state-owned banks to small coal miners. Shadow loans typically carry extremely high interest rates, which are manageable in boom times, such as 2009 & 2010, but when business slumps, as started happening in 2011, small-scale coal miners are suddenly unable to pay back their loans[113]. Falling market prices have forced many small miners to close or integrate with the larger coal miners (see above).

5.4.3 Profits slump

From 2002 to 2011 – the 'golden years' of the coal industry – the sector enjoyed double-digit profits, peaking at above 15 per cent in 2008. Since then, profits in the sector have shrunk: in 2013, the sector earned a profit of RMB236.99 billion ($37 billion), down 33.7 per cent year-on-year, according to NBS. Profit from the major companies (with an annual revenue above RMB20 million) reached RMB203.49 billion, plummeting 44.1 per cent from 2012, while unprofitable producers recorded a combined loss of RMB40.6 billion.

Even the largest coal mining companies were impacted. In 2013, Shenhua posted a 5.8 per cent decline, with net profit slipping to RMB45.7 billion ($7 billion), down from RMB48.9 billion in 2012. China Coal Energy Co., the nation's second-largest producer, reported a 61.5 per cent decline in 2013 net profits to RMB3.58 billion, while Yanzhou Coal Mining Co. profit plunged 88 per cent.

The Chinese National Coal Association (CNCA) indicated that in the first half of 2014, more than 70 per cent of China's coal companies reported losses and more than half of them had difficulties in paying worker wages[114].

5.4.4 Measures to resolve overcapacity: coal output to decrease in 2014

In November 2013, the government announced a series of measures aimed at stabilizing domestic mining and addressing its financial difficulties. The State Council's opinion on 'promoting the smooth and steady operation of the coal industry'[115] highlighted five approaches, namely:

- Curbing the disorderly growth of coal production by closing the least profitable small mines and tightening the approval of new coal mines (see Section 5.3.1);
- Reducing the tax burden on coal companies by tracking down illicit regional taxes (see Sections 3.5.2 and 5.4.2);
- Strengthening the management of coal imports and exports by formulating commercial coal quality national standards, considering differentiating tariffs to encourage high-quality coal imports, banning sale and imports of low-grade coal with high ash and high sulfur contents, and adjusting coal export policies in a timely manner in accordance with domestic and international market circumstances (see Chapter 8);

[113] South China Morning Post, China's coal miners in crisis, 2 April 2014, http://www.scmp.com/business/commodities/article/1462997/chinas-coal-miners-crisis

[114] Platts, CNCA head calls for production cuts to boost China's ailing coal sector, 25 July 2014

[115] State Council, opinion on "promoting the smooth and steady operation of the coal industry", 28 November 2013, http://www.gov.cn/zwgk/2013-11/28/content_2536862.htm

- Improving the level of coal production and operation, mainly by improving internal management and safety level of production;
- Creating a favorable environment for the development of coal enterprises, by better coordinating supply and demand balance and promoting long-term contracts between producers and users.

In May 2014, the NDRC announced further measures targeting over-mining and safety problems in coal industry[116]. The NDRC's guidelines call for coal industry regulators, safety officials, and state-owned mines to curb the over-mining problem and improve working safety standards in three years. For large and medium-sized mines, the newly constructed mines are restricted to exploit coal at a depth of less than 1,000 meters, and no more than 1,200 meters for those with capacity expansion after reconstruction. For small mines, both new and reconstructed mines are restricted to less than 600 meters deep.

Production is to be controlled and if adjustments are necessary in certain months, revised monthly production plan should not exceed 10 per cent of the average monthly output during the year, and mine managers will be held responsible for over production.

In August 2014, the government announced a new order that regulates the coal sector[117], replacing the previous regulations which were in place since 2004. Among other key changes, the order simplifies companies' entrance in the coal business, but increases their supervision. Potential operators no longer need to go through a long qualification process in order to participate in the coal business, and instead need only to register with relevant government authorities, though they will, however, be required to report details of their operations to the relevant authorities as part of efforts to strengthen integrity of the industry. The NDRC will establish a uniform supervision and management information system to better regulate coal businesses. The new order also prohibits local governments and transport hubs, such as rail stations and ports, to impose unreasonable fees, while encouraging coal producers to sign long-term supply contracts with end users directly.

The details of the new supervision and management information system are not yet known. However, it seems that two of the objectives are to better supervise supply and demand balance and avoid illegal mining and oversupply issues. This will greatly enhance the central government's control over the sector and over coal prices.

In addition to central government's efforts to tackle the overcapacity issue, in July 2014, China National Coal Association (CNCA) called on large coal producers to cut production by 10 per cent during the second half of 2014, to reduce coal inventories and to control coal imports[118]. In response, Shenhua announced its intention to cut production by 50 Mt or about 10 per cent of its original target for 2014, China Coal Group announced a reduction of 20 Mt[119], while Datong Coal Mine Group, based in Shanxi, said it would cut coal production and sales by 10 Mt. In a further step, in the middle of August 2014, the NDRC issued a notice aimed at curbing coal production, calling on local governments to curb overproduction at coal mines in the second half of the year[120].

Coal production in the first ten months of 2014 had already declined 1.5 per cent to 3.16 Gt. It is estimated that the announced cuts will see China produce some 200 Mt less coal in 2014 than expected at the beginning of 2014[121]. This corresponds to a decline of 2.5 per cent compared with

[116] China Coal Resource, China targets overmining in coal sector, 14 May 2014

[117] NDRC (2014), Coal business regulatory approach, Order N° 13, 6 August 2014, http://www.ndrc.gov.cn/zcfb/zcfbl/201408/t20140806_621405.html

[118] FinanceChina, 26 August 2014, http://finance.china.com.cn/news/20140826/2636599.shtml

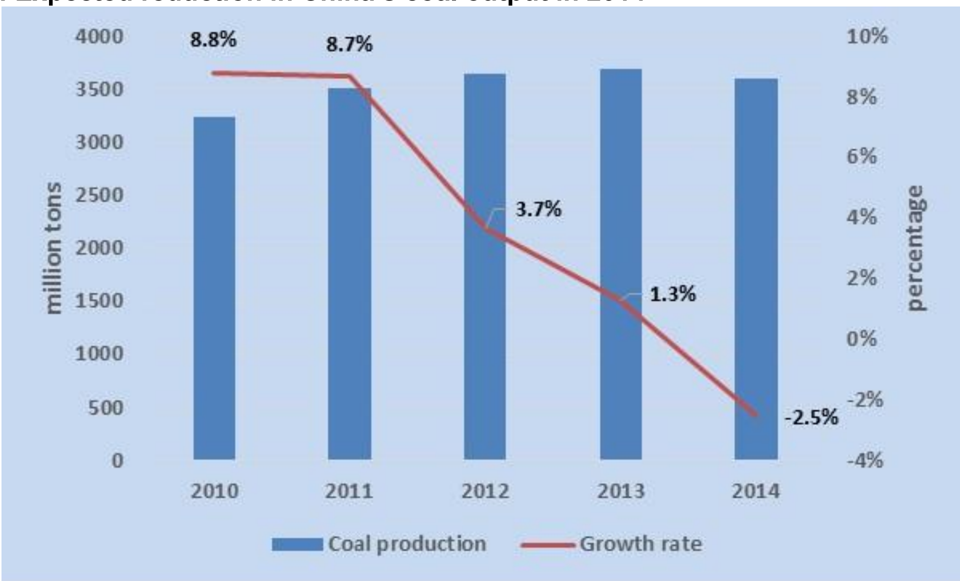
[119] China Coal Resource, China Coal Energy cuts 2014 output target by 10 pct, 13 August 2014

[120] China Coal Resource, China coal giants axe output to bolster struggling market, 28 August 2014

[121] The top 10 companies had a combined output of around 1,500 Mt in 2013. Assuming all of them cut their production by 10 per cent, this would represent a cut by 150 Mt in the second half of 2014. Adding the cut in small mines production, this would represent a reduction in total coal output of some 200 Mt to 3.6 Gt in 2014, instead of 3.8 Gt expected at the beginning of 2014.

2013 and would be the first reduction in China's coal production since 1998. Solving the overcapacity issue, however, requires strict discipline among producers.

Figure 20: Expected reduction in China's coal output in 2014



Source: 2010-2013: NBS, 2014: author's estimates.

5.5 New capacity: moving westwards

At the same time that the central government is ordering closure of outdated and small coal mines and measures to resolve the oversupply issue, new, modern, large-scale mining capacity is to be added. According to the Coal Plan, China plans to add new coal production capacity of 740 mtpa in the five years ending 2015, with the total capacity limited to 4.1 Gt. This means that the development of the coal industry will continue, but move westwards. Indeed, the national development goals are to 'control the output in the eastern region, stabilize the output in the central region, and develop the output in the western region'. According to the plan, by the end of 2015, the country will build 530 mtpa of new capacity in the western regions (Inner Mongolia and Xinjiang mainly), accounting for 72 per cent of total construction. About 25 per cent of new-builds (185 mtpa) will be built in central regions and 3.3 per cent (25 mtpa) in the east and northeast.

In 2013, the government approved the construction of 15 new large coal mines with 101.3 mtpa of capacity, up from 16.6 mtpa approved in 2012. The projects involved a total investment of RMB54.1 billion ($8.9 billion). Much of this new capacity is in newer sources of supply in Shanxi, western Inner Mongolia, and Shaanxi (the 'Tri-West area'), reflecting the strategy to close small mines and consolidate output in a series of large bases that will deliver thermal power to markets via the grid and convert coal into high value-added products. In Inner Mongolia, the NDRC approved the development of the Ordos Shanghaimiao Mining Area – the first state-level energy and chemical industry base in Inner Mongolia – with a capacity of 61.6 Mt per year.

The approval process of new mines in the Tri-West area has continued since January 2014, and by May 2014 the NDRC had approved nine projects totaling 49.8 Mt of new capacity, evenly distributed in the three provinces, with investment estimated at RMB31.5 billion[122].

However, the largest development is expected to come from the northwestern Xinjiang region, which holds almost 40 per cent of the country's coal resources (2.19 trillion tons). The coal is of good quality and the deposits are at shallow depth, thus reducing production costs. Xinjiang produced only 142 Mt

[122] China Coal Resource, Three coal mine projects gain govt approval in May, 29 May 2014

in 2012 (an estimated 160 Mt in 2013), though the government aims to boost annual coal capacity to 400 Mt by 2015 (the regional Coal Plan sets a target of 420 Mt).

Box 15: Xinjiang: future super energy base

The Uygur Autonomous Region aims to become the country's onshore strategic energy base, according to a plan drafted by the Xinjiang Development and Reform Commission, the regional counterpart of the NDRC[123]. The draft plan includes the construction of the nation's 14th large coal production base by focusing on development of coal, power, and coal conversion industries. The region, also rich in oil, gas, and renewable resources, expects to build a large oil and gas production and processing base and a wind-power base. According to the draft plan, the region will have an annual energy delivery capacity of 50 Mt of crude oil, 100 bcm of gas, and 30 GW of power by the end of 2015.

In March 2014, the region received NDRC's approval to construct four major bases (Turpan-Hami, Junggar, Ili, and Kubai), including 36 mining areas. As approved, the Turpan-Hami coal base will focus on the delivery of coal and thermal power outside the autonomous region, the Junggar and Ili coal bases will mainly develop coal chemical demonstration projects and power generation, while other bases will produce coal for regional industrial and residential needs. The approval enables Xinjiang to achieve its coal production capacity target of 420 mtpa by 2015, with 204.1 mtpa in Junggar, 78 mtpa in Turpan-Hami, 100 mtpa in Ili, and 37.9 Mt in Kubai[124]. Xinjiang has been developing its coal industry vigorously, aiming to raise production capacity of large mines to 340 mtpa by 2015, or 81 per cent of the total planned capacity, and that of medium-sized mines to 77 mtpa or 18 per cent of the total, while controlling the number of small mines to 30 or so with annual capacity of 3 mtpa or 1 per cent of the total.

The Xinjiang Development and Reform Commission has master plans for the development of 42 mining areas, with a 1,746 mtpa of coal capacity, representing almost half of China's total coal output in 2013[125]. In July 2014 the NDRC approved the master plans of 22 coal mining areas, which have a combined production capacity of 817 mtpa. The master plans for another 12 mining areas with planned capacity of 522 mtpa are waiting for approval from the NDRC, while plans for the other eight mining areas with capacity of 407 mtpa are being formulated.

