



A QUARTERLY JOURNAL FOR DEBATING ENERGY ISSUES AND POLICIES

This edition of the *Forum* is dedicated to developments in Chinese energy.

One of the top concerns for commodities markets is the health of the Chinese economy. In his article, Damien Tobin examines some of the implications of moves to rebalance the economy away from high savings and fixed investment towards private consumption. He argues that while the Chinese leadership can point to many successes, which include managing economic growth in a highly uncertain environment, the rebalancing has had some unintended consequences in terms of urban labour shortages and rising costs. Furthermore, the author argues that one of the biggest threats to rebalancing is the legacy of the fiscal stimulus, which has resulted in the accumulation of significant local government debt. The article notes that while risks exist, the Chinese Government still has ample scope to maintain growth, though the margin for policy errors has decreased.

In their article, Bassam Fattouh and Amrita Sen examine some of the implications of China's rebalancing on oil consumption patterns. They find that in the last few years the growth in gasoline and jet fuel consumption – fuels more geared toward consumers – has been robust, unlike that of diesel, which has witnessed a slowdown in growth as

the Chinese economy continues to shift away from investment-led growth. The authors argue that this trend is expected to persist as the number of vehicles continues to grow at a robust pace, and the appetite for luxury cars is on the rise. These changing demand dynamics will have a big impact on global petroleum products trade flows where China has already turned into a net exporter of diesel.

In his article, Trevor Sikorski points to the fact that, unlike its position in relation to other commodities, China has not been central to the global natural gas story over the last 10 years. However, this is about to change as the country aims to increase the role of gas in its energy mix, to meet demand for urban heating as China takes steps to replace coal-burning boilers with cleaner gas-burning systems to deal with the pollution crisis. With the rapid increase in demand, China has become more reliant on gas imports, including LNG. However, given the various potential sources of gas supply both domestically and from abroad, there is a wide uncertainty regarding future Chinese LNG demand. As the article concludes, by 2020, there will be significant liquefaction capacity in China and in principle the country could constitute an important market for LNG, but the uncertainty is very substantial.

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In her article, Liu Xiaoli addresses one important source of uncertainty: the prospects of shale gas development in China. The author notes that the development of shale gas resources has become central for Chinese government energy policies, especially given the large scale of the resource base. The article outlines some of the major initiatives adopted by the government to encourage shale gas development. However, some key challenges – including technological, logistical, regulatory, and environmental – remain. Despite these challenges, the author expects shale gas to make an important contribution to China's energy mix in the next two decades.

Tatiana Mitrova examines the ongoing transformations in the global gas markets and the opportunities these changes present for China. The author identifies the following major trends: the approaching LNG glut; increased competition and shrinkage of uncontracted niches in Asia; and the challenge to oil-linked pricing as market-based gas pricing becomes more widespread. Despite China's dependency on gas imports, the author argues that China could be a winner in this gas 'Great Game' as a result of these transformations.

Yingxia Yang and Hengwei Liu explore the challenge of balancing China's environmental protection with its energy security. China's State Council recently announced the *Atmospheric Pollution Prevention Action Plan*. One important measure involved the use of natural gas to replace coal. However, this implies increased reliance on natural gas imports, raising concerns about energy security. The authors argue that the US shale gas revolution and US LNG exports have the potential to improve China's energy security in three ways: geographic diversification of energy supply sources, a reduction in international prices for natural gas,

and reduced oil-related price volatility for imported natural gas.

Keun-Wook Paik analyses the latest developments in Sino-Russian energy cooperation. A recent agreement to increase Russian oil exports reflects a sharp decline in China's domestic production and China's need for alternative, secure supplies. There has, however, been little progress in relation to Russian natural gas exports; this is largely due to disagreements on price, and to China's unwillingness to accept Russia's strategy of sharing natural gas supply sources with Europe. Meanwhile, China has found alternative supplies. Russia has announced important changes that could lead to an increase in their natural gas exports, but great uncertainty remains.

Li Junfeng, Yang Xiu, and Zhang Minsi analyse the debate concerning the need to balance economic growth with environmental protection and carbon emission control. Policies increasingly support sustainable economic development and environmental protection, and there is growing support for the view that China should establish a greenhouse gas emissions peak. However, critics of such a view argue that no other countries have taken measures to achieve an emissions peak before completing the process of industrialization and urbanization, and that setting a peak will negatively affect China's economic development.

Li Ji explores the relationship between electricity and China's CO<sub>2</sub> emissions. High coal intensity and rapid demand growth for power explain why China became the world's largest emitter of CO<sub>2</sub> in 2008, although its emissions are less than they would have been in the absence of a variety of policies aimed at limiting carbon intensity. These policies include closure of inefficient coal-fired power stations, promotion of non-fossil fired generation (nuclear,

hydro, and renewables), and pressure on state-owned enterprises to reduce demand. CO<sub>2</sub> emissions from power will continue to grow, but efforts to curb this growth will intensify further.

Renfeng Zhao analyses last year's EU-China trade dispute over solar PV products and its consequences. He argues that it revealed the lack of trust between the two sides in combating the global threat of climate change, as well as intrinsic flaws in the international trade system. The introduction of a price floor for Chinese imports into the EU has raised prices and reduced demand for solar PV, while damaging many solar companies in China and the EU. The dispute casts a shadow over Sino-European relations and undermines efforts to reach consensus on tackling the global issues of energy security and climate change.

Christian Ellermann and Constanze Böning explain the nature of the new pilot greenhouse gas emission trading schemes (ETS) in China, as well as the significance of their introduction. By moving towards the allocation of emission rights through market mechanisms, the government is signalling that it is addressing climate change seriously and that it wishes to be compared to Europe and the most progressive regions of North America that have also adopted emissions trading. However, the authors also argue that a transition to a more important role for markets in the area of energy and the environment is still in its very early stages.

Xu Qinhuo offers four clues to the process of understanding China's international policy with respect to energy. The first is that China is increasingly taking a market-driven approach to domestic and international energy, involving a greater role for private and mixed companies. The second is the opening up of the midstream and downstream oil



and gas sectors in China to foreign investment and technology. The third is the country's increased reliance on multilateral cooperation. Finally, China is putting increased emphasis on a low-carbon energy mix in China and abroad.

In his article, Gal Luft examines some of the implications of America's energy revolution for China. The author dismisses the myth that US military and diplomatic involvement in the Middle East is tied to

US dependence on imported oil from the region. After all, the USA only imports a small share of its oil from the region. However, stability in the Middle East is key for oil price stability, which remains a major concern for US policymakers. Hence the concerns of some Chinese officials – that US energy self-sufficiency will reduce the interest in the Gulf and increase the risk of disruption from the region – are misplaced. Luft

argues that China should embrace the US shale revolution, as the revolution has enlarged the world's energy pie and offered China more opportunities to have access to this bigger pie.

*All views expressed are solely those of the authors. They do not necessarily represent the views of the Oxford Institute for Energy Studies, any of its Members, or any other organization or company.*



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## Slowing growth and economic rebalancing in China

Damian Tobin

Recent data show that the Chinese economy grew by 7.7 per cent in 2013, slightly ahead of official projections but unchanged from the previous year's growth – which had been China's slowest since 1999. Guidance from China's State Statistical Bureau indicates that future annual GDP growth rates will be in the region of 7–8 per cent. The slowdown in China's economic growth has been accompanied by policies that have sought to shift the economy from its base in labour-intensive export-oriented manufacturing towards a focus on talent and domestic consumption. Efforts to rebalance China's economy are neither new nor unique, but what is interesting is the willingness of Chinese officials to tolerate lower rates of growth in order to rebalance the economy. Many developed economies have also sought to rebalance their economies in the aftermath of the global financial crisis. What distinguishes China's efforts from these is that instead of reorienting towards manufacturing, China's challenge is one of how to raise the share of services in the economy as part of the transition from a middle- to a high-income economy. However, a continued reliance on investment-driven growth, weak fiscal capacity at the local level, and the emergence of a large shadow banking system all threaten to derail this agenda.

### Rebalancing targets

The reasons for the change in China's growth model are, in many ways, intuitive. The economic, social, and environmental costs of maintaining an investment-based growth strategy which is heavily dependent on surplus labour and fossil fuels are no longer sustainable. Although recent data suggest that this model has made

China the world's largest trading nation, the country continues to perform very poorly in terms of value added. Many of the factors that have formerly sustained its growth model now represent obstacles to future growth. An IMF working paper looking at the issue of overinvestment in China has linked overinvestment to the increased probability of a systemic crisis. Administrative and quantity-based controls over monetary policy and interest rates, which initially facilitated rapid growth by channelling low-cost subsidized credit into state-owned industry, are now viewed as a drag on the real economy.