The development of coal production in Xinjiang is a major challenge: the Uygur Autonomous Region is located in the extreme northwest of the country, nearly 3,000 km away from major northeastern ports, thus making transportation of coal to the east and center of the country a major bottleneck. To tackle this issue, new railways and UHV lines are being built, while the region is also stepping up transportation of SNG via the East-to-West pipelines and dedicated SNG pipelines.

A key challenge to coal production and conversion projects in Xinjiang is the high water requirement of these operations. In Xinjiang's dry climate, water management will be a key issue for coal miners given the regional water requirements for agriculture. Water issues will be the restrictive factor to the development of the coal industry, as envisaged by the Xinjiang Development and Reform Commission.

5.6 Future coal production constrained by sustainability factors

In the short term, growth in national coal production is limited by oversupply issues, while in the medium and long term, although China holds very large coal resources, sustainability factors may limit the portion that can be produced under existing technology. Coal production in China faces many challenges, such as over-mining and depletion of resources in East China, quality and safety issues

[123] China Coal Resource, Xinjiang aims to become strategic energy base, 25 April 2014

[124] China Coal Resource, Xinjiang gains approval to build large coal bases, 28 March 2014

[125] China Coal Resource, NDRC approved 22 coal mining area master plans in Xinjiang, 10 July 2014

with a large proportion of resources that will never be produced (deep underground deposits, high-sulfur coal), and environmental constraints.

5.6.1 Quality issues

Quality issues have been under discussion since the beginning of 2013, both for imported and domestic coal, with a proposed ban on the production, import, and sale of low-quality coal with high sulfur and high ash contents. The ban under discussion in May 2013 [Measures of Commercial Coal Quality Management (Draft)] was less stringent for domestic coal than for imported coal. The draft document (never officially published) envisaged the regulation of commercial coal quality management and circulation flow, the improvement of commercial coal quality and the promotion of clean coal use[126]. The proposed restriction for domestic coal applied to lignite with energy content lower than 2,870 kcal/kg, net-as-received (NAR) and 3,587 kcal/kg, NAR for all other thermal coals, sulfur and ash content higher than 3 per cent and 40 per cent respectively[127]. The proposal was later modified in December 2013 and the thresholds on calorific values revised upwards. The new draft also prohibited the transport of low-quality, high-sulfur, and high-ash coal over distances beyond 600 km. The measure was viewed as a way to reduce dust associated with the inland transport of low-quality coal, the use of which (complying with some defined criteria on caloric value, sulfur, and ash) would be restricted to local use in power plants adapted to burn these fuels and equipped with depollution devices.

New quality restrictions for low-calorific value coal and high ash and sulfur content were published by the NDRC in September 2014 ('Commercial coal quality management Interim Measures'[128]) and will become effective on 1 January 2015. Although they apply to both domestic and imported coal, their impact, largely commented for imported coal (see Section 8.4) has not got a lot of attention on the domestic market, despite the fact that the measures could significantly restrict domestic production of low-quality coal. The new restrictions prohibit the production of lignite with ash and sulfur content higher than 30 per cent and 1.5 per cent respectively. They also prohibit the transport of low-quality coal (less than 3,946 kcal/kg), high-ash (higher than 20 per cent) and high-sulfur (higher than 1 per cent) coal over distances beyond 600 km. They also prohibit the production of bituminous coal with ash and sulfur content higher than 40 per cent and 3 per cent respectively. An additional restriction applies to the three target regions and prohibits the sale of high-ash and sulfur coal (above 16 per cent ash and 1 per cent sulfur) in line with the APPC.

Chinese coal typically has a sulfur content of 1 per cent or less, but a high-ash content of 23 per cent on average and even higher in some regions[129]. Some coal qualities in Southwest China have high sulfur content (above 3 per cent) but their production is already restricted. Energy content tends to be low (5,400 kcal/kg NAR on average) but could be improved by washing. According to the APPC, the proportion of thermal coal washing has to be increased to 70 per cent by 2017, compared with less than 40 per cent currently[130]. Washing coal decreases dust emissions and improves its energy content. It is estimated that unwashed coal (run-of-mine) contains on average 18 per cent of gangue (sand, rock, and other impurities), which implies that transportation and burning of coal can be improved if more coal is processed.

The stringent criteria on coal quality may cut production of low-calorific coal and high-ash coal. China produces around 370 Mt of lignite, most of it in Eastern Mongolia and some in Yunnan. Lignite production in Eastern Mongolia (340 Mt) has an average calorific value of 3,500 kcal/kg and would not

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126 Greenovation: Hub (April 2014), op. cit.

127 Wood Mackenzie, China's proposed low energy coal ban, Coal Market Service Insight, May 2013, http://www.woodmacresearch.com/content/Coal_Markets_Service/Insights/Thermal_Trade/CMS20134028094019/WM_Coal_Market_Service_Insight_China_proposed_low_energy_coal_ban.pdf

128 NDRC, Interim Measures on Management of commercial coal quality, 15 September 2014

129 Sun G. (2010), Coal in China: Resources, Uses, and Advanced Clean Coal Technologies, PEW Center on Climate Change, http://www.c2es.org/docUploads/coal-in-china-resources-uses-technologies.pdf

130 China Coal Resource, China thermal coal washing rate remains low, 22 February 2013

be permitted under the guidelines to be transported over distances beyond 600 km. On this quantity, Deutsche Bank China Metals and Mining[131] estimates that 50 to 80 Mt typically transported over distances beyond 600 km could not be upgraded. In addition, 33 Mt of lignite production in Yunnan with an ash content above 35 per cent would be prohibited from being produced. Therefore the total impact of the new guidelines on domestic coal production may be in the range of 80-110 Mt. It may result in shortage of some high-calorific value, low-sulfur coal, needed in the three target regions, which may have to be imported. However, the current oversupply on the domestic market may limit these requirements in the short term as spare capacity is available to compensate for the shutdowns required and investments in transportation allows more flexibility in moving coal.

5.6.2 Sustainable coal production

In addition to quality issues, sustainability issues may limit future coal production using current coal mining technologies, despite the abundance of coal resources. Research by the Sichuan University and the NDRC's Energy Research Institute[132], shows that sustainable capacity for China's coal mining is limited due to limited resources (coal resources buried at a depth of 1,000m account for 53 per cent of China's total reserves), poor geological mining conditions (inappropriate for large-scale mechanized production), safety issues (high gas content leading to frequent mining accidents), and environmental issues. Water shortages in key producing regions of Shanxi, Shaanxi, Inner Mongolia, and Ningxia limit the production capacity there. In addition, the hydro-geological conditions and ecology in most of China's coal-rich regions are fragile because of severe soil erosion, frequent geological disasters, and low vegetation cover. Based on a detailed analysis of these factors, the authors concluded that China's maximum annual coal production capacity should be limited to 3.8 Gt to maintain the sustainable development[133] of the coal industry, and highlighted a need to gradually phase out or upgrade non-sustainable mines and develop new sustainable mines. By 2030, the authors estimate total sustainable capacity of coal mining at 3.0-3.5 Gt.

The level of production discussed here may be increased by the adoption of new clean mining technologies and innovation throughout the industry. Such approaches include water conservation, full resource utilization, increased oversight of mining activities, and more land reclamation and environmental rebuilding efforts.

From 2015, it is expected that the level of coal production will be controlled, not only to avoid oversupply issues, but with a sustainability target in mind. It can be expected that a binding cap on regional and national coal production will be set in the 13th FYP (2016-2020) with a strong emphasis on quality of production (and use) rather than increasing volume. The balance between supply and demand in the medium/long term, and demand for coal imports, is therefore not a straightforward process.

[131] Deutsche Bank, Thermal coal: China import ban takes shape, 22 September 2014

[132] Heping X., Gang W., Hong L., China's Coal Industry Must Follow the Path of Sustainable Production Capacity, Cornerstone, 24 July 2013 http://cornerstonemag.net/chinas-coal-industry-must-follow-the-path-of-sustainable-production-capacity/

[133] The authors' definition of sustainable coal mining capacity refers to the maximum coal mining capacity that can be achieved using safe, highly efficient, and environmentally friendly methods under the premise that the coal reserves can be sustainably mined for a specific period of time.

6. Transportation bottlenecks to ease

The majority of China's coal resources are located in the western and northern provinces, while the major consumption centers are located in China's heavily populated eastern and southern provinces. This unbalanced distribution means that coal must be transported long distances via railways, roads, or waterways (both inland river and coastal marine transport). Integrated railway and coastal marine shipping is the most important mode of coal transport in China. As China does not yet have dedicated southbound rail lines, coal from the northern and western provinces destined for consumption in the south needs to be first moved eastward to seaports around the Bohai Bay in northeast China. From there it is shipped to major coal ports along China's southeastern coastline[134]. So far, coal output has grown at a higher rate than the capacity to carry coal via railway, and transportation bottlenecks have thus been a recurrent theme. This has led to frequent coal shortages prone to aggravation by extreme weather conditions, as observed in winter 2010/11, when heavy snow in northern China disrupted mining operations and railway transportation. This has driven southeastern power plants to increase their imports to secure coal supplies. Also, the capacity expansion of major coal ports of discharge in the southeastern provinces has allowed consumers there to choose between domestic coal from the northern ports and overseas coal from the international market. The oversupply on the domestic market has not changed their purchasing strategies as foreign supplies are sold at a discount on domestic supplies burdened by heavy taxes and high transportation costs. The situation is changing, however, with the easing of transportation bottlenecks thanks to massive investment in new railways. China's coal rail transport capacity may even exceed demand in the future, as more coal-dedicated rail lines are expected to come online, while coal demand growth is set to decelerate amid slowing economic growth and the government's clean air drive.

6.1 China's port capacity: no bottlenecks

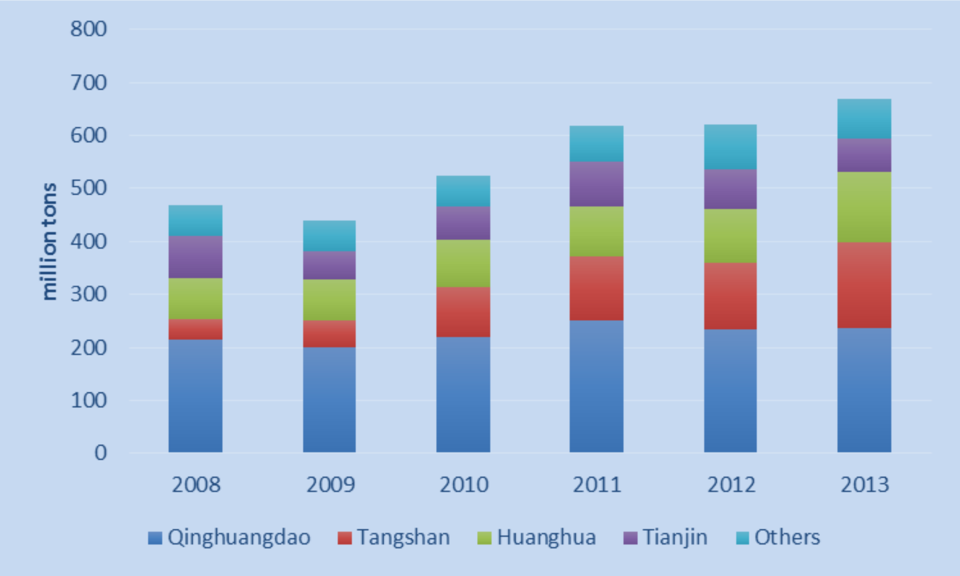
China has several of the world's largest coal ports, most of them located in the Bohai Rim. Qinhuangdao is the world's largest coal port and Tangshan (which includes Jingtang and Caofeidian) is the world's second largest by throughput. The seven major ports in northern China, including Qinhuangdao, Tangshan, Tianjin, Huanghua, Qingdao, Rizhao, and Lianyungang, shipped 617 Mt of coal in 2013[135], 38 per cent of which (236 Mt) was from Qinhuangdao. Due to the sheer size of its shipments, Qinhuangdao serves as a reference for domestic coal prices. Coal is transported to the major ports of discharge around the Pearl River Delta, the Yangtze River Delta, and southern China (Guangzhou).

The capacity of the northern ports has expanded rapidly since the end of the 1990s when the coastal port sector was opened up to competition, which resulted in increased investment in port facilities and led to a seaport building boom. Capacity at major northeastern ports is currently 750 mtpa and is to be expanded to 1,050-1,100 Mt by 2017 (see Box 16). The port handling capacity will play a more important role in ensuring coal consumption for coastal regions and trigger more competition among ports to secure southern clients. It will also trigger more competition between domestic and foreign supplies to serve southeastern demand.

[134] Jianjun Tu K. Johnson-Reiser S., Understanding China's Rising Coal Imports, Carnegie, Policy Outlook, 16 February 2012, http://carnegieendowment.org/files/china_coal.pdf

[135] China Coal Resource, N. China ports 2013 coal shipment up 9.55 pct,7 February 2014

Figure 21: Chinese domestic shipments by northeastern port



Source: Chinese Customs Data

Box 16: Throughput capacity of coal terminals at major northern ports

Main ports in northern China are further boosting their coal handling capacities by accelerating construction and upgrading of relevant facilities. Total coal handling capacity at the major northeastern ports is estimated to increase from 750 Mt in 2013 to 1,050-1,100 Mt by 2017[136].

Qinhuangdao Port (current capacity of around 230 mtpa) is currently expanding and is targeting a capacity of 280 mtpa in the short term. The port is the end of the Daqin Line.

Tianjin Port (current capacity of 88 mtpa) is connected to the Huangwan Line which is connected to the Shuohuang Line, thus coal transported by the Shuohuang Line also feeds into Tianjin Port. The port has two coal terminals: Tianjin Port coal terminal, which is owned by Tianjin Port (43 mtpa), and Shenhua Tianjin coal dock, which is owned by Shenhua (45 mtpa). Shenhua plans to expand capacity by 35 mtpa.

Jingtang Port is located in the Tangshan Port area and is connected to the Zhangtang Line. Throughput capacity is around 45 mtpa.

Caofeidian Port, also located in the Tangshan Port area and connected to the Zhangtang Line, is being expanded and will become the largest port dedicated to coal. The capacity was expanded to 150 mtpa in 2013 and construction of additional berths will add another 50 mtpa by 2018. In the long term, the port's capacity could reach 350 mtpa. In the future, coal mainly from Western Inner Mongolia will be unloaded here.

Huanghua Port is at the end of the Shuohuang Line. Its capacity was expanded to 150 mtpa in 2013.

Rizhao Port is at the end of the new planned Central-Southern Shanxi Line. It currently has a capacity of 35 mtpa, to be expanded to 45 mtpa by 2015.

Lianyungang Port is at the end of the Longhai Line. It currently has a capacity of 10 mtpa.

Jinzhou Port is at the end of the Fujin and Jinchi lines, which transport coal from eastern Inner Mongolia. Its current capacity of 25 mtpa will be expanded to 50 mtpa by 2015.

[136] China Coal Resource, N China ports to boost coal handling capacity, 23 October 2012

6.2 Railway transportation bottlenecks

In contrast with port capacity, Chinese railways encountered great difficulty in keeping pace with the country's booming coal production in the past decade. One of the reasons for the sharp contrast in capacity expansion lies in the organizational structure of railways and ports. Until 2013, China's Ministry of Railways was both the regulator and the monopoly operator of China's national railway network, and a lack of competition led to insufficient investment in coal rail lines. A major reform was initiated in March 2013 when the Ministry of Railways was dissolved. Railway market operation and administration were divided and allocated to Chinese Railway Corporation, a state-owned company created to handle rail operations, and the Ministry of Transport (National Railway Bureau) was founded. The reform broke the previous monopoly and will influence railway transportation price, profitability, services, upstream, and downstream business in future. It is the first step towards marketization of railway.

The transportation of coal accounts for about 60 per cent of China's overall freight business. In 2013, China's railways carried almost 4 Gt of freight, of which 2.32 Gt was coal[137].

The railways from coal supply regions are divided into three routes[138]:

- the northern route for transportation of coal from northern Shanxi, northern Shaanxi, and Inner Mongolia
- the middle route for coal from central Shanxi
- and the southern route for coal from central and southern Shaanxi

The northern route is the most important, as it includes two major dedicated coal lines (the Daqin and Shuohuang lines) to haul coal to northeastern ports from which coal is shipped down to the south. While the port capacity has increased notably, transport capacity of the two lines is currently limited[139].

6.3 Ambitious construction projects may ease railway bottlenecks

As the railway capacity is still far from adequate, coal miners are forced to rely on an already congested road network to deliver coal to the ports. Trucking is not only a more expensive way of transporting coal, increasing the delivered price of coal, but also a more polluting one. China therefore strives to expand rail lines from the major production and exporting provinces (Shanxi, Shaanxi, Western Inner Mongolia, Ningxia, Gansu, and Xinjiang) to northeastern ports and central/south China. The government has set a plan to achieve 3 Gt of rail coal transporting capacity during the 2011-2015 period, basically meeting the expected demand of rail transportation (2.6 Gt or 66.7 per cent of the expected 2015 output of 3.9 Gt). However, following the high-profile and fatal high-speed train crash in Wenzhou in 2011, approvals for new railway projects were reduced in 2011, and then halted completely amid rising safety concerns. Construction investment vanished and new coal rail projects were delayed, with only 179km commissioned in 2012, though delayed projects were restarted in 2013.

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[137] China Coal Resource, China 2013 rail coal transport up 2.6 pct YoY, 27 January 2014

[138] Standard Chartered, China coal, Mind the gap – Railway bottleneck to re-emerge, 20 November 2012

[139] Daqin, the nation's top coal-dedicated line is a 653 km line in north China. Its name is derived from its two terminal cities, Datong, a coal mining center in Shanxi province, and Qinhuangdao, of Hebei province, on the Bohai Sea. The line has an annual capacity of 450 mtpa. The line transported 445 Mt of coal in 2013, up 4.5 per cent from 2012. Unlike most other railways in China, which are run by the Chinese Railways Corporation, the Daqin Railway is operated by Daqin Railway Company Limited, a publicly traded stock company. Potential capacity addition to Daqin is rather limited, mainly from upgrading some branch lines. The line is expanded to 460 mtpa in 2014.

Shuohuang, another coal dedicated rail line connecting Huanghua port, is one of five railways in a 1765-km network owned by the Shenhua Group. The 588 km line carried 234 Mt of coal in 2012 from the Shanxi Province to Huanghua port. Here the line connects with the 67.8-km Huangwan Railway which runs from the port of Tianjin. The line has a capacity of 240 mtpa.

In January 2014, the NDRC announced that the country aimed to boost its railway capacity for coal haulage by around a third to 3 Gt per annum by 2020**.** The announcement is part of the strategy that aims to shift much of the coal capacity further west and consolidate output in a number of large-scale coal production bases. The NDRC aims to create a number of 'channels' to connect these production regions to major energy consumers in the east and the south. Construction of multiple coal-dedicated railroads is expected to materially ease the long-standing bottlenecks constraining the transportation of coal. A number of projects are under construction and are expected to be commissioned by 2014/15, while the expansion of the cross-province railway capacity in the six major western producing/exporting provinces is expected to increase from 1.4 Gt per annum at end 2013 to 2.3 Gt per annum in 2017. Capacity expansion will come mainly from the Shuohuang and Lanxin lines and from the construction of three major new lines: Zhangtang, the Inner Mongolia–Central China Line, and the Central–Southern Shanxi Line (see Box 17). Already in 2014/15, the commissioning of new railway lines to the major northeastern ports is expected to ease railway bottlenecks significantly.

Box 17: Major expansions and new railway lines from the six western producing provinces

Shuohuang (Shanxi/Huanghua port) is expected to see its transport capacity expanding from 240 mtpa to 350 mtpa by 2015. Shenhua has plans to expand the capacity of the line by 30-40 mtpa to reach 400-600 mtpa in the next five to eight years.

A new 542-km Zhangtang railway, from Zhangjiakou (Inner Mongolia) to Caofeidian is to be commissioned in 2014. It could reach its design capacity of 200 mtpa by 2017.

The 1260-km Central-Southern Shanxi Line, from Luliang in central Shanxi to the eastern port of Rizhao will start to operate from September 2014 and gradually ramp up capacity to 250 mtpa by 2017.

The Jinchi line linking Inner Mongolia to Liaoning port will become operational in 2014, providing a capacity of 100 mtpa.

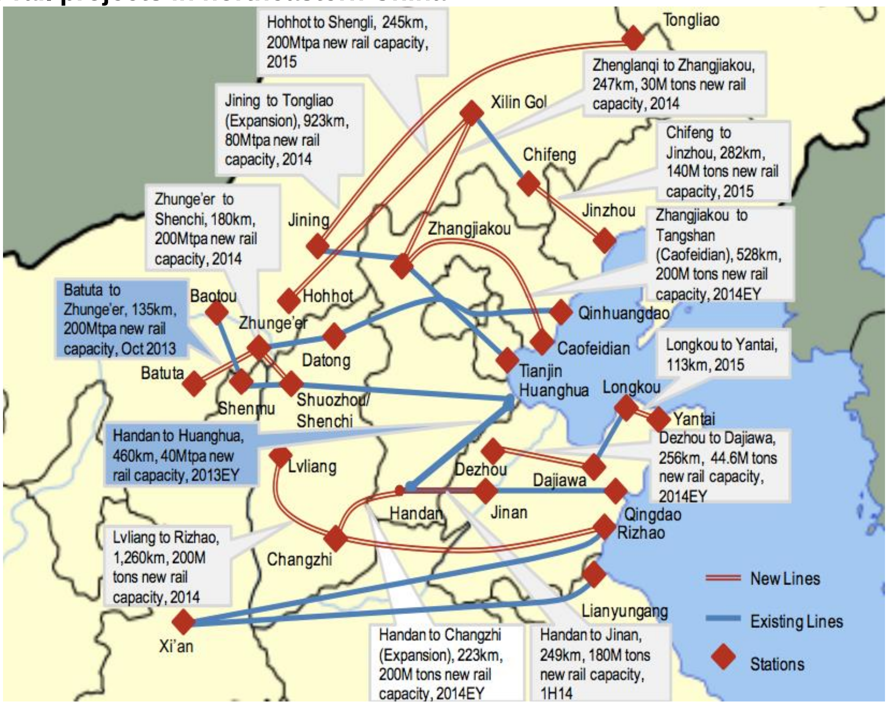
Mon-Hua railway, north to south line, is a major project approved by the NDRC in March 2013. The line will transport coal from west Inner Mongolia through six provinces in northern and central China and end at Ji'an in the southeastern province of Jiangxi. Its capacity is set at 100 mtpa at the initial stage but will be raised to 200 mtpa by 2017. This new project marked the launch of the 'great channel' for transporting coal from north to south. Construction costs of the 1,837-km line are estimated at RMB159.82 billion ($25.4 billion). The NDRC and the Ministry of Railways adopted a new approach for the financing of the line, under which the new railway will be funded mainly by local governments, local businesses, and energy enterprises, which will build and operate the railway.

Lanxin. Another major new channel is the transportation of coal from the western Xinjiang. Thanks to the commissioning in 2014 of a new parallel line dedicated to serving travelers, the old 1,904-km Lanxin line (from Lanzhou, Gansu to Urumqi, Xinjiang) is now fully dedicated to freight transportation. It transported about 30 Mt of coal in 2013 and may reach a capacity of 100 mtpa in the future. Other railways are being built in the province, such as Guanghui Energy's branch railway linking its coal mines to Lanxin Railway.

A new line, connecting Hami, eastern Xinjiang and Ejina Banner, Inner Mongolia, will be built to transport coal, iron ore, and other mineral resources from Xinjiang, Gansu, and Inner Mongolia to the rest of China. Upon completion, the line will become a key backup line of Daqin rail line.

In addition, seven major rail projects that link to ports in the northeastern Bohai Bay will be completed by 2015 (see Map 3). The Jin-Yu-Lu rail line, the third coal-dedicated railway connecting major mining areas in central-south Shanxi to Rizhao port in eastern China, is expected to finish construction by the end of 2014, adding 200 mtpa of transport capacity. Once operational, the combined transport capacity of the new line together with Daqin and Shuohuang rail lines would exceed 800 mtpa, higher than the total outbound shipment to northern China ports, which was 617 Mt in 2013.