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**'MANY OF THE FACTORS THAT HAVE FORMERLY SUSTAINED ITS GROWTH MODEL NOW REPRESENT OBSTACLES TO FUTURE GROWTH.'**

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In industry, the policy direction advanced during the meeting of China's National People's Congress and at the recent Third Plenary Session of the Chinese Communist Party (CCP) in 2013 has once again focused attention on the future of the state sector. These events followed the release, in 2012, of the World Bank's 2030 China report (*China 2030: Building a Modern, Harmonious, and Creative Society*). The report, a collaboration with China's highly influential and reform minded Development Research Center of the State Council, envisages a significant scaling back of the state's role in economic activity, improvements in corporate governance, and an expanded role for the private sector. Other targets set out in the report include an increase in the share of consumption from 47 per cent of GDP in 2010 to 66 per cent by 2030 and a

reduction in the share of investment from 46 per cent to 34 per cent over the same period. At the same time it envisages an increase in the share of services in GDP from around 43 per cent of GDP to over 60 per cent by 2030.

These objectives are not new. China has had a long-term concern with economic modernization that predates the open-door policy. Since 1999, China has sought to develop the western and north-eastern regions of China, regions which have either not received the same investment inflows as southern coastal provinces or which have suffered significantly from deindustrialization. The objective of achieving a more harmonious, balanced, and sustainable form of economic and social growth was enshrined in the Eleventh (2006–10) and Twelfth (2011–15) Five Year Plans. This objective was reinforced and given a new direction by the recent Third Plenary Session of the Chinese Communist Party which, in setting the agenda of future reform, emphasized the importance of modernizing the governance system and its capabilities. More fundamentally, it suggested that while the relationship between the state and market had yet to be resolved, the market would have the decisive role in the allocation of resources.

### Unintended consequences

The Chinese leadership can claim a strong record of success in delivering on its economic policy targets, as set out under the system of Five Year Plans. It has met many of its targets on conservation, energy consumption, and the environment. It can also claim a degree of success in its political and economic handling of the uncertain



global economic environment that emerged after 2008. Preliminary data suggests that China may have become the world's largest trading nation in 2014. But many of these successes carry unintended consequences that threaten to derail the current rebalancing agenda.

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**'PRELIMINARY DATA SUGGESTS THAT CHINA MAY HAVE BECOME THE WORLD'S LARGEST TRADING NATION IN 2014.'**  
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Policies aimed at boosting domestic consumption – which have included increases in minimum wages, lower agricultural taxes, and increased subsidies and prices for farmers – have had the unintended consequences of urban labour shortages and rising costs. For example, although Guangdong Province in southern China has raised the nominal minimum wage by 66.6 per cent in tier-one cities between 2006 and 2011, it has experienced recurrent bouts of labour shortage. Such wage inflation has inadvertently made China less attractive for foreign direct investment, particularly in labour-intensive manufacturing. Similarly, a more rigorous enforcement of environmental standards has increased the business costs of resource-intensive firms. China's strong controls over its banking sector, which include restrictions on loan-to-deposit ratios and interest rate controls, have helped protect the financial system. Deposit rate ceilings have protected the deposit bases of the state-owned banks, thereby ensuring a steady supply of cheap credit to the state sector. But these controls have also resulted in the growth of a large shadow banking system, as depositors seek higher returns and private firms seek access to credit.

One of the biggest threats to rebalancing is the legacy of the 2008/9 state-driven fiscal stimulus. The

stimulus, which was implemented via the state-owned banking system and local government funding platforms, resulted in an explosion in local government debt. A recent audit of local government debt by China's National Audit Office indicated that many local governments now have debt ratios exceeding 100 per cent. It also showed that local governments continue to add significant amounts of debt, with almost 30 per cent of the current stock of debt being added in 2012. In 2013 the IMF estimated that, taking into account the liabilities of local government, China had an augmented fiscal debt of 50 per cent of GDP with corresponding fiscal deficit of 10 per cent. While this is still a relatively manageable debt level, local governments face urgent demands to invest in local infrastructure, housing, and services, but lack the fiscal capability to finance this.

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**'MEETING THE TARGETS ADVANCED IN THE TWELFTH FIVE YEAR PLAN WILL REQUIRE AN INCREASING EMPHASIS ON "GREEN" TECHNOLOGY AND SUSTAINABLE ENERGY SOURCES.'**  
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In its industrial sector, China has set out ambitious targets to reduce the country's dependence on coal and other fossil fuels. The Twelfth Five Year Plan (2011–15) indicates that by 2015, non-fossil energy will rise to 11.4 per cent of national total primary energy consumption and energy consumption per unit of GDP will drop by 16 per cent, and that CO<sub>2</sub> emissions per unit of GDP will decrease by 17 per cent from 2010. In implementing this, it has sought to increase the capacity of plants in key sectors such as coal, steel, and petrochemicals. However, the environment under which these targets have been set has not changed fundamentally. Meeting the targets advanced in the Twelfth Five Year Plan will require an increasing

emphasis on 'green' technology and sustainable energy sources. This appears at odds with the continued reliance on, and expansion of, coal and oil enterprises. China is now more dependent than ever on heavy industry and on the raw inputs for manufacturing that such industry supplies. The share of manufacturing in GDP remains relatively high at around 47 per cent and the state lacks the authority to simply close down many of the smaller industrial firms that it privatized in the late 1990s.

**Ample scope**

Despite these risks, the Chinese government retains ample scope to grow the economy. However, slowing economic growth implies that the margins for policy errors have narrowed considerably. For this reason it is unlikely that China would seek to implement another fiscal stimulus on the scale of 2008. The decisive role of the market advocated by the leadership at the recent Third Plenary Session of the Chinese Communist Party indicates that future policies are likely to focus on eliminating inefficiencies such as obstacles to competition in the state sector, the gradual removal of caps on deposit rates, and the greater use of the Renminbi in trade settlement. Policies are also likely to continue to focus on how to unravel the overlapping and complex connections between the state bureaucracy, party officials, and large state-owned banks and enterprises. While there appears to be some agreement that this relationship now represents an obstacle to economic efficiency, the relationship remains a strong source of legitimacy for the CCP. A more likely outcome is a political compromise that balances the need for greater competition and more transparent governance with maintaining the legitimacy of the CCP.

## China's rebalancing and oil consumption patterns

Bassam Fattouh and Amrita Sen

China has constituted the most significant source of the incremental growth in global oil demand over the last decade, adding around 5 million b/d between 2000 and 2012. This is expected to continue well into the future: the International Energy Agency (IEA) estimates that China will account for more than 40 per cent of the increase in oil demand to 2035. A big part of that growth story has related to diesel, which has assumed a growing importance in the energy production and consumption of the world's fastest growing emerging market economies. Fuelled by trade and investment, China's growth has strongly supported diesel demand over the last decade. The dominant position of diesel in commercial freight traffic, be it by truck or rail, has made it the fastest-growing demand component. In China, the government mandate requiring all trucks to be fuelled by diesel by 2010 simply accelerated the already rising momentum of diesel demand growth. Further, diesel demand received an extra boost from power problems that led to greater use of diesel as a back-up fuel. In 2004, 2008, and 2010, power shortages during the winter months together with periods of government power rationing (to achieve environmental targets) contributed to buoyant diesel demand. The heavy industrial and mining sectors – such as coal, ship building, steel, and cement – that rely heavily on diesel, boomed throughout the 2000s. It is thus hardly a surprise that diesel was the backbone of Chinese oil demand growth, to the extent that Chinese oil demand growth was synonymous with diesel demand growth.

### Chinese diesel and gasoline demand dynamics

Given the importance of China in global commodity markets, questions abound as to how the nation's development path and economic rebalancing will impact its future commodity demand. However, the objective of the rebalancing is ultimately to transfer more power to consumers, which does not necessarily imply lower commodity demand across the board. In fact, any sector that is more geared towards consumer demand rather than investment will benefit, and this is already evident in China's changing oil consumption patterns. Gasoline and jet fuel – petroleum products more geared towards consumers – have been performing robustly, in comparison to diesel and petrochemical feedstock, which are more leveraged to investment demand.