Map 3: Major rail projects in northeastern China



Source: Bernstein Research

6.4 Further reforms will improve railway transportation and coal logistics

The reform of the railway sector, which started in 2013 with the creation of the Chinese Railway Corporation (CRC), is deepening with railway finance and freight rate reforms.

In April 2014 the State Council approved a financing reform, including a new railway development fund financed by both state and private capital. Also in April, CRC raised its fixed-assets investment target to more than RMB800 billion for 2014 from the previous 630 billion.

Further railway reform includes the marketization of freight rates. CRC, like the Ministry of Rail before it, does not control the price of its products and services, as freight rates are set by the NDRC and adjusted annually. However, the NDRC kept freight rates too low for the Ministry of Rail to maintain profitability. As a result, in recent years the Ministry of Rail (and now CRC) fell into a cycle of debt accumulation as profitability declined. To improve the situation, the NDRC is going to increase rail freight rates by RMB0.03/t.km to RMB0.16/t.km in 2014 from the 2013 average of 0.13/t.km. Despite this increase, the rate will remain much lower than the road freight rate, estimated at RMB0.5/t.km. The overcapacity on the Chinese market and the low price of coal helps the reform of the railway sector. As coal prices are currently very low, the increase in freight rates will not represent a significant burden for coal users[140].

The intention is to move to full marketization of the price of rail transportation. In a first attempt in April 2014, the NDRC announced it would allow market forces to determine rail cargo costs on the Zhunchi Railway. Freight rates for the line will be determined by the carrier, its clients, and investors. The 180-km railway, which links a major coal-producing region between Inner Mongolia and Shanxi province, started service in June 2014. It was built by Shenhua.

[140] The average travelling distance of coal from Datong to northern ports is about 600 km, meaning an increase of RMB18/ton of rail transportation cost from RMB78/ton in 2013 to RMB96/ton in 2014. It will nevertheless hurt the small coal mining companies selling at northern ports which are already struggling with low coal sale prices.

The Chinese government also released a new Coal Logistics Development Plan (CLDP) at the end of 2013 which will further ease domestic coal transportation problems. The CLDP was developed to ensure China's coal supply chain was both secure and competitively priced, and its recommendations include a proposal to develop 11 key coal hubs and a further 30 large coal storage and distribution nodes in key production and consumption areas[141]. These hubs and nodes will be strategically located along oceans and waterways and at the junction of rail lines. They will be connected by the construction of 15 rail lines, nine of which will go from north to south and six will connect the east and west. The hubs and nodes will provide coal storage and distribution bases, ensure there are available contingency reserves, provide coal chain access to road, rail, and ports, and also reduce distribution bottlenecks. The plan also proposes the development of a national coal trading center in order to effectively manage government regulation, reduce distribution costs, optimize the allocation of resources of coal, and improve the nationwide flow of coal.

6.5 The easing of transportation bottlenecks favors domestic coal against imports

With many railroads planned or under construction, China is expected to see a fundamental change in rail coal transportation in the future. With rail tension gradually easing, imported coal is losing a key supporter of its positive price differential and a fiercer market competition is emerging. This will continue as railways are reformed and bottlenecks unclog, allowing coal to be transported from remote provinces such as Xinjiang.

The impact of railway reform on the coal sector, while increasing freight rate and transportation burden at short term, will be positive in the medium term. It will attract private investment in railroads and development of coal transportation capacity which will substitute trucking transportation. The final outcome would be a reduction in average domestic transportation costs and increased competitiveness of domestic coal against imports. Moving from road transportation to railway can save RMB68/ton ($11) on coal transportation (based on a transportation distance of 200 km).

Finally, the new coal logistics plan will allow more secure supplies even during extreme weather conditions, and the creation of a national trading platform will ensure better coordination of the different segment of the supply chain. With these different initiatives, the Chinese authorities are removing logistical obstacles that led to the surge in coal imports in the past few years.

[141] Salva, Is China's Coal Logistics Plan a game change for coal imports?, 29 May, 2014 https://salvareport.com/chinas-coal-logistics-plan-game-change-coal-imports/

7. Coal prices

Historically, China's coal market used a dual-track pricing system of regulated and market prices. Steam coal prices sold to power utilities were tightly regulated by the central government and set far below market coal prices. In December 2012, the State Council of China issued the 'Guideline on Deepening the Market-Oriented Reform of the Thermal Coal Sector', featuring a liberalization plan for the coal sector, which ended the dual-track pricing system and removed price control for steam coal used by power utilities. Since then, domestic prices have been left to market forces but remain strongly influenced by government policies on supply and demand.

7.1. Coal marketization

Before market liberalization, China's steam coal market used a dual-track pricing system of 'planned coal' and 'market coal', sold at government-regulated contract prices and open-market prices, respectively. Coal-price contracts were signed every year at an annual meeting organized by the China National Coal Association (CNCA) and the NDRC, whereby coal suppliers agreed to sell certain quantities to power companies at prices set far below the market rates. The Ministry of Railways then allocated transportation quotas for the contracted coal. With this pricing and transportation arrangement, the government hoped to ensure enough supplies for power plants and avoid widespread blackouts. Contract prices for 2012 were set at around RMB599 ($95) per ton during the government-led negotiations, while market prices at the end of 2011 stood at RMB821 ($130) per ton. Power utilities were able to buy nearly half their annual coal consumption at the preferential rates, while they had to purchase the remainder of their needs at market prices. As retail electricity prices remained tightly regulated by the central government to control inflation, utilities had encountered great difficulties to pass the increased costs of coal to consumers and suffered heavy losses. At the beginning of 2012, the central government capped market prices at RMB800 ($127) per ton, hoping to stem heavy losses from power plants.

The dual-price mechanism did not work very well and the NDRC had to intervene in frequent disputes between coal miners and power utilities. When spot coal prices were much higher than term rates, coal miners would either fail to supply the agreed volumes under the annual contracts or send out poorer quality coal. However, when spot prices declined below the term rates, many power companies defaulted on their contracts, which caused miners to incur heavy losses as they also had take-or-pay contracts with the Railway Bureau for transport capacity.

In 2012, the oversupply on the Chinese market drove a sharp fall in spot prices. Prices at the Bohai Rim fell from around RMB780 per ton in the first five months of 2012 to RMB634 at the end of 2012. The convergence between spot prices and term prices allowed the central government to liberalize the thermal coal market. In December 2012 the government eliminated the price control of coal sold to power utilities, ending the double-track system for steam coal. Key contracts between miners and power utilities were cancelled and the allocation rights of railway transportation capacity were released. The government also abolished the price ceiling on coal prices, starting 1 January 2013. As production picked up while demand moderated in 2012, the concern about coal shortage was eased.

Since then, coal mining firms and power producers have been able to sign contracts at their own discretion without government intervention and contracting parties have to negotiate directly with railway departments to secure transport capacity. The NDRC continues to encourage miners to sign long-term contracts with power companies, but gives sellers the freedom to adjust prices on a regular basis. The NDRC also no longer allocates or guarantees railway capacity, despite some priorities for long-term contracts signed by large coal firms.

To secure rail capacity, the main coal and power producers signed term contracts in early 2013 and early 2014 for a large part of their production, with prices mostly linked at some discount to the Bohai Rim Steam-Coal Price Index (BSPI), reflecting steam coal prices at major loading ports and launched in 2010. Small producers, however, could not sign indexed contracts and sold at fixed prices.

The government's decision to discontinue coal price control benefits larger coal miners, including China Shenhua Energy and China Coal, which have established long-term relationships with power producers. Smaller miners suffered a squeeze on their market share as the market has weakened. Without government allocation of rail capacity, coal producers had to negotiate with the Ministry of Railways, and now the Chinese Railway Corporation on supply contracts. Shenhua, which operates its own railways, and China Coal, a major shareholder in Daqin Railway, are less affected by the reforms than small operators.

Box 18: Coal/electricity price linkage

The NDRC is also trying to improve the coal-fired power linkage system with the final objective to liberalize electricity prices. Since the start of 2013, on-grid electricity prices (the price of power sold by power plants to grid companies) are adjusted annually according to coal price fluctuations. Under the new arrangement, if the average coal price changes by more than 5 per cent within a year, 90 per cent of that change will be passed through to end users via an adjustment in on-grid tariffs. Power producers will bear the remaining 10 per cent of the coal price change. In comparison, regulatory reviews were not conducted on a regular basis under the previous mechanism, and power utilities had to shoulder 30 per cent of the change in coal costs.

The linkage between coal and electricity prices is important as coal is utilized for around 75 per cent of China's electricity production and thus has a large impact on electricity generating costs. Previously, government controls on coal contract pricing and the price the grid paid thermal power producers squeezed thermal power plants and reduced pressure to raise end users' prices. For decades, the price of electricity – controlled by the NDRC – has been kept low to control inflation. It was so low that the average returns on the assets of electric power producers and distributors were significantly below the cost of financing those assets. The deregulation of coal prices and more market-oriented 'on-grid' tariff have improved the profitability of thermal power producers. The profit of the power and heat generation industry surged 27.3 per cent in the first five months of 2014 to RMB162.36 billion, attributed largely to falling coal prices. The stronger linkage between coal and electricity prices paves the way for setting up a truly competitive power industry, which is essential for introducing more competition in the power sector and introducing new energy sources into the electricity mix.

7.2 Trading and 'financialization' of coal

This key step towards full market liberalization has been accompanied by other measures to establish a competitive and transparent market. The guidance on coal market liberalization also tasked the China National Coal Association with nurturing and developing a national coal market trading system.

New indexes were created in 2013, in addition to the most frequently used BSPI and the China Coal Price Index, reflecting price levels in eight different Chinese regions. In May 2013, the China Taiyuan Coal Transaction Center launched the Coal Trade Price Index (CTPI)[142], covering steam coal, coking coal, and pulverized coal injection (PCI) coal in Shanxi. The CTPIis the country's first index to be based on a major coal-producing base. A new internet-based trading platform was also launched in May 2013 in Shanxi. Compared with other coal price indexes in China, the new index better reflects price changes in the coal production base, while the BSPI is used as a reference for coastal sales from northern ports to southeastern provinces.

The coal futures market has also developed. In September 2013, steam coal futures agreements started trading at Zhengzhou Commodity Exchange. Major coal mining companies have already started to hedge spot coal prices fluctuations and conduct coal futures[143]. Shenhua Energy and China Coal, the two largest national coal producers, and Yanzhou Coal Mining, another leading coal

[142] Xinhua, China launches major coal price index, 24 May 2013

[143] China Coal Resource, China Coal to conduct thermal coal futures, 15 May 2014

producer based in the eastern Shandong province, entered into thermal coal futures market in 2014, although volumes have remained low[144].

In May 2014, the government announced plans to establish two or three national exchanges for coal trading[145], located close to main production and consumption areas, railways and key transfer ports, and able to connect with coal-related futures markets. Relevant standards for spot transactions at these exchanges would be close or even identical to futures contract standards, and gradually develop toward general practices in the international market. The document issued by the NDRC indicated that the transaction volume of a national coal exchange should be at least 200 mtpa, while regional and local trading exchanges should be actively developed as a supplement to the national exchange, with annual transaction volume of more than 10 Mt and 2 Mt.

Finally, in July 2014, China's central bank approved the launch of the country's first thermal coal swap contracts[146], giving coal industry participants new financial tools to hedge against price volatility. The new contracts will be priced in renminbi and trade over the counter with clearing handled by the Shanghai Clearing House. The contract will be based on the Bohai Rim Steam Coal Price Index[147].

The improvement in coal spot price indexes and the development of futures and swap contracts push forward the marketization of China's coal industry and lay the foundation for the establishment of coal trading in China, for both domestic and imported coal, based on electronic platforms and denominated in RMB with the BSPI as a reference price.

7.3 Price falls and the role of major coal companies

Since the middle of 2012, the demand growth slowdown has created a large oversupply on the Chinese market, aggravated by the influx of cheaper international coal. This has led to a drop in domestic coal prices, which collapsed from an average of RMB811 per ton in 2011 to RMB634 at the end of 2012. Coal supply remained abundant in China in 2013 due to weak demand growth and still rising imports. Prices followed a downward trajectory for most of the first three quarters, with the BSPI price falling to RMB510 per ton by late September. Prices rebounded in the last quarter, but were still below levels seen at the beginning of 2013. On average, coal prices fell 16 per cent from RMB706 in 2012 to RMB591 in 2013. In the first eight months of 2014, prices set new record lows, falling by more than RMB130 from January to reach RMB478 by the end of August. Prices remained impacted by slower demand, also depressed by strong hydropower production, rising coal inventories, and an influx of cheap imports. Despite the current oversupply and excess coal stockpiles, imports stood at 160 Mt in the first half of 2014, a modest rise of 0.9 per cent – but still a rise – compared with the same period last year. Amid abundant supply, both on domestic and international markets, coal trade has turned from a seller's market to a buyer's market. Some power generators in the southeast coast have slashed their purchase volume of domestic thermal coal and relied on the oversupplied international market. Indeed, the marketized competition has always included imports.

As coal imports have continued depressing the Chinese market, large domestic coal producers, such as Shenhua and China Coal, have entered a price war to increase their market share. Shenhua, as the largest coal producer in the country, is a price setter for coastal sales in China. More than 80 per cent of coal shipments from the major northeastern ports are realized by large mining groups. Shenhua alone accounted for 35 per cent of coal shipments from the major northeastern ports in 2013 (250 Mt). After a commercial policy to sustain coal prices in the last quarter of 2013, the company started to reduce its price offer at the beginning of 2014 to gain market share. The company reduced

[144] The volume of futures hedging of Shenhua Energy is controlled below 10% of Chinese seaborne coal sales in 2014, with margin no more than RMB300 million.

[145] China Coal Resource, China to build national exchanges for coal trading, 22 May 2014

[146] A swap contract is a cash-settled derivative between a seller and a buyer at a fixed price for a set amount of time, providing price certainty for both parties on the underlying commodity.

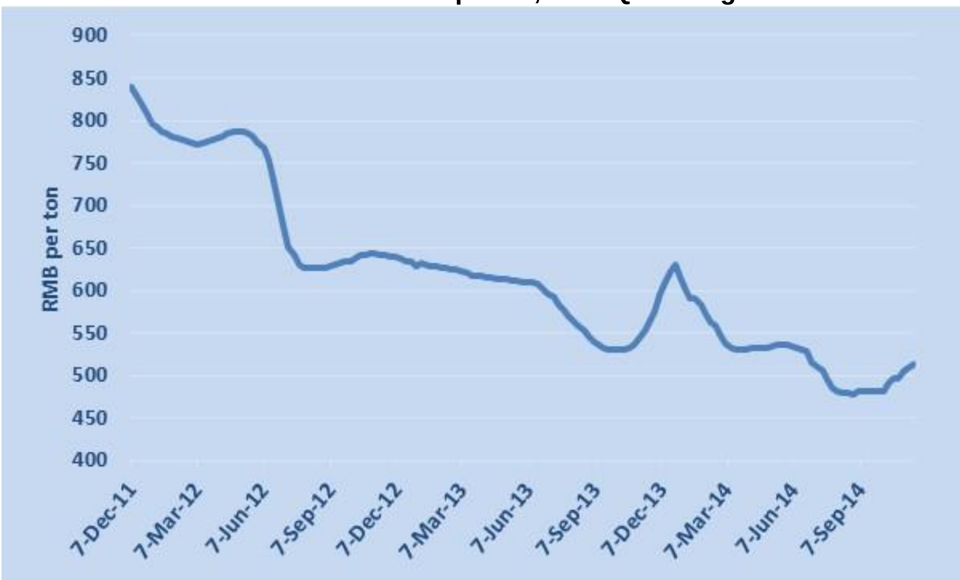
[147] China gives regulatory approval for iron ore, thermal coal swaps, 14 July 2014, http://www.anirudhsethireport.com/china-gives-regulatory-approval-for-iron-ore-thermal-coal-swaps/

its offer price to domestic utilities multiple times in the first seven months of 2014. As other major coal producers followed suit, these price declines had the effect of dragging down the Bohai index to very low levels. Only major producers are able to compete at such levels, thus aiding the consolidation of the coal mining industry. The pricing strategy by major mining companies in China reveals their power to influence the BSPI, and indirectly, international prices.

7.4 A modest recovery in prices

After the instructions given by the NDRC to resolve the oversupply issue on the domestic market (see Sections 5.4.4, 8.4 and 8.5), Shenhua has started to increase its sale price offer each month since August 2014. This has helped stabilize the market. Spot prices stood at RMB513/ton on 19 November, up RMB35 from their bottom level reached at the end of August.

Figure 22: Recent evolution of domestic coal prices, FOB Qinhuangdao



(5,500 kcal/kg NAR, including value-added tax)

Source: China Coal Resource, cqcoal.com

The decline in coal prices in China has allowed the central government to push forward key reforms in the coal sector, such as the liberalization of the price of coal sold to power companies and the further restructuring of the mining sector. However, the fall had reached a point where it created concerns about the viability of the sector and economic growth and stability in some mining regions. Such low coal prices do not fit with the environmental policy of the new leadership, nor with the need to invest in clean energy sources, including clean coal. We can therefore expect current efforts to stabilize the market to continue.

8. Coal import policy

8.1 A surge in coal imports in 2009-2013

China's imports surged from 41 Mt in 2008 to 327 Mt in 2013. As seen previously, a key driver of this spectacular increase has been the generally lower level of international coal prices compared to domestic prices. Despite a 17 per cent import tax, purchasing coal from the international market has been a viable alternative to domestic coal deliveries, particularly in the coastal southern regions. Additionally, the steady appreciation of the Chinese renminbi against the US dollar since 2010 has created a competitive advantage for coal imports. Transportation bottlenecks supported this increase and also constituted a key factor favoring imports in the southern coastal provinces, while the rapid growth in coal consumption between 2008 and 2011 also provided some support.

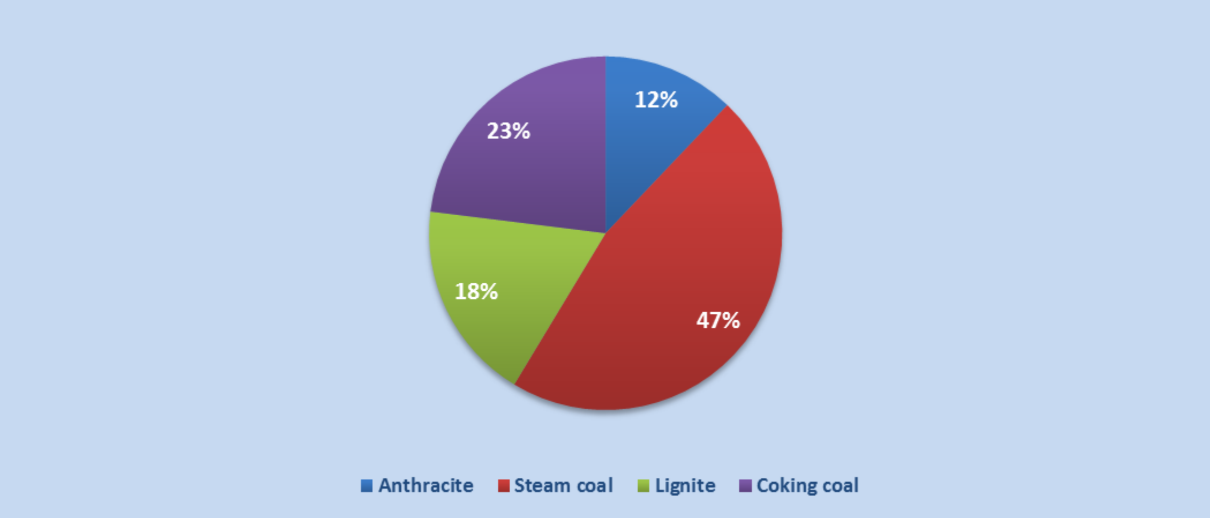
However, the slowdown in coal consumption since 2012 has reduced demand for imported coal, which grew just 13.4 per cent in 2013 in comparison to previous annual growth rates above 30 per cent. In the first half of 2014, imports totaled 160 Mt, a modest growth of 0.9 per cent year-on-year. The price differential between imported and domestic steam coal narrowed following several rounds of price cuts by major domestic miners in June and July 2014, resulting in imports of higher-quality steam coal becoming less competitive against domestic supplies. In response, imports fell in July and August, bringing total imports in the first eight months of 2014 down 5.3 per cent to 202 Mt. Since international low-calorific value coal (lignite) has continued to be priced at a discount to higher-quality coal, power companies have kept costs down by continuing to use a blend of lignite and higher-quality coal in power plants. Thus despite the oversupply on the domestic market, lignite imports remained high, in fact lignite imports surged 20 per cent to 45 Mt in the first eight months of 2014.

Box 19: Different types of imported coal

China imports four types of coal: anthracite, the highest rank, mainly used in specific industrial applications; steam coal and lignite used in power plants and factories; and coking coal used for the fabrication of coke in the iron and steel industry. Lignite has played an increasingly important role in China's coal imports since 2009. Used largely in power generation (but also in paper mills and in the manufacture of building materials), lignite has a lower calorific value than other types of coal[148]. For this reason, it is generally used close to the mine and is hardly traded internationally. However, Indonesia exports large quantities at discount prices of low-calorific value coal falling under this sub-category. China imported 60 Mt of lignite in 2013, up 11 per cent over 2012, mainly from Indonesia.

[148] Chinese customs statistics classify coal with a calorific value of between 3800-4200 kcal/kg as lignite.

Figure 23: China's coal imports by type, 2013



Source: China's Customs Data

8.2 A shift in Chinese import players

In contrast with oil and gas imports, which are dominated by several large companies, coal imports so far have been realized by hundreds of small- and medium-sized coal traders. This has made it difficult for any policy to control the pace of coal imports and rebalance the domestic market. However, falling prices in particular in 2014 have accelerated a reshuffle of Chinese import players[149]. State-owned firms, and in particular major power plant groups, have replaced southern Chinese private importers in the top ranks. Datang Group, Huaneng Group, and Guangdong Yudean Group were the top 3 importers in the first half of 2014, while major private importers from southern China, which used to dominate this trade, reduced their demand for imported coal. This is in stark contrast to the rankings in 2012 when 40 per cent of the top 20 importers were privately-owned firms from the south. Recent policy measures encourage this trend. The new order on the regulatory approach of the coal sector, released in August 2014[150], encourages miners to contract directly with end users. This move will greatly help the government to implement its new measures aiming at solving the oversupply situation and reducing both domestic production and imports.

8.3 Australia and Indonesia are the major suppliers

The surge in China's coal imports has mainly benefitted Indonesia and Australia, which between them accounted for 67 per cent of China's total coal imports in 2013 and 80 per cent of its steam coal and lignite imports. Other countries, such as Russia, Mongolia, the United States, and Canada, also took a share of the Chinese market. The relative share of suppliers is mainly driven by their competitiveness and more and more by quality issues, a factor that will be reinforced by the coming regulation on low-grade coal imports.

With a market share of 38 per cent in 2013, Indonesia is the main supplier of Chinese imports. Indonesian exports to China increased tenfold from 2008 to 2013. Coal from Indonesia is highly competitive thanks to its proximity to China's southern provinces, meaning lower maritime transportation costs, as well as the abundance of its coal reserves, in particular low-calorific value coal (lignite) sold at a discount on the Chinese market. In 2013, lignite exports from Indonesia accounted for 90 per cent of all coal imported in China under this sub-category. While exports of

[149] China Coal Resource, A look into China's evolving coal import market, 4 August 2014

[150] NDRC (2014), Coal business regulatory approach, Order N° 13, 6 August 2014, http://www.ndrc.gov.cn/zcfb/zcfbl/201408/t20140806_621405.html

steam coal increased rapidly, the share of lignite in total Indonesian coal exports rose from 14 per cent in 2009 to 46 per cent in 2013. Total Indonesian exports registered a small growth in 2013, up 3.8% to 123 Mt, as Chinese buyers turned to higher rank coal suppliers.