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### 'CHINA HAS CONSTITUTED THE MOST SIGNIFICANT SOURCE OF THE INCREMENTAL GROWTH IN GLOBAL OIL DEMAND OVER THE LAST DECADE ...'

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Indeed, in a notable reversal of trends, diesel demand growth has slowed to 3.5 per cent so far this decade, after having averaged 8.7 per cent in the last decade. The downswing from the peak rates is even greater, with double-digit growth having been seen in 2004 (0.4 million b/d or 23.4 per cent), 2008 (0.3 million b/d or 12 per cent), and 2010 (0.36 million b/d or 13.2 per cent). This tapered off to flat-to-negative demand growth in 2012 (40 thousand b/d or 1.2 per cent). In comparison, gasoline demand growth has increased steadily over the past few years, picking up pace in recent months. In the last decade, Chinese gasoline demand has increased on

average by 7.4 per cent per year. The momentum has continued into this decade, averaging 10.6 per cent so far. In 2013, gasoline demand was up by nearly 10 per cent, while diesel demand has been lacklustre, up by a mere 0.6 per cent year on year. The market for gasoline used to be half the size of that for diesel in China; it has now become two-thirds its size, with the gap between gasoline and diesel demand rapidly narrowing.

Although diesel demand growth is unlikely to turn negative in the coming years, a longer-term rebalancing away from investment-oriented growth implies far lower growth rates in mining and heavy industries. Such a rebalancing and tighter credit conditions are likely to taper the rates of growth in overall diesel demand. Gasoline demand, on the other hand, has been supported primarily by consumers, with the transportation sector accounting for nearly 50 per cent of total gasoline consumption by 2010. The increasing ownership of private cars and buses is the primary reason for the rising gasoline consumption in the transport sector. While rapid economic development and urbanization over the last three decades have resulted in an average GDP growth rate of 8–10 per cent, the number of passenger cars in China has risen by an average of 25 per cent since 2003, with over one million cars sold each month from early 2009 through 2010. Total numbers of passenger vehicles grew from 12.19 million cars in 1997 to over 100 million cars in 2012, an average annual growth rate of over 15 per cent.

Despite the impressive growth in vehicle numbers, gasoline consumption growth has been far less dynamic than that of diesel in the



past decade. Usage of gasoline has been less diverse when compared to diesel, and gasoline most definitely did not benefit from exposure to heavy industries or swing use in power generation. Other constraints on gasoline demand include poor road infrastructure, congestion, and the simple lack of driven miles, despite car ownership. The final factor reflects a trend of cars being bought for gains in social status rather than as a means of transportation. There tends to be a lag, particularly in emerging markets, between the rise of auto sales and the picking up of gasoline consumption, but this is usually restricted to two to three months at most. In China, while that was broadly the case through to 2009, the correlation then broke down for about three years.

In 2009, the government halved the sales tax to 7.5 per cent on cars with engines smaller than 1.6 litres, subsidized vehicle trade-ins in rural areas, and introduced tax breaks to encourage car ownership. This resulted in an 83 per cent increase in total auto sales comprising new passenger vehicles and light trucks. Indeed, in 2009 auto sales increased year on year by 49 per cent and in 2010 by another 36 per cent. However, although auto sales soared, gasoline demand failed to follow, with 2009 demand growth at 7.1 per cent and that for 2010 at 5.8 per cent. Between 2008 and 2011, gasoline demand increased from 1.47 million b/d to 1.78 million b/d, an increase of 21 per cent – far below the 83 per cent increase in auto sales.

**Gasoline demand picks up with a lag**

Interestingly, gasoline demand started to pick up just when the Chinese government began to roll back incentives for buying new cars owing to rapid increases in air pollution; indeed four municipalities/cities began to enforce a quota on new vehicle

registration. A main reason for the increase in gasoline demand has been improved road conditions, as a result of which miles driven are on the rise. But equally, despite a hit to household income from the correction in the property market and tightening credit, income levels on the whole have continued to increase. This is evident in the pick-up in growth rates of luxury car sales, particularly of SUVs, in China in recent months. These luxury cars tend to have larger and less efficient engines, meaning they consume more gasoline – so much so that they have mostly offset the various green measures that the government has implemented during the time period, including the reduced incentives to purchase cars and penetration of natural gas vehicles (NGVs) into the bus and taxi fleet.

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**‘THE INCREASING OWNERSHIP OF PRIVATE CARS AND BUSES IS THE PRIMARY REASON FOR THE RISING GASOLINE CONSUMPTION IN THE TRANSPORT SECTOR.’**  
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Rather like its penchant for luxury fashion brands, China’s tremendous appetite for premium cars has increased luxury auto sales at an impressive rate of 36 per cent per year in the last decade, faster than the 26 per cent annual growth in the overall Chinese passenger vehicle market during the same period. Sales of premium cars in China reached 1.25 million vehicles in 2012, making it the second biggest luxury market in the world, after the USA. The premium car market in China represented 9 per cent of all passenger car sales in 2012, a higher proportion than in Japan (4 per cent) and South Korea (6 per cent). Although some government incentives remain in place for trade-ins of cars that do not meet the specified emission standards or for new cars with engine smaller than 1.6 litres, Chinese consumers are clearly veering towards

larger luxury brands, which is in turn boosting gasoline demand.

A McKinsey consumer research survey recently showed that 80 per cent of Chinese premium car owners have an annual disposable household income of more than \$32,000. The report notes that this affluent segment of society is set to grow at a compound annual rate of 16 per cent between now and 2020, offering underlying support for the premium car market. By 2020, the survey forecasts that there will be 23 million affluent urban households in China – 7 per cent of the population.

The results of this survey have two important implications for the future of gasoline. As the government attempts to rebalance towards consumption and unlock the true potential of the Chinese consumer, which has been suppressed thus far, both the auto sector and hence gasoline demand can continue to find a significant scope for growth. Historically in other countries, vehicle ownership has grown relatively slowly at the lowest levels of per capita income, about twice as fast at middle-income levels (from \$3,000 to \$10,000 per capita), and about the same rate at higher income levels, before reaching saturation. Clearly, as incomes increase, the potential for gasoline demand to continue to rise strongly is highly plausible, despite improved public transportation systems and increasing density of cities.

Second, not only is the auto sector likely to keep growing as incomes rise, but the luxury car sector may continue to outpace overall auto-sector growth. If realized, this is likely to offset a wide range of green transport policies that the Chinese government is currently undertaking to reduce the environmental impact of rising car sales. In this regard, although the number of natural gas vehicles (NGVs) has started to grow rapidly, a trend that is expected to continue, these vehicles

(almost 1.5 million by the end of 2012) are concentrated in certain areas such as taxi fleets and buses. A widespread substitution of NGVs for purchases of new gasoline-powered vehicles is unlikely, as they remain costly, offer limited model choices, and have further problems related to the lack of fuelling stations. For buses and taxis, however, higher mileage and more predictable routes have made the switch to natural gas cost effective. Of course, further penetration of NGVs into the taxi and bus fleet will temper gasoline growth rates in the future, as will increasing congestion, but the overall impact on

gasoline will also be determined by the rate of increase of the numbers of (less efficient) luxury cars in the auto market. Thus, gasoline demand growth is expected to continue strongly from now through to 2020.

The changing demand dynamics in China will also have a big impact on global products' trade flows for the rest of this decade. China's refining capacity has risen sharply in recent years and is mainly biased towards hydrocracking. Accompanied with the slowdown in domestic diesel demand, this has already turned China into a net

exporter of diesel. In contrast, China is expected to be net short gasoline by 2015, as gasoline demand outpaces existing refining capacity, particularly as the economic rebalancing takes effect and the demand for private transport continues to rise. In fact, the wider Asian region is already short gasoline as a result of rising income and growth trends in countries such as Indonesia, Malaysia, and Vietnam. Thus, Asia will continue to rely on growing gasoline imports from Europe, which may provide some limited relief for European refineries.



## China: the upcoming global gas giant

Trevor Sikorski

The global natural gas market has been unusual among commodities in that it has not had a China story over the last ten years. The market has seen significant volatility, due in part to its shallow liquidity pool and some big fundamental swings – Qatari LNG trains and post-Fukushima Japan being the stand-out ones. But the fundamental swings have not been about China – that is, until now. At the start of this winter, the biggest single question was how cold would it get in China and how big would the demand side response be, given China's rush to get 9.2 Mtpa of LNG regas capacity operational in Q4 13. With all of that new capacity on-line, LNG spot cargoes shot above the \$18/MMBtu level at the start of the heating season and have simply not come down. Even after a mild December and January, these spot prices are staying at these advanced levels.