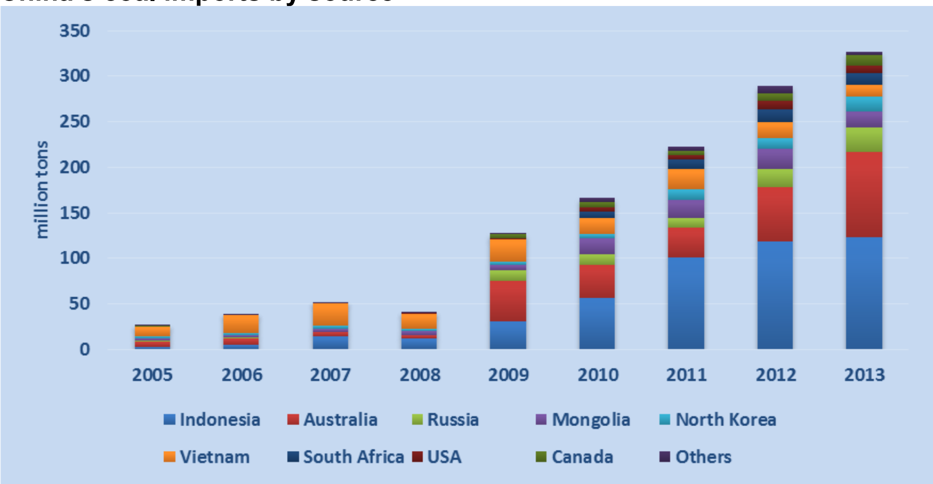
Australia ranks as the second-largest coal exporter to China by volume (29 per cent in 2013) and exports both steam and coking coal. Its share of the Chinese market has fluctuated significantly in recent years depending on its selling price. It shrunk in 2010 and 2011 when Australian coking coal – whose price peaked at $330 per ton in the second quarter of 2011 after flooding in Queensland restricted coal production – was displaced by much cheaper Mongolian, and to a lesser extent Canadian and U.S., products. Likewise, higher steam coal prices displaced Australian imports. By contrast, in 2013, Australian exports to China registered a strong growth (up 57%) to 93 Mt, as Australian exporters adapted their pricing and quality policy to the Chinese market.

China's imports from Russia totaled 27 Mt in 2013, up 35 per cent, making Russia the third-largest coal exporter to China. They are expected to grow further in the coming years thanks to new coal contracts signed with Russian suppliers.

Rising coal imports in China attracted new suppliers to the market, in particular U.S. producers, seeking new overseas outlets as domestic demand has been reduced by the shale gas competition. However, the collapse of coal prices since the middle of 2011 has made these exports uncompetitive for most U.S. steam coal exports.

Mongolia plays a strategic role among new suppliers to the Chinese market. The landlocked country has huge reserves, including the Tavan Tolgoi, the world's largest coking coal deposit. However, its exports to China, currently its only outlet, have not developed as expected, with transport constraints and high logistical costs of trucking coal making exports unprofitable at current weak coal prices. This may change in the future with the signing of a contract with Shenhua involving coal exports of 50 Mt per year.

Figure 24: China's coal imports by source



Note: Total coal imports (anthracite, steam coal, lignite and coking coal).

Source: China's Customs Data.

8.4 2014: Ban on low-grade thermal coal imports

Since 2013, China has discussed whether to ban or restrict production, imports, and sale of thermal coal with low calorific values and high ash and high sulfur contents. Low-grade coal, with high sulfur and ash contents, is sold at a very attractive price, but exacerbates China's air pollution because it releases more sulfur, ash, or volatile matters when used[151]. Low-calorific value coal also emits more CO_2 per kWh.

The Opinions on Promoting the Smooth and Steady Operation of the Coal Industry[152], issued by the State Council in November 2013, indicated that the government intended to strengthen the management of coal imports and exports, by formulating national standards for commercial coal quality, considering differentiating tariffs to encourage high-quality coal imports, banning sale and import of low-grade coal with high ash and high sulfur contents, and adjusting coal export policies in a timely manner in accordance with domestic and international market circumstances.

An order, issued on 6 August 2014 by the NDRC[153] (Coal business regulatory approach, Order N° 13), finally implemented a ban on the sale and import of high-ash and high-sulfur low-grade coal. However, the order did not specify the thresholds applicable to calorific values, sulfur and ash contents. A document, published by the NDRC on 15 September ('Commercial coal quality management Interim Measures'[154], hereinafter referred to as 'the measures'), specifies the qualities of coal prohibited on the Chinese market. The ban on low-quality coal is scheduled to take effect on 1 January 2015. Since their publication, the measures have caused waves on the global seaborne market due to the ambiguous interpretation of the regulation.

The measures apply to both domestic and imported coal and cover the production, processing, transport, storage, import, sale and use of commercial coal products. Like the previous drafts of the measures (see Box 20), coal with low-calorific values, high-ash and sulfur content is prohibited with different thresholds applied to lignite and bituminous coal, and coal transported inland beyond 600 km from either a port or a mine. However, in addition to the previous drafts, the new measures add a third category specific to the three target regions covered by the APPC, Beijing-Tianjin-Hebei, the Pearl River Delta, and the Yangtze River Delta. This third level of regulation sets very stringent criteria for ash and sulfur content, namely it restricts coal with ash above 16 per cent and sulfur above 1 per cent.

Table 13: Coal quality restrictions

	Ash content (ad, air dried)	Sulfur content (St, d)	Heat value (NAR)
A. Lignite	≤ 30%	≤ 1.5%	-
If transported over 600 km	≤ 20%	≤ 1%	≥16.5 MJ/kg (3,946 kcal/kg)
B. Bituminous coal	≤ 40%	≤ 3%	-
If transported over 600 km	≤ 30%	≤ 2%	≥18 MJ/kg (4,300 kcal/kg)
C. Beijing-Tianjin-Hebei, Pearl River Delta and Yangtze River Delta	≤ 16%	≤ 1%	

Source: NDRC

In addition, thresholds are also set for trace elements, as follows: 0.6 µg/g mercury maximum, 80 µg/g arsenic maximum, 0.15 per cent phosphorus maximum, 0.3 per cent chlorine maximum and 200 µg/g fluorine maximum.

The official issuance of the ban in September 2014 follows two main objectives. It is part of the government efforts to combat worsening air pollution as sales, inland transport, and imports of high-sulfur and high-ash coal aggravate the haze problem. Another important reason for the NDRC to limit coal imports is the current oversupply and weak domestic market. Since last year, domestic coal companies have been urging the government to introduce some limitations on imports.

[151] Volatile matters of lignite can exceed 40%, aggravating air pollution.

[152] State Council, opinion on "promoting the smooth and steady operation of the coal industry", 28 November 2013, http://www.gov.cn/zwgk/2013-11/28/content_2536862.htm

[153] NDRC (2014), op. cit. and Xinhua, China bans high-ash coal, 6 August, 2014

[154] NDRC, Interim Measures on Management of commercial coal quality, 15 September 2014

Box 20: Various drafts of the ban on low-grade imports

The Chinese government has been trying to implement such measures since early 2013, releasing several drafts publicly, though all were shelved after strong protests of utilities and traders among others. The first version of the restriction, released in May 2013, targeted imports of thermal coal with a calorific value lower than 4,544 kcal/kg NAR (net as received) and coal with a sulfur and ash content higher than 1 per cent and 25 per cent respectively. The proposed restriction also applied to domestic coal but with less stringent criteria. The proposal was modified in December 2013 and prohibited lignite imports with caloric value lower than 3,940 kcal/kg NAR and sulfur and ash contents above 1 per cent and 20 per cent respectively. For all other types of thermal coal, the calorific value had to be above 4,300 kcal NAR, with sulfur and ash content lower than 2 per cent and 30 per cent respectively. Thresholds were also set for chemicals, including mercury, phosphorus, and chlorine. The criteria also applied to coal with transport distances over 600 km. Again at the end of March 2014, a joint guidance document on air pollution control of the NEA and the Ministry of Environmental Protection[155], vowed to accelerate formulating measures on coal quality, to prohibit imports of high-ash and high-sulfur coal, and to limit exploration and use of high-sulfur and high-ash coal. The document, however, didn't mention low-calorific value imported coal.

Since May 2014, the Fujian province has been chosen to begin new quality checks on imported coal in what was seen as a test run of the low-quality coal ban[156]. From June 2014, all imported coal arriving in the province was subject to new criteria and, according to a notification sent to local customs authorities, cargoes failing the checks would not be allowed to discharge. The criteria were less strict than the previous draft proposals. Lignite imports should have ash content below 30 per cent and sulfur under 1.5 per cent, while all other thermal coal required ash below 40 per cent and sulfur of 3 per cent maximum. No threshold was indicated for calorific values. For imported coal with a final destination more than 600 km beyond the port at which it clears customs, a stricter set of criteria was applied. In those instances, for lignite, calorific values needed to be above 3,946kc NAR, ash below 20 per cent and sulfur below 1 per cent. For all other thermal coals in this scenario, calorific values should be 4,300kc NAR minimum, ash below 30 per cent and sulfur under 2 per cent.

Impact of the ban on Chinese coal imports and international coal trade

Most of imported coal complies with the first two levels of regulation and the impact of the measures on international trade should be marginal.

For instance, the impact on Indonesia, the largest lignite exporter to China, is marginal. While Indonesian lignite has low-calorific value, it is renowned for its low ash and sulfur content (6-7 per cent and 0.4 per cent typically). Indonesian lignite exports therefore comply with the ash and sulfur standards set in the first level of regulation on lignite. In energy content, however, most of Indonesian lignite exports fall below the 3,946 kcal/kg standard for lignite with a transport distance more than 600 km beyond the port at which it clears customs. Indonesian lignite exports may therefore be significantly affected by the ban. However, the vast majority of imported lignite and steam coal is in fact consumed in coastal regions, with transport distances generally below 600 km. Therefore, the impact of the ban on Indonesian lignite exports should be minimal. Indonesia also exported 65 Mt of bituminous coal in 2013. Most of it has low-ash and sulfur content and again the impact on Indonesia steam coal exports may be minimal.

Typical steam coal exports from Australia's New South Wales and Queensland generally have energy content above 5,500 kcal/kg, which is largely above the threshold of 4,300 kg/g set in the measures. They have high ash content (22 per cent) and a sulfur range of 0.7-0.8 per cent, both lower than the thresholds for bituminous coal.

[155] China Coal Resource, China reiterates banning imports of low-grade coal, 21 May 2014

[156] McCloskey Coal Report, Coal ban test run underway at Chinese ports, 13 June 2014

Even low-calorific grade coal from the US Powder River Basin (4,725 kcal/kg and 0.3-0.4 per cent sulfur typically) complies with the threshold for imported bituminous coal, included with transport distance above 600 km.

However, the actual impact on trade is uncertain as it depends on the interpretation of the third level of regulation. One interpretation is that all coal consumed in the three target regions has to comply with the 16 per cent ash and 1 per cent sulfur thresholds. This interpretation has a significant impact on coal exporters. For instance, due to its high ash content, Australian bituminous coal would be significantly impacted. Australia exported 54 Mt of bituminous coal to China in 2013, almost 45 per cent had a higher ash content than 16 per cent and would be prohibited in the three target regions. However, the second interpretation is that the thresholds specified for the three target regions only apply to coal use in small industrial boilers, domestic heating and small commercial heaters ('scattered' users), and not to power plants and large industrial users. This is obviously the favoured interpretation of international market participants but also the most probable one. First, the power sector and large industrial users in the three regions are already regulated and have depollution devices in place or have to install them before the end of 2015 (see Sections 3.3.1 and 3.3.3). Second, the strictest interpretation would not only hurt exporters, but also domestic producers since coal in China has typically a high ash content and sulfur above 0.6 per cent. It would be difficult to comply with the strictest interpretation of the measures without significantly disturbing domestic miners.

Overall, one can expect that foreign suppliers will adapt the quality of their exports to the new Chinese requirements. In anticipation of the restrictions exporters have already been selling lower-sulfur coals, which are more expensive. Moreover, in the circumstance a coal product does not comply, it can be 'washed' or blended with other high-quality material to meet the thresholds. The ban would therefore increase the price of imports, reducing their competitiveness against domestic coal, and create a two-tier international coal market, with sales of high-quality coal sold at a premium, and low-grade coal discounted still further.

It will serve Beijing's policy to reduce air pollution by controlling the quality of coal imports. Low-calorific and high-ash and sulfur coal (within a certain threshold) would still enter the Chinese coal market at discounted rate, allowing power companies to decrease costs, but this coal would be burned only at coastal power plants and not transported inland, thus decreasing the dust issue.

8.5 2014: Reduction in coal imports

The chronic overcapacity and weak demand caused by slower economic growth and increasingly stringent environmental regulation has continued to depress the market. It has put the sector in a distressed situation, with 70 per cent of the mining companies reporting losses in the first half of 2014 and companies have been struggling to pay salaries, according to CNCA[157]. This situation led the government to take strong measures to resolve the oversupply situation. At the end of August 2014, in addition to the instruction given to large mining groups to reduce coal production, the NDRC instructed leading power groups to reduce coal imports significantly in the last four months of 2014[158]. The measure, which applies to large energy groups, may lead to a 50 Mt fall in total imports to 277 Mt in 2014[159], following a fall of 5.5 per cent (to 202 Mt) already registered in the first eight months of the year. It remains to be seen, however, how the measure can be enforced[160]. Most cargoes for the end of the year are already sailing or have been contracted with foreign suppliers or Chinese traders.

[157] Platts, CNCA head calls for production cuts to boost China's ailing coal sector, 25 July 2014

[158] China Coal Resource, NDRC asks top power groups to slash coal imports, 29 August 2014

[159] According to the instruction, average monthly imports over September to December 2014 should be no more than 50% of the monthly average in the first eight months of the year. The measure applies to power producers, including Huaneng Group, Datang Group, Huadian Group, Guodian Group, China Power Investment Corp., China Resources Power, Zhejiang Energy Group, and Guangdong Yudean Group. Shenhua Group, which operates power plants and imports coal, has been instructed to halt its coal import business for the rest of the year.

[160] McCloskey Coal Report, China still locked in talks over import rule changes, 5 September 2014

Around 60-70 per cent of southern coastal power plants supplies are currently based on imports. Enforcement of the instruction would carry a risk of breaching commercial contracts, with associated financial and legal consequences. Nevertheless, coal imports continued to fall and stood at 243 Mt in the first ten months of 2014, down 7.7 per cent year-on-year.

This reduction concentrated in the last months of 2014 has significant spillover effects on international coal trade and prices. In the short term, this sudden large reduction in Chinese purchases from the international thermal coal market further depresses international steam coal prices, although prices are so low that they cannot fall much further. Australian Newcastle thermal coal FOB price settled at $52/ton (5,500 kcal/kg NAR) on 14 November 2014. They have lost $4/ton since the import reduction was announced.

In China, the measure helps to stabilize domestic coal prices, although it may take longer and require harsher measures to rebalance the market. With inventories of around 300 Mt across the country, China's supply needs to fall 7-8 per cent to restore market balance. It nevertheless sends a positive signal to domestic coal miners and therefore helps to modestly increase prices despite the oversupply situation. Combined with the reduction in coal production mandated by the government (see Section 5.4.4), the rebalancing of the domestic market appears closer.

The increase in Chinese coal prices will not only help the mining sector, but enable the price to reflect the true cost of coal burning, thus easing China's transition to greener fuels.

8.6 Coal tariff policy

The ban on sale and import of low-grade coal is only a first step in the adjustment of China's coal trade policy. The State Council's 'Opinions on Promoting the Smooth and Steady Operation of the Coal Industry'[161] indicated that the government was considering differentiating tariffs to encourage high-quality coal imports. From 15 October 2014, China has reinstated import duties on coal imports that were removed in 2007[162]. The import duties are 3 per cent on anthracite and coking coal, 5 per cent on briquettes and 6 per cent on other coals. This measure reinforces the competitiveness of domestic coal against foreign coal. At 6 per cent, the duty on steam coal imports translates into an increase of $3 to 4/ton. The tariffs do not affect shipments from Indonesia, as it has a free-trade agreement with China through the Association of Southeast Asian Nations (ASEAN). For other suppliers, the new tariff is an additional shock after the announcement of the ban on low-grade coal and the reduction in coal imports in the last four months of the year. Australia, the second largest coal exporter to China, would also be exempted from the tariffs after the signing of a free trade agreement between the two countries, according to a memorandum of understanding the two countries signed on 17 November 2014. Coking coal would be exempted immediately, while steam coal would be exempted within two years, giving time for Chinese coal miners to rebalance the oversupplied domestic market.

The State Council's document also indicated that the export policy was going to be adjusted in a timely manner in accordance with domestic and international market circumstances. China currently imposes a 10 per cent duty on exports. Although the reduction is not yet official, it is expected that the duty on coal exports will be reduced to 3 per cent from 1 January 2015, encouraging large domestic coal mining groups to export coal.

These moves signal a more balanced approach to coal trading in China, with an optimization of resources taking into account not only domestic coal but also overseas resources ('the two markets, two resources' concept). For international suppliers of coal to Asian markets, it would mean growing competition from China's large mining groups, a competition that almost disappeared in recent years as China's coal exports collapsed from 47 Mt in 2008 to 7.5 Mt in 2013.

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[161] State Council, opinion on "promoting the smooth and steady operation of the coal industry", 28 November 2013, http://www.gov.cn/zwgk/2013-11/28/content_2536862.htm

8.7 Chinese coal mining investments abroad

China's coal imports will decrease in the short term but not vanish entirely. As soon as the domestic market stabilizes, the arbitrage between domestic and international prices will again play a key determining role. As long as foreign coal meets the quality standards required by the government, there is no reason for the government to impede this trade. On the contrary, it allows an optimized structure of coal supply and it extends the lifetime of national coal resources.

In addition, overseas investment in mining and infrastructure by large Chinese mining groups will also play a significant role in the pace of future imports and the eventual participation of these groups in international coal exports. Overseas investment has been encouraged since 2001 by the government's 'go out' policy which encourages large mining groups to look beyond the domestic market and engage in direct investment abroad. According to the 12th FYP, 'China will make full use of international and domestic markets and two resources, strengthen international exchanges and cooperation, actively participate in overseas coal resources development and utilization, and further expand international trade of coal'.

Large Chinese mining companies were particularly active in investment in coal mining abroad until the beginning of the decade, particularly in Australia and Indonesia. For instance, Shanghai Baosteel, one of China's largest steel producers, acquired a 15 per cent ($240.5 million) stake in Aquila Resources in Australia in 2009 as part of a strategic cooperation agreement to expand Aquila's raw materials projects, including iron ore, coal, and manganese. Also in 2009, Yanzhou Coal Mining, China's fourth-biggest coal producer, bought Australia's Felix Resources Ltd. for about $2.9 billion to secure supplies. China's Shandong Energy Group and Kailuan Group also invested in countries rich in coking coal, such as Mozambique and Canada.

At the beginning of this decade, Chinese investments in coal mining fell significantly as previous investments in overseas coal mines appeared to be costly as many assets bought at the peak years of the coal industry had to be written down. However, Chinese companies are again expanding overseas, benefitting from the low price of coal assets and welcomed by foreign coal producers which are struggling in a difficult environment. Their investments are more oriented towards large cooperation agreements, including financing of mining and transportation infrastructure in exchange for coal supplies. In 2013, only one large new Chinese coal M&A transaction was announced, in the United States – a relatively new destination for overseas mining investment – with the $544-million acquisition by ceramics and hardware fittings company Guizhou Guochuang of Triple H Coal, a Tennessee-based clean-coal company.

Large mining and infrastructure contracts announced recently include a $6 billion agreement signed in October 2013 between China Rail Corporation and China's Eximbank with Indonesia's coal and power company PT Indika Energy to develop coal mining and transportation infrastructure in Papua and Central Kalimantan provinces.

In Australia, China Power Investment Development Ltd reached a $6.4 billion agreement with Resourcehouse, allowing the development of the Galilee Basin in Queensland. China Power International Development is expected to be supplied with 30 to 40 Mt of thermal coal each year. Another deal which received Australian media attention involves the 98-year lease of Newcastle port, the largest coal export port in the world, to a Chinese-backed consortium for $1.6 billion. Newcastle port exported 143 Mt of coal in 2013, primarily to China and Japan.

The recent signing of major supply contracts in key neighboring countries (Russia and Mongolia) reflect the new security and trade policy of China favoring links/pipelines with its energy-rich neighbors – the so-called 'Silk Road' policy.

In Russia, Shenhua will explore for coal in a joint venture with Russia's En+ Group (Zashulankskoye coal deposit in the Transbaikal territory). The two firms will invest more than $900 million on the project and produce up to 6 Mt of high-quality, low-sulfur coal per year. The deal, signed in 2014, follows a larger contract signed in 2012 between Russia and China's Eximbank, under which the latter will grant $5 billion of funding for coal, iron ore, and copper mining in Eastern Siberia, in return for a guarantee to increase supplies to China. China is also involved in the financing of Metchel's Elga coking coal project and other mines in the Russian Far East.

China has also signed a huge deal with Mongolia. In October 2013, Shenhua signed a memorandum of understanding with the three companies that operate the giant Tavan Tolgoi mine – Erdenes Tavan Tolgoi, Mongolia Mining Corporation, and Tavantolgoi – for the purchase of 1 Gt of coal over the next 20 years, or 50 Mt per year. A new rail link is to be built between the two countries by 2015. Although it will take time to realize the target of 50 Mt, the financing for the building of the new railway was agreed in August 2014. It will remove the main bottleneck faced currently by Mongolian exporters. China's Sinopec and Mongolia have also reached an agreement to develop coal-to-gas projects in Mongolia and export SNG to China, while China has agreed to provide Mongolia with access to its northeastern ports.

While China's involvement in the Central Asian coal sector is limited, in contrast with oil and gas, China has plans to import coal from Kyrgyzstan to Xinjiang. Chinese involvement in energy, mainly oil and gas, in central Asian countries is one of the pillars of China's foreign trade and security policy though its 'Silk Road' policy.

Finally, another significant development was the creation in December 2013 of a joint venture between Shenhua and US firm Peabody, one of the largest coal mining and trading companies in the world. The two companies agreed to create Sino-Pacific Coal Trading Corporation, a Singapore-based joint venture that will supply Shenhua's coal import demand with thermal coal from Peabody's global production and coal trading platforms. Peabody Energy operates mines in the Powder River Basin in the US, as well as in Australia.

These contracts and joint ventures illustrate that China is not going to withdraw from the international coal market. However, its imports will be more selective in terms of quality and the supply/demand balance of the government-controlled market until the market itself allocates domestic and imports more efficiently.

9. Conclusion

Coal, the only abundant conventional energy resource in China, has been the backbone of the country's industrialization and fuelled its economic development. However, the environmental costs linked with its extensive use and production are pushing the government to re-orient the energy mix towards cleaner energy sources and to adopt a less energy-intensive growth model. Coal will see a significant reduction in its contribution to the energy and electricity mix following the acceleration of the development of non- or low-carbon energy sources. Coal, however, should continue to play a dominant role for many years, as China continues its economic development and urbanization, thus further spurring its energy demand. But the constraints on coal production and use make it necessary to move to a more rational development model based on clean-coal technologies.

China's coal industry is still being developed and is now using a new model. Sustainable production and use is being promoted, while backward and excess capacity is being eliminated. Massive investments are being realized in transportation and storage/hub facilities, trading platforms are being launched, and e-commerce has been initiated. Meanwhile, the coal industry is becoming more flexible and better prepared to respond to changes in domestic and international markets.

The radical transformation of China's coal production and use has far reaching implications for the Chinese and international coal trades. In the short term, the priority is to resolve domestic overcapacity exacerbated by growing imports. This means reducing production and imports, in particular those of low-quality coal which aggravate the haze and smog problem. In the medium/long term, the key question is how to ensure the balance between sustainable production moving westwards and controlled coal consumption. There is no straightforward answer to that question which is linked to policy decisions.

In the first half of 2014, despite a growing overcapacity on the domestic market and an easing of transportation bottlenecks, China's coal imports continued to grow, further exacerbating the collapse in coal prices and worsening the financial situation of the coal mining sector. This has forced the government to intervene to stabilize the coal market, with large mining groups instructed to cut their output of the second half of 2014 and power companies to reduce their coal imports in the last four months of the year. In addition, since 15 October 2014, China has reintroduced a duty on coal imports, which makes domestic coal cheaper than international supplies. The sudden reduction in Chinese imports, estimated at 50 Mt in 2014, comes at a time when the international coal market is still oversupplied despite cuts in production in several exporting countries. Coal exporters to China have difficulties in finding another buyer. This further depresses international steam coal prices, although prices are so low that they cannot fall much further.