### China's increased gas consumption

The sudden importance of China to the global gas market comes against the

background of the country seeing rapid increases in gas consumption. Since 2000, China has seen gas demand grow at an average of 16 per cent per annum, which has turned China into the world's fourth-largest gas consumer, with total consumption in 2012 at 144 Bcm (13.9 bcf/d). While this growth has come from all major sectors, the biggest changes have been seen in the urban gas sector, as municipalities look to replace inefficient and polluting coal-fired heating systems with cleaner gas systems.

### 'Air-mageddon' – China's need for gas as a clean fuel

The push for gas to go into urban gas (as opposed to industrial use or power generation) has its roots in China's current 'air-mageddon' crisis, with urban air quality suffering from advanced levels of particulate matter pollution. Much of this pollution is caused by inefficient coal-burning boilers being used in residential heating; municipalities across northern China have taken rapid steps to

replace these systems with cleaner gas-burning systems. The scale of the shift was sufficient for China's NDRC, back in October 2013, to send out warnings that the country was facing a 10 Bcm gas shortage over the November to March period if the winter was of normal severity. In response, it mandated that urban users would be allocated gas, to the potential detriment of the industrial and power sectors.

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**'SINCE 2000, CHINA HAS SEEN GAS DEMAND GROW AT AN AVERAGE OF 16 PER CENT PER ANNUM, WHICH HAS TURNED CHINA INTO THE WORLD'S FOURTH-LARGEST GAS CONSUMER ...'**  
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The increased gas demand for urban heating ensures that consumption growth will remain fairly rapid over the coming years. While this source of gas demand will probably crowd out some further gas demand growth from the industrial and power sectors, it will be sufficient to see gas consumption exceed 300 Bcm/year by 2020.



**China's gas production**

China's domestic production in 2012 was 107 Bcm, and it has shown good consistent growth, averaging 12.1 per cent per year since 2000. Almost all of that growth has come from conventional onshore production, with a relatively small offshore contribution and almost no shale gas production. China has the world's thirteenth largest proven gas reserves, and this recent growth has turned the country into the world's seventh largest gas producer.

However, the rapid increase in peak gas demand has outpaced domestic Chinese gas production. Future increases in production will come from both conventional and unconventional gas resources. The Chinese government is targeting some 80 Bcm/year of shale gas production by 2020. In China's favour for increasing its production of shale gas includes its sizeable shale gas resource base and the state of its onshore drilling industry (which is fairly well developed).

China has good shale gas resources, with the 2013 study by the EIA / ARI putting China as the country with the most recoverable shale gas reserves (31.6 Tcm), a level of reserves comparable to the USA and Canada together. The reserves are located predominantly in the South China Shale Corridor (Sichuan, Yangtze Platform, Jiangnan, and Subei basins), with the Tarim basin (north-west), the Junggar basin (north-west), and the Songliao Basin in north-east China.

Chinese shales do, however, tend to exhibit more complex geology than those in North America, and this does mean that the speed of uptake is unlikely to be as fast as in the USA. China also has to do a lot more exploratory drilling and it does need to grow its drilling service sector. Having

said that, production in China by 2020 could well be around 40 Bcm/year, around half of the government target. Such a number is plausible even if China just focuses on the exploitation of its southern corridor production basins, the basins currently attracting most interest.

**China's need for gas imports**

With consumption having outpaced production growth, China has increasingly had to import gas. The sources of imports have been pipeline gas from Central Asia and imports of LNG. In terms of pipeline gas the Eurasian gas exporters – Turkmenistan (since 2010), Uzbekistan (since August 2012), and Kazakhstan (since August 2013) – export gas to China through the Central Asia Natural Gas Pipeline (CAGP). This pipeline runs 1,833 km from Turkmenistan, through Uzbekistan and Kazakhstan, and into China at Horgos, Xinjiang province, where it connects with the second West–East pipeline. China has no pipeline connections with Russia, although the two have been negotiating such a pipeline since signing a cooperation agreement in 2004. In late 2013, Russia announced that the much delayed supply agreement with China was imminent.

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**'WITH CONSUMPTION HAVING OUTPACED PRODUCTION GROWTH, CHINA HAS INCREASINGLY HAD TO IMPORT GAS.'**  
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Investments underway could mean that gas imports from Central Asia will increase from current levels of around 20 Bcm/year to 65 Bcm/year by 2020. Such levels of imports would be facilitated by the completion of the third and fourth West–East gas pipelines. Some 15 Bcm/year of gas could be imported from Russia into north-

eastern China, through Gazprom's proposed 'Power of Siberia' pipeline, if a supply agreement is eventually reached.

The remaining imports are expected to come in through LNG. China has seen a rapid increase in LNG regas facilities, adding some 19 Mt of import capacity in the last three years. As a result, imports have expanded from around 5.7 Mt (7.75 Bcm) in 2009 to being on track to total 18 Mt (24.5 Bcm) in 2013. By 2020, LNG imports will have to increase to between 35 Mtpa (48 Bcm/year) and 77 Mtpa (105 Bcm/year), depending on how well domestic production performs in the future.

**Uncertainty surrounding China's future need for imported LNG**

This discrepancy in estimates of future Chinese LNG demand highlights the inherent uncertainty surrounding the future progress of the country's conventional and shale gas production. If domestic production maintains its current growth levels, then the growth in LNG imports will be much slower than if domestic production growth were to fall short. The difference is enough to have a material impact on spot LNG prices; however, although even then we do not expect prices to drop much below the \$12/MMBtu level, as prices below this could well start to close the US arbitrage window.

With the possibility of there being a greater risk of production falling short of targets, actual Chinese demand for LNG imports could well be at the higher end of that forecast range (77 Mtpa). Come 2020, there will be a lot of liquefaction capacity around, and China could provide considerable demand. However, such demand is far from certain.



# Shale gas development and challenges in China

Liu Xiaoli

## Strategic significance of shale gas

China is now undergoing rapid industrialization and urbanization and its demand for energy will see long-term increases. Over recent years, the Chinese government has been plagued by environmental disruption and greenhouse gas emissions, caused by the longstanding focus of its energy mix on coal, and by its energy security having been compromised by high dependence on imported oil and natural gas. In 2013, Beijing, Tianjin, Hebei province, North China, the three provinces in the north-east of China, and some provinces in China's central region saw frequent widespread haze disasters. Such events greatly threaten human health and the country's sustainable economic and social development, imposing enormous pressure on the government. Therefore, securing low-carbon energy with long-term stable supply inevitably becomes a hot topic.

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**'THE CHINESE GOVERNMENT HAS ATTACHED GREAT IMPORTANCE TO THE DEVELOPMENT OF SHALE GAS, INTRODUCING MANY INCENTIVE POLICIES TO SPEED UP ITS DEVELOPMENT AND UTILIZATION ...'**  
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Low-carbon energy, represented by renewable energy, has gained momentum in recent years, but it is now difficult for non-fossil energy sources alone to improve China's energy mix. In the USA, the 'shale gas revolution' has been successful, and in addition to helping that country realize self-sufficiency and push forward its 'energy independence' strategy, the revolution has had a profound influence on the global oil/

gas market, and has significantly strengthened China's confidence in shale gas. It is therefore natural that the exploitation of its shale gas resources – which have great potential – has become a strategically important option for China, one which could enable it to improve its natural gas supply capacity, energy mix, and atmospheric environment.

## Exploration and development of shale gas

Data released by the Ministry of Land and Resources in November 2012 show that there are 25.08 trillion cubic metres (Tcm) of recoverable shale gas in China. This figure, though obviously different from that of the Energy Information Administration (EIA) (see the table 'Latest estimates of shale gas reserves') nevertheless indicates great shale gas potential in China.

In recent years, the Chinese government has attached great importance to the development of shale gas, introducing many incentive policies to speed up its development and utilization, and to bring its strategic role in China's energy development into full play. In 2011, the National Development and Reform Commission, the Ministry of Finance, the Ministry of Land and Resources, and the National Energy Administration jointly released the Shale Gas Development Plan for the Twelfth Five Year Plan Period, and

set ambitious goals of increasing shale gas output to 6.5 Bcm (billion cubic metres) by 2015 and to 60–100 Bcm by 2020. To encourage businesses to increase their efforts in shale gas exploration and development, the Ministry of Finance together with the National Energy Administration announced a 0.4 RMB (6.4 US cents) per m<sup>3</sup> subsidy for shale gas that is developed and consumed from 2012 to 2015. In the Shale Gas Industry Policy, shale gas exploration and development is, for the first time, supported with policies and financial aids as an independent and strategic emerging industry.

In order to break the longstanding monopoly held by several oil companies in the upstream areas of conventional oil and gas, the Ministry of Land and Resources has defined shale gas as an independent mineral and has conducted the first and second rounds of exploration rights bidding, giving non-oil and private enterprises the opportunity to take part in the exploration and development of such resources. Furthermore, the National Energy Administration, with the aim of driving the whole shale gas industry, has set up a number of national shale gas exploitation demonstration zones. These include: Sichuan Changning–Weiyuan National Shale Gas Demonstration Zone, Yunnan/North Guizhou Zhaotong National

**Latest estimates of shale gas reserves**

	<i>Ministry of Land and Resources, China*</i>	<i>Energy Information Administration, USA†</i>
Recoverable shale gas in China (excluding the Qinghai–Tibet region)	25.08 Tcm	36 Tcm

\* for 2012

† for 2011



Shale Gas Demonstration Zone, and Yan'an National Continental Shale Gas Demonstration Zone.

By the end of October 2013, China had drilled 178 shale gas wells; this figure includes 38 wells with a daily output of over 10,000 m<sup>3</sup> and 16 wells of over 100,000 m<sup>3</sup>. According to a 2013 report (a restricted document) – Development of Oil & Gas Industry In and Outside China – by China Petrochemical Corporation's Economic Technology Research Institute, China produced 50 million cubic metres of shale gas in 2012, accounting for 0.05 per cent of the natural gas produced that year. The figure is expected to be close to 200 million cubic metres in 2013.

Currently, PetroChina and Sinopec are the dominant players in China's shale gas development. PetroChina has completed pre-evaluation for the Changning–Weiyuan and Yunnan Zhaotong national shale gas demonstration zones. Fifty horizontal wells were planned. Up to November 2013, in the Changning–Weiyuan Zone, PetroChina had finished drilling 16 wells and testing for 12 fractured wells. Daily output of the vertical and horizontal wells is 2,000–30,000 m<sup>3</sup> and 10,000–160,000 m<sup>3</sup> respectively. In the Yunnan Zhaotong Zone, PetroChina has finished drilling seven wells. Daily output of the vertical and horizontal wells is 2,500 m<sup>3</sup> and 15,000–36,000 m<sup>3</sup> respectively. At the same time, Sinopec has made breakthroughs in productivity construction of the Maxi Formation shale gas exploitation experimental well group at Jiaoshiba, Fuling, commencing the drilling of 24 wells, finishing 15 wells, testing five wells, and putting four wells into operation. The total daily shale gas output is 550,000 m<sup>3</sup>. In June 2013, CNPC announced that it has started building the country's first dedicated shale gas pipeline in Sichuan province. The pipeline will stretch 92.8 kilometres, linking shale gas production wells Ning 201-H1 in

Changning district to the Shuanghe gas processing station, and connecting to the existing Sichuan Naxi to Yunnan Anbian pipeline. It will have a capacity of 4.5 million cubic metres a day.

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**'BY THE END OF 2013, CHINA'S OIL COMPANIES HAVE MADE INITIAL ATTEMPTS TO EXPLORE MARINE, CONTINENTAL, AND TRANSITIONAL SHALE GAS.'**  
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Apart from PetroChina and Sinopec, Yanchang Petroleum (a provincial state-owned oil enterprise and one of four oil/gas exploration and development companies), has drilled 24 shale gas wells and 14 fractured wells, and made breakthroughs in continental shale gas in the Ordos Basin. China United Coalbed Methane Co. Ltd. defined Shouyang, Qinyuan, and Jingcheng as favourable areas in the Qinshui Basin of Shanxi. It is also worth noting that the winning businesses in the second round of shale gas mining rights bidding have made substantial progress. For example, Tongren Energy Investment Co. Ltd drilled the first well in the Qingong Block in Guizhou on 5 December 2013. And the bid winners will drill a batch of wells in early 2014. By the end of 2013, China's oil companies had made initial attempts to explore marine, continental, and transitional shale gas.

**Major challenges**

Although the development of China's shale gas has received close attention from both government and industry, and the country's oil companies have made progress in shale gas exploration and development, the industry is still in its infancy in China. The exploitation and utilization of shale gas resources on a large scale is faced with the following problems:

*How can the potential of shale gas be unearthed?* Knowledge relating to

the existence and location of shale gas resources is necessary before shale gas exploitation and industry development can take place. Some scholars and institutes in the country have conducted preliminary studies on geological theory, potential evaluation, and favourable selection of areas in relation to shale gas, but systematic conclusions have not yet been reached. The Ministry of Land and Resources and the Chinese Academy of Engineering have organized research on shale gas accumulation mechanisms and enrichment rules in China; these, however, are not supported by sufficient data, due to shortage of exploration wells. In terms of resource potential and economic benefits, only marine shale gas is studied in detail. Evaluation of coal and lacustrine shale gas is sketchy, so the results might vary greatly. Taking the USA as an example, the learning process prior to rapid development of shale gas lasted two to three decades. China needs to deepen its knowledge in relation to shale gas reservoir features and physical properties, as well as mining characteristics. In short, this work will take considerable time and great effort.

*Immature core technologies constrain the rapid development of shale gas in China.* The country has accumulated some experience in developing tight gas and coalbed methane (CBM), and has developed initial technical capabilities with respect to shale gas exploitation, – such as 8–20 section fracturing and drilling of long-distance horizontal wells – but it is still some distance from being able to support its shale gas exploration and development fully. There are currently two major technical challenges. On the one hand, due to lack of in-depth analysis and research on shale gas resource prospecting, evaluation, exploitation, and production activities, a shale gas exploitation technology

system adapted to China's geological characteristics is yet to be formed, and resource evaluation, horizontal wells, output increase through fracturing, and other key technologies have not been fully mastered. On the other hand, successful US shale gas exploitation technologies cannot be simply copied in China because the geological structure is different. Localization is inevitable for the technologies introduced. China needs to explore and evaluate new technologies during exploration and development.

*Exploration rights management and regulatory policies need to be improved.* The current legal framework for unconventional natural gas mining rights is slowing the development of unconventional natural gas – this is illustrated by the slow development of CBM. At the end of December 2011, the Ministry of Land and Resources defined shale gas as an independent mineral, and announced that shale gas would be invested in and managed separately; however, corresponding laws and regulations are inadequate. The problem is that there are several gas reservoirs which feature both conventional and unconventional natural gas resources on the same geological profile, so it is difficult to divide gas reservoirs clearly during exploration and recovery. If we are unable to do this, how can we manage shale gas separately? And how can we measure shale gas and calculate the subsidy for it? Current shale gas exploration and development blocks largely overlap with the areas where oil companies hold conventional oil and gas rights. In order to encourage oil companies to speed up the exploration and development of shale gas, or to give other companies more opportunities to enter the race, the Ministry of Land and Resource issued the 'Notice on the Strengthening of Shale Gas Resources Survey & Exploration and the Supervision &

Management of the Work' ('the Notice') in November 2012. The Notice states that shale gas exploration rights for the existing oil and gas block will be subject to the principle of 'explore or exit'. But in practice, the issues of how to exit, and how to properly link oil, natural gas, and shale gas exploration work are still uncertain. China's rights regime is potentially the biggest bottleneck for shale gas development.