Furthermore, the ban on the production, imports, and sales of low-calorific coal with high sulfur and high ash contents, under discussion since early 2013, will become effective on 1 January 2015. It is expected to have limited impact on international markets although interpretation of the regulation is not yet fully clear.

On the Chinese market, in contrast, domestic prices are rising, but the increase will be limited as long as the overcapacity is not eliminated. With inventories of around 300 Mt across the country, China's supply needs to fall 7-8 per cent to restore market balance. The instruction given to major Chinese producers to cut their production should speed up the process.

For coal suppliers to China, these sudden changes highlight increasing uncertainty and risks. China's coal imports will decrease but not vanish, some coal qualities will be prohibited, while others may be in high demand. Eventually, the rebalancing of the Chinese market and further policy measures, such as the reform of the coal resource tax and the implementation of a national carbon trading scheme, will increase China's coal prices and make foreign coal more competitive.

Another major change at work is the trading/exporting role that China's large mining groups are expected to play. According to domestic and international coal market evolution, China may again become an exporter in the Pacific Basin, not only selling its surplus production, but also acting as a global trading player from its portfolio of overseas mines. If Chinese coal demand peaks sooner than expected – from the viewpoint of domestic producers and foreign coal exporters – ASEAN coal demand still registers strong growth, offering an opportunity for China's major mining groups to expand their presence overseas and increase their source of revenues. Massive current investment in coal-dedicated railways, expansion of port capacity, improvements in mine productivity, development of coal trading platforms, trading exchanges, and the launch of the first swap contracts priced in renminbi, may well serve this vision.

Annex 1: Different types of coal and main conversion units

Different types of coal

Coal is a complex matter, and not a uniform one. It is divided into two categories: hard coal and lignite. 'Total coal' designates hard coal and lignite.
Coal used by power utilities includes steam coal, which is subdivided in three ranks: anthracite, bituminous, and sub-bituminous coal, as well as lignite.

Hard Coal

Hard coal is subdivided into two types:
Steam (or thermal) coal, used primarily for power generation and in industrial applications; and
Metallurgical coal, or coking coal, used by the iron and steel industry as a feedstock in the production of coke, which is used in traditional steel production (via the BOF process, basic oxygen furnace) as a fuel and reducing agent to smelt iron ore in a blast furnace.
Hard coal has an energy content above 4,500 kcal/kg and water content lower than 35 per cent.
Usually, only hard coal is traded internationally. However, in the past few years, some low-grade coal (lignite) has been exported, mainly from Indonesia.
The physical and chemical qualities of the different coals are important factors to determine their use and price, and include: percentage of volatile matters, ash, sulfur, moisture, fixed carbon, grinding index HGI, calorific value, and coke strength - CSR value - for coking coal.

Lignite or Brown Coal

Lignite has energy content lower than 4,500 kcal/kg and water content over 35 per cent. It is therefore used mainly on regional/local markets and almost exclusively for power generation.

Units and conversions

Two units are commonly used in the coal scene: ton (t) and ton coal equivalent (tce). When coal is measured in volume (ton), the calorific value of the coal in question must be given as it differs largely from one type of coal to another.
Steam coal traded on the international market is usually expressed in ton with a calorific value of 6,000 kcal/kg. Low-grade coal refers to calorific values of 4,500 kcal/kg or below.
In coal statistics, coal volumes in tons are converted to tons of coal equivalent (tce). The conversion is done by multiplying the calorific value of the coal in question by its volume, measured in physical units (tons).
One tce has an energy content of 29.3 Gigajoules (GJ) or 7,000 kcal and corresponds to 0.7 tons of oil equivalent (toe).

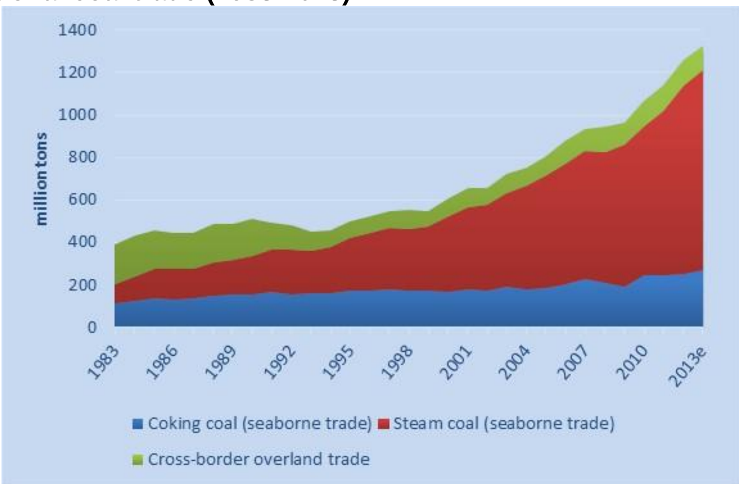
Annex 2: Overview of the global steam coal trade

Global coal trade is growing but still represents a small share of total production

International hard coal trade has grown continuously over the past three decades driven by a sustained growth in steam coal trade. Total trade reached an estimated 1,326 Mt in 2013, including 1,017 Mt of steam coal and 309 Mt of coking coal. The seaborne steam coal trade tonnage is about 90 per cent of total steam coal export sales worldwide. The remainder of the cross-border trade is done overland, usually by rail, between neighboring countries.

Despite its sustained growth, the international hard coal trade is less developed than that of competing fuels: it accounts for 17 per cent of hard coal production, a much lower share than oil (over 60 per cent) and natural gas (30 per cent). This is mainly due to the difficulties and costs associated with its inland transportation, which is often a bottleneck in the coal supply chain.

Figure 25: International coal trade (1983-2013)



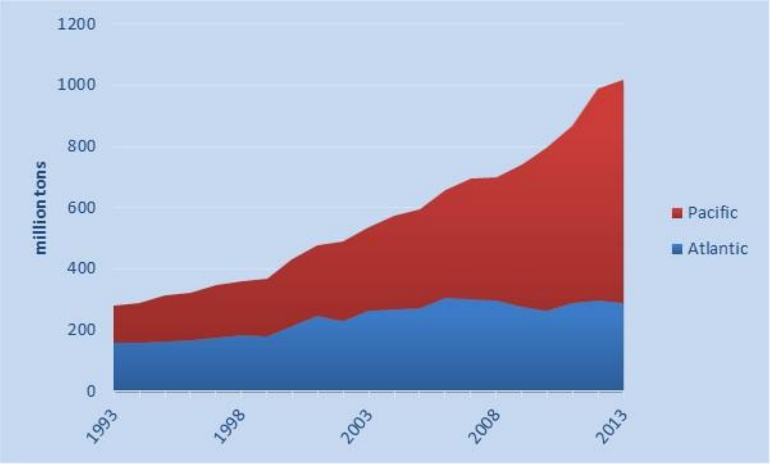
Source: IEA, 2013: estimates.

Steam coal trade has increased fourfold since 1990, from 364 Mt in 1990 to an estimated 1,017 Mt in 2013, at an average annual growth rate of 7.4 per cent. While Europe and Japan accounted for the bulk of demand until 2000, Asia has accounted for most of the growth in the last decade. On the supply side, Indonesia has become the dominant world supplier of steam coal. Australia, Russia, Colombia, South Africa, and more recently the US are the other major suppliers to the international market.

A shift to the Pacific Basin

The steam coal market is split into two major markets, the Atlantic and the Pacific Basins. The Atlantic Basin is made up of utilities and traders from Europe (including the countries bordering the Mediterranean), the eastern seaboards of North, Central and South America, and the northern and western coasts of Africa. The Pacific Basin is made up of utilities from China, India Japan, South Korea, and Taiwan. Other smaller buyers include Malaysia, Philippines, Thailand, and the west coast of North America and South America.

Figure 26: Steam coal imports by Basin (1993-2013)



Notes: includes cross-border over-land trade.

Source: VDKI, IEA, BREE.

The surge of Asian imports has shifted the center of gravity in international coal trade to the Pacific Basin. With steam coal imports of 730 Mt in 2013, the Pacific Basin has a leading position in the international market: it accounts for 72 per cent of the steam coal trade, up from just 28 per cent in 1990. The trend was remarkable in the past five years, with a 15 percentage point increase in the Basin's share during 2008-2013, driven by the surge in China's imports. In the Atlantic Basin, although Europe is still a major player on the international coal scene, its role is shrinking from year to year. Today, it accounts for just 16 per cent of global steam coal imports, down from 44 per cent in 1990.

Figure 27: World steam coal imports by key regions/countries

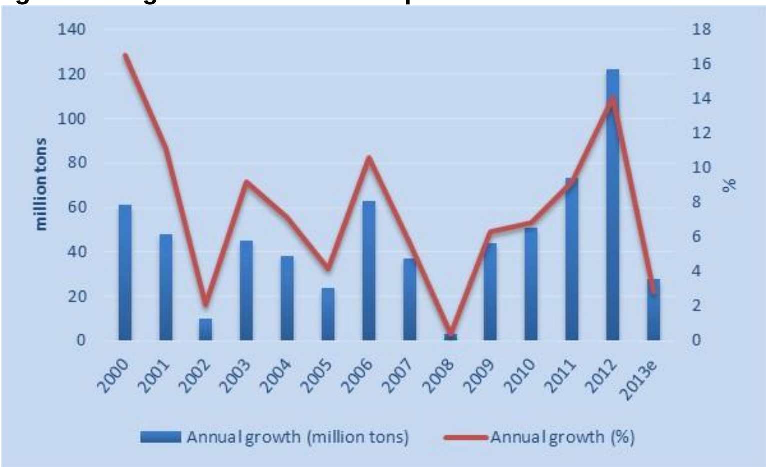
Other: mainly cross-border over-land trade.

Source: IEA, EUROSTAT

A recent slowdown in steam coal trade

The growth in steam coal trade is slowing down. In 2013, the growth was only 2.8 per cent as the growth in imports by China slowed drastically. China imported 235 Mt of steam coal in 2013, still a huge amount but a mere 7.8 per cent increase over 2012, in sharp contrast with the dazzling growth of 59 per cent recorded in 2012.

Figure 28: Annual growth in global steam coal imports



Source: IEA, estimates

International steam coal prices: 'boom and bust' is the rule

International prices for steam coal are mainly determined by market forces (domestic prices may include subsidies). Due to long lead times for the development of new coal mines, railways, and export capacity, coal prices are cyclical. When supply is tight prices can rise steeply, incentivizing investment in new infrastructure, while excess supply leads to falls in prices until the market rebalances. In the short term, prices are volatile. Supply constraints (flooding of mines for instance) make coal vulnerable to sudden shocks. On the demand side, lower electricity demand, high coal stocks may lead to a fall in international coal prices. Figure 28 illustrates the long-term evolution of Australian FOB prices since 2000 and shows boom and bust cycles in coal prices. Since the middle of 2011, prices have fallen from $121/ton in July 2011 to $73/ton in March 2014.

Figure 29: Australian FOB steam coal prices

FOB Newcastle

Source: World Bank

The coal market is a global one: prices are similar on the Atlantic and Pacific Basins

In contrast with natural gas, the coal market is truly global, and thanks to low maritime transportation costs, international steam coal prices are similar in the Atlantic and Pacific Basins. The premium paid by Asian customers is low and has decreased since 2011 as both Basins have been characterized by oversupply. Suppliers, such as Russia and South Africa, but also increasingly the US and Colombia, are able to swing some of their exports between the Atlantic and Pacific markets and, in recent years, growing volumes of exports from these traditional suppliers of the Atlantic Basin have been sold to Asian buyers. This has reinforced the links between the two Basins.

Despite this strong relationship, in the short term, prices do react to regional events on each market. In March 2011, when the Fukushima accident occurred and Germany announced the closure of seven nuclear reactors, European coal prices rose by $10/ton to nearly $130/ton, with the markets anticipating a shortage of coal in Europe, although paradoxically European demand was weak. In contrast, prices on the Pacific market continued declining.

Figure 30: International CIF steam coal prices

Asia: Asian price marker. Europe: European price marker

Source: McCloskey

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