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**'... SUCCESSFUL US SHALE GAS EXPLOITATION TECHNOLOGIES CANNOT BE SIMPLY COPIED IN CHINA BECAUSE THE GEOLOGICAL STRUCTURE IS DIFFERENT.'**  
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*Environmental and social problems constrain the sustainable development of shale gas industry.* The hydrofracture technology used during shale gas recovery may consume a lot of water resources, pollute the underground freshwater layer, and emit methane and poisonous and harmful exhaust gas, jeopardizing the local environment and human health. In the USA, the environmental and social issues related to shale gas exploitation have become noticeable and receive close attention from stakeholders. Most of China's shale gas resources are in Sichuan, Tarim and Ordos Basins, east Chongqing, west Hubei, Guizhou, and Hunan in Midwest China, where shale gas mining is faced with many environmental and social problems which are more challenging than those in the USA. For example, large-scale well site operation is difficult to achieve because some of the regions feature complex topography and significant height differences. In densely populated regions, shale gas well sites need to occupy agricultural, industrial, and residential land. Some of the regions with abundant shale gas resources suffer from water shortage; even those in south-west China, with more water resources, have seen

frequent drought disasters in recent years. Shale gas mining produces effluent, which can contaminate the surface and ground water if it is not disposed of properly. China's environmental protection laws and regulations related to oil and gas exploration and development are not complete. Those which have been adopted contain many principled provisions, but lack stipulations on actual operation. The government's supervision of the industry depends mainly on the players' self-discipline, but China has already suffered from frequent environmental pollution accidents and the public is sensitive to environmental issues. Considering the potential diversity of the shale gas exploitation participants, self-discipline alone is not enough. The government therefore needs to study the impact of shale gas exploitation on the ecology and environment in advance, and establish an environmental supervision system for shale gas exploitation.

*The slow construction speed of natural gas infrastructures, and the incomplete access mechanism.* A cross-regional natural gas trunk pipeline network has been created in China in recent years. By 2012, the total length of natural gas trunk pipelines amounted to 55,000 km (not including city gas distribution pipelines), and the annual transmission capacity was over 160 Bcm. But when compared with a mature natural gas market, as seen in other countries, construction of China's natural gas pipeline network, gas storage, and other infrastructures lags seriously behind, restricting shale gas exploitation and utilization and hampering industrial development. Almost all of the existing natural gas pipelines in China are owned by CNPC (for example the West–East Gas pipelines) and SINOPEC (for example the Sichuan–Shanghai Pipeline). In order to promote fair and open access to oil and gas pipeline networks



and improve the utilization efficiency of gas facilities, in February 2014, the NEA issued the 'Regulatory Approach for Fair Open Access to Oil and Gas Pipeline Facilities (Trial)'. This states that when there is surplus capacity, oil and gas pipeline facility operators should provide equal access to third-party market players. Users should be given non-discriminatory access to transportation, storage, gasification, liquefaction, and compression services. However, as natural gas pipeline network development is lagging behind production, there is insufficient network transmission capacity and higher utilization of existing pipelines. In these

circumstances, it will probably be difficult to implement this new approach. Therefore, large-scale development and utilization of shale gas will face the challenge of constructing new natural gas infrastructures.

**Conclusions**

China has abundant shale gas resources and the basic geological conditions to accelerate shale gas development, but shale gas cannot become a major energy source for China in the near future because its exploration and production are still in their infancy. However, as long as the country understands its shale

gas resource base objectively, goes forward step by step, makes technical breakthroughs, improves exploration right management and environmental supervision, and accelerates the construction of a national gas pipeline network while establishing third-party access to the pipelines, China's shale gas industry will make remarkable progress and see great momentum in the coming five to 10 years. Shale gas will become an important source of China's future natural gas supplies in the long term, making a significant contribution towards improving the energy mix and ensuring the country's energy security and environmental protection.



## The implications of global natural gas market developments for China

Tatiana Mitrova

The ongoing transformation of the world's gas markets is significantly altering the positions of the major global players, with the USA and China emerging as the main winners. It is clear to see that the USA, as the pioneer of the shale revolution, will receive the greatest benefits. North America will achieve complete gas self-sufficiency while low prices for hydrocarbons will boost new industrialization; it will also be able to contribute 60–80 million tonnes to the global LNG market, respond flexibly to changing market conditions, and quickly redirect supplies to the most profitable regional markets.

The outcome for China is less obvious and actually quite surprising. How can an import-dependent country with booming gas demand, limited production options, and subsidized domestic prices actually become a winner in this gas 'Great Game'? In fact China is successfully carrying

out a policy of import diversification, rapid construction of the necessary infrastructure, and enhancing its position in other regions by engaging its national companies in the development of their gas resources. It also has its own large reserves of unconventional gas, which could add to the diversification of its supply mix. China's balanced and forward-looking policy will allow the country to share the fruits of the shale revolution with the USA and benefit from the unique situation that is currently evolving in global gas markets.

**Buyers' market for LNG by 2020**

Firstly, the main new trend in global gas markets is the anticipation of the approaching LNG glut. Seven new LNG projects will make Australia the world's leading LNG producer by 2018, and other new projects in the country are under consideration. Though extremely expensive, they are under way already

and, despite incredible costs, they will bear fruit, and most likely at very high utilization rates.

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**'... THE MAIN NEW TREND IN GLOBAL GAS MARKETS IS THE ANTICIPATION OF THE APPROACHING LNG GLUT.'**  
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North American LNG is another game changer. Export volumes are so far uncertain (and limited by US political decisions), but with the permits already granted, LNG production capacity might exceed 60 Bcm/year in the USA plus at least 30–40 Bcm/year in Canada by the end of this decade.

East African LNG will probably add to this situation of oversupply in the early 2020s. As a result, global LNG supply is expected to boom by the beginning of the next decade. According to announcements that have been made, liquefaction capacities could increase by 80–90 per cent by 2020, so it seems likely to become a buyers' market

post-2018–20. Of course, a significant amount of these newly announced capacities is speculative (as usual), but even the more modest additions seen in 2008–11 caused huge market changes.

### Dash for Asia

The second important trend is seen in Asia, in the form of increased competition and shrinking uncontracted market niches. Zero import needs in North America, weak gas demand in Europe (accompanied by much lower prices for gas than in Asia), and unstable demand in South America make Asia a well-established, growing market and, with its premium prices, the destination of choice for all LNG producers. In deciding where to send their LNG in the future, they will opt to target Asia, and this would be an absolutely reasonable decision when the price differential with European markets exceeds \$3–4/MMBtu on average. Theoretically, US, Canadian, and East African LNG should be competitive in Europe, but Asia is a much more attractive market, offering far higher margins.

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**‘... MAKE ASIA A WELL-ESTABLISHED, GROWING MARKET AND, WITH ITS PREMIUM PRICES, THE DESTINATION OF CHOICE FOR ALL LNG PRODUCERS.’**  
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Moreover, pipeline gas suppliers such as Russia and the Central Asian countries have been very disappointed by the development of the European gas market and have no hopes for any improvement there. Of course, Russia is not going to turn its back on this well-established, profitable market with its existing infrastructure and huge portfolio of long-term contracts lasting beyond the 2030s, but there is nearly no room for any increase in gas exports to Europe. As a result, CIS

countries now pin their hopes for gas export growth not on the West, but on the East. Newcomer Iran, more likely than not, will join this club of Asia’s ‘admirers’.

It seems, therefore, that nearly all new gas supplies (including those from Russia) will end up in Asia–Pacific, with the Asian market becoming the main battleground for the increasingly expensive new LNG and pipeline projects.

Asia, Japan, and South Korea (mature and lucrative markets, which are facing serious threats to their national energy security as a result of declining LNG supplies from their traditional suppliers, Malaysia and Indonesia) are the most attractive markets. They are contracting Australian, US, and Canadian LNG very rapidly. North American contracts to supply gas to Japan and South Korea (the latter, incidentally, is party to a free trade agreement, and therefore does not need special export permission from the US DOE) already total 48 Bcm/year – an amazing result for a marketing campaign that has only been running for one and a half years.

China, with its state corporations, lower prices, and resolute bargaining position, seems to be less attractive, but it is still unclear how much new gas OECD Asian countries will really need, taking into account their quite weak economic performance and their unclear energy policies concerning coal and nuclear, together with their energy efficiency gains. It may well be that they will follow the current trajectory of the European market, where high gas prices coupled with the economic slowdown have resulted in declining gas demand. If so, the Asian market will face a tremendous oversupply of gas and it will obviously be China, with its regulated demand, which will be able to profit from this. So China, with its rapid rate of infrastructure construction (both LNG regasification

terminals and pipelines) might become a kind of ‘swing consumer’ in Asia–Pacific, ready to absorb any excess gas if it is provided at an acceptable price.

### Prices

Gas prices are becoming the key issue for the development of the Asian market. This has recently been the case in Europe, where the inability and/or unwillingness of producers (such as Russia and Norway) and intermediaries (European gas trading companies, among others) to lower prices has nearly killed the market for gas in the power sector.

North American market-based gas pricing already affects pricing systems in Asia–Pacific, with Henry Hub indexed contracts (despite their negligible volumes) having initiated the new era of the hybrid pricing system there. US LNG, whose arrival is still anticipated, is already changing the pricing mechanisms, with more and more Asian buyers referring to Henry Hub as a benchmark, pointing to the tolling contracts signed for US-produced LNG, whereby customers procure their own feed gas, deliver it to the liquefaction plant, and pay for the liquefaction service. Ironically, US LNG, if not physically, then psychologically, has already had an impact on Russian gas-price negotiations for all its new contracts in Asia. Now any commercial proposal is compared to the US ‘Freeport’ tolling contracts, with even the Chinese asking Gazprom for Henry Hub indexation during pipeline contract negotiations; while this was against any market logic, it reflected the sentiment in the market.

Most of the US contracts were signed not with the final consumers, but with the aggregators, who will most likely resell this LNG at the oil-linked price in Asia. But expectations and hopes are often dashed by reality: Asian buyers want lower prices, and now have the



'Freeport' contract argument. Of course China, which is well known for tough negotiating, is already using this argument and will continue to insist on lower prices. Coupled with potential oversupply, this pressure from all Asian buyers might result in the Asian pricing mechanism evolving in a manner similar to that observed recently in Europe – with an increasing share of spot-based contracts and downward price reviews in the oil-linked contracts, which would be an outcome much to China's liking.

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**'NORTH AMERICAN MARKET-BASED GAS PRICING ALREADY AFFECTS PRICING SYSTEMS IN ASIA-PACIFIC ...'**  
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**Chinese import needs**

One of the most intriguing questions is: how much imported gas will China need in the period 2020–30? Our estimates show that despite the widespread perception of the 'bottomless' Chinese market, there is no market niche in China at all before 2020. By 2030 the uncontracted market might reach a maximum of 50–60 Bcm/year. The current portfolio of gas import contracts looks well balanced; it includes pipeline gas from three Central Asia countries (Turkmenistan, Uzbekistan, and Kazakhstan) and from Myanmar, along with a diversified portfolio of LNG import contracts.

China is well positioned now to make a rational choice: whether to contract new pipeline gas from Russia (which would be an excellent decision from the energy security point of view) or to sign contracts for new LNG imports (assuming the forthcoming Asian LNG glut comes to fruition and completion of the extensive regasification capacities in China). LNG is a better option in terms of logistics, given that the major consuming regions are concentrated in coastal areas. An alternative is to go for a combination of these two (though

Russia in this case might lose the 'economy of scale' effect).

It is worth noting that even with higher gas demand projections (which have a strong inverse correlation to price) China would not necessarily need more gas imports. Analyses of all official Chinese forecasts show that projected import needs are in a tight range. In a planned economy, with gas demand regulated by the authorities (which allow defined levels of consumption or restrict gas use in certain regions), demand growth projections to a large extent reflect expectations concerning domestic conventional and unconventional gas production growth and do not affect import estimations, which are all in the range of about 190–200 Bcm by 2030.

**Covering uncontracted Chinese import needs**

China has already covered a significant proportion of its future import needs with its long-term contracts with Central Asian countries (65 Bcm/year), Myanmar (12 Bcm/year), and various LNG producers (70 Bcm/year). So by 2030 there is an uncontracted niche for imports left in China of just 50–60 Bcm/year. It is much lower than Russian official estimations of gas export volumes to China (68 Bcm/year by 2030), according to the General

**Scheme of Gas Industry**

Development-2010 (Generalnaya Skhema Razvitiya Gazovoi otrasli na period do 2030 goda, Moscow, 2010; <http://docs.cntd.ru/document/902292511>). And it is not only Russia that is targeting this market.

On a regional level, the main part of this uncontracted import niche will be concentrated in the coastal areas of the south-east. A detailed assessment of Chinese regional gas balances shows that incremental uncontracted gas demand by 2030 in Bohai region will reach 36 Bcm, and just 8–9 Bcm in the north-east provinces, creating a window of opportunity for 40–45 Bcm of Russian pipeline gas. However, by that time LNG supplies from all over the world could easily have this covered.

So China is well positioned to adjust to any development of the Asian gas market. If there is an oversupply of LNG, China can easily absorb it. If LNG is limited and expensive, China can opt for Russian pipeline gas (and probably for additional Central Asian supplies).

**Russia is still in limbo with its Eastern Gas Program**

Russia approved its 'Eastern Gas Program' in 2007, but so far very little has been done to make it a reality.

<b>Chinese gas balance, Bcm/year</b>			
	2012	2020	2030
Demand	144	307	470
Indigenous production	107	178	266
Contracts for pipeline gas from Myanmar	0	12	12
Contracts for pipeline gas from Central Asia	23	65	65
Contracts* for LNG	30	71	68
Uncontracted market niche	-16	-19	59

\* Contractual quantities may exceed the real supply volumes

Sources: BP Statistical Review of World Energy 2013; World Energy Outlook 2013, IEA, Paris; The LNG Industry 2012, Groupe International des Importateurs de Gaz Naturel Liquéfié, Paris, 2013; LNG Liquefaction Projects With Purchase Contracts, Cedigaz Database, 2012; Energy Research Institute of the Russian Academy of Sciences estimations.

From the very beginning, the program had incorporated several pipeline options, and even today there is still no clarity concerning pipeline routes, with all of them at various times having been described as being ‘possible’: ‘Power of Siberia’ from Chayandinskoye field to Vladivostok with a leg to China, ‘Sakhalin–Khabarovsk–Vladivostok–China’, and even ‘Altai’ from Western Siberia to China.

The initial Program did not envisage any LNG production development (apart from the Sakhalin-2 project). Now the situation is changing. The LNG business is becoming a battleground between the leading Russian oil and gas companies, with Rosneft and Gazprom announcing three LNG projects in the Russian Far East (Sakhalin-2, Sakhalin-2 train 3, and Vladivostok LNG), while Novatek also has its sights set on the Asian market with its Yamal LNG project.

There are too many competing projects and contradictory signals concerning their priorities and sequence.

At the same time, Eastern Siberia and the Far Eastern regions of Russia are not yet ready for a massive increase of exports, with the resource base still being at a very early stage of development. While Sakhalin Island is estimated to have huge hydrocarbon reserves, so far only Sakhalin-1,-2 and -3 are under development. Their production will peak in 2020 at approximately 50 Bcm/year, which will be utilized mainly for LNG production and Russian Far East gasification.

A realistic timeframe for bringing the Eastern Siberian fields (Chayandinskoye, Kovyktinskoye, Yurubcheno-Tokhomskoye, and Kuyumbinskoye fields) online is in the early 2020s (at the same time as the expected LNG glut) with a plateau production of up to 70 Bcm. This

means that by 2020, the total export potential of Eastern Siberia will be limited to 15 Bcm, and that of the Far East to 40 Bcm (both pipeline and LNG exports). It is only by 2030 that the export potential of Eastern Siberia may reach 68 Bcm, and that of the Far East 40 Bcm. So as it stands, Russia, which is prioritizing LNG export development, has very limited capacity to organize pipeline exports to China. Realistically, Russian pipeline gas exports to China might start post 2020 at 40 Bcm/year maximum, though there is a danger that by that time Chinese demand would already be satisfied by LNG.

In any case, China will have the whole period from 2014 to 2020 to assess both the feasibility of domestic shale gas production and the supply–demand balance on the global LNG market, and be in a position to choose the optimal mix of gas supply sources. And now it is in a really good position to make that choice.



## Impacts of the US shale gas revolution on China’s national energy security

Yingxia Yang and Hengwei Liu

In China’s Atmospheric Pollution Prevention Action Plan, newly-announced by the country’s State Council, an important measure aimed at addressing China’s severe air pollution problem is the use of natural gas to replace coal in supplying energy. However, because domestic natural gas production cannot meet the rising demand for clean energy, gas imports will have to increase, raising the concern of energy security. Under this new situation, how should China consider its energy security and maintain the balance between energy security and environmental protection? At the same time, the USA’s shale

gas revolution is reshaping the global energy market. What does this imply for China’s energy security?

### Natural gas as a clean fuel and its place in China’s energy mix

The problem of air pollution will worsen with further industrialization and urbanization in the future. A major contributor to air pollution in China is coal’s dominance of the energy mix; coal currently provides about 70 per cent of the country’s total energy consumption, and has contributed more than 85 per cent of China’s CO<sub>2</sub> emissions and more than 50 per cent of suspended

particulate matter, sulphur dioxide, and nitrogen oxides. As such, in order to control air pollution, restructuring the energy mix is inevitable. As an energy source that is cleaner than coal, safer than nuclear, and more stable than wind and solar power, natural gas should be the first choice on the list to replace coal.

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**‘CHINA’S NATURAL GAS CONSUMPTION ACCOUNTS FOR ONLY 5 PER CENT OF PRIMARY ENERGY CONSUMPTION;’**  
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With the same heat content, natural gas emits just half the CO<sub>2</sub> and about a fifth of the nitrogen oxides as coal, and almost no sulphur dioxide.



Despite these merits, the role of natural gas in China's energy structure has remained minimal. China's natural gas consumption accounts for only 5 per cent of primary energy consumption; this is not just far below the USA, Europe, and other developed countries, but is also much lower than the international average of 24 per cent.

China's natural gas resources are relatively scarce, with remaining recoverable reserves of less than 2 per cent of the world's total, and proven remaining recoverable reserves per capita only about 7 per cent of the world average. Even though some reports indicate that China may have the world's largest shale gas reserves potential, its shale gas development is still in its infancy, and any meaningful production may not happen until the 2020s – not to mention the uncertainty on underground reserves and the cost of extracting them.

Although China's domestic natural gas production increased at an annual rate of 12.5 per cent from 2000 to 2011, it still cannot meet the rapid growth of domestic demand for natural gas. From 2007 to 2012, China's natural gas imports increased by more than 10 times, from 4 billion cubic metres (Bcm) to 42.5 Bcm. As a result, its import dependence has increased from 2 per cent to 27 per cent.

**Re-evaluate energy security**

The traditional view of a country's energy security is that the more it relies on foreign imports, the less secure its energy supply is. While high utilization of domestic energy resources is a top contributor to a county's energy security, this view ignores other dimensions of energy security, such as the diversification of energy supply channels and the pricing mechanism.

The severity of China's air pollution problem also urges us to re-consider the balance between energy security

and environmental protection. When pollution seriously impacts people's daily lives and threatens their health, it becomes inappropriate to excessively emphasize the self-dependence of energy supply. While vigorously developing domestic resources helps to improve self-sufficiency, improving a country's energy security requires a global disposition. Not only for China, but also for any country in the world, it is unrealistic to achieve national energy security by relying solely on domestic resources and being completely isolated from the world.

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**'... IT IS UNREALISTIC TO ACHIEVE NATIONAL ENERGY SECURITY BY RELYING SOLELY ON DOMESTIC RESOURCES AND BEING COMPLETELY ISOLATED FROM THE WORLD.'**  
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**The US shale gas revolution and its LNG exports**

The US shale gas revolution is changing the energy outlook for the USA and for the rest of the world.

According to the US Energy Information Administration (EIA), US shale gas production has increased more than 20 times during the past five years. In 2009, with shale gas production of 584 Bcm, the USA for the first time surpassed Russia and became the world's biggest producer of natural gas. Research from a well-known consulting firm, ICF, shows that the USA has 90 trillion cubic metres (Tcm) (about 3,000 trillion cubic feet) of natural gas reserves, which can last 130 years, assuming its 2011 annual consumption of 650 Bcm. Of these reserves, about 35 Tcm (about 1,200 trillion cubic feet) are at a cost of \$5 or less per MMBtu.

The shale gas revolution has fundamentally changed the US domestic supply and demand balance for natural gas. In 2007, the US energy

industry was investing billions of dollars on the construction of LNG import terminals, but now the USA is already in discussion about whether it should export its gas.

According to the Natural Gas Act (NGA), part of Energy Policy Act revised in 1992, any export of natural gas from the USA must obtain approval from the US Department of Energy (DOE). One critical condition required to obtain this approval is that it must comply with public interest. While natural gas exports to the US Free Trade Agreement (FTA) countries are automatically considered to be in the public interest, exports to non-FTA countries, which include China, Japan, and India, require special assessments to gain approval. Because non-FTA countries are those from which the major natural gas demand growth will come in the future, the DOE's decisions about whether US projects can export to non-FTA countries are very important.

There is still uncertainty over the future of US LNG exports and heated debate over its impacts. The supporters, which include natural gas upstream enterprises and free trade supporters, view natural gas exports as a driver for economic recovery, trade deficit reduction, and the reduction of Russia's global leverage. The opponents, which include manufacturers, chemical industries, and other downstream gas businesses, fear that natural gas exports will result in increased domestic gas prices, thereby reducing the competitiveness of these industries and the employment opportunities they provide. This is compounded by the concerns of environmentalists in relation to water consumption, methane leakage, and groundwater pollution issues in the shale gas development process.

Nevertheless, the DOE has approved three additional LNG export terminals (Freeport in Texas, Lake Charles in Louisiana, and Cove Point in Maryland) following the completion of two studies commissioned by the DOE, which showed that although the increased export of natural gas will lead to higher domestic gas prices and decreased domestic consumption, and may disfavour some sectors, such as manufacturing, with increasing operating costs, it would benefit the US economy overall. Together with the Sabine Pass LNG export terminal in Louisiana that was approved prior to the two studies, the DOE thus far has approved four LNG terminals to export natural gas to non-FTA countries.

#### **Diversification of China's LNG import sources**

The shale gas revolution is changing the US economy and may have a significant impact on the global LNG market.

Not only has the USA become a potential LNG exporter due to the shale gas revolution, it also requires fewer imports from Canada, which now has to find new buyers. At the same time, the economic crisis in Europe continues to reduce demand from Europe, and the gas-exporting countries, such as Russia and Qatar, have to find new markets. Asian markets, especially countries with growing demands, such as China and India, have become the important markets. This increases the natural gas available to the Asian market, together with the negotiating power of buyers in the Asian market. This shift is reflected in recent progress made towards reaching agreement between China and Russia on importing quantities, following many years of discussion.

For China, this means that the possible natural gas import channels include both the existing sources, including Central Asia, Turkmenistan, south-eastern Asia (Myanmar, Malaysia, and Indonesia), Australia, the Middle East (Qatar), and the new sources such as Russia, the USA, and Canada. This geographical diversification greatly helps to reduce the risk associated with imports, thereby improving energy security.

#### **Downward pressure on China's LNG import prices**

Since shale gas production has increased, US natural gas prices have remained at very low levels. In 2012, the Henry Hub price reached as low as about \$2/MMBtu, in comparison to \$10/MMBtu in Europe and \$15/MMBtu in Asia on average. Today, it is around \$3–4/MMBtu and according to the EIA analysis, the US wellhead price may remain between \$3–8/MMBtu for a long period of time. Including the investments required to build LNG export terminals and infrastructure, as well as transportation fees and other associated costs which total approximately at \$5–10/MMBtu, the total price for gas exported from the USA to China is around \$8–18/MMBtu. As a comparison, in 2012, the average LNG import price in China was \$11.4/MMBtu. Of all the imported LNG, about 40 per cent was at \$14/MMBtu or more. In particular, 35 per cent of the imports were from Qatar at an average price of \$19.8/MMBtu.

This shows that the North American exports may put downward pressure on the natural gas market price, which China can benefit from whether it imports natural gas from the USA directly or indirectly.

#### **Price stability for China's gas imports**

In addition, North American imports

are more unique and appealing because they help to diversify the price mechanism, thus improving price stability. This uniqueness is based on the independent pricing mechanism of the North American natural gas market.

#### **'IN RECENT YEARS, US SHALE GAS PRODUCTION HAS LED TO THE DECOUPLING OF THE GAS PRICE AND THE OIL PRICE.'**

In contrast to the international oil markets, international natural gas has remained regionalized, mainly due to transportation constraints. It is comprised of the North American market (which includes the USA and Canada), the continental Europe market, and the Asia–Pacific market, with Japan and South Korea as major importers and China and India becoming increasingly important. The price of gas is determined in a similar way in continental Europe and the Asia–Pacific markets, in that it is linked to alternative energies, especially oil and petroleum products, and so the price will fluctuate with changes of oil prices. Alternatively, in the North American market, the natural gas price tends to reflect the supply and demand of the natural gas market itself, with oil prices having only a small influence, due to market deregulation, the large number of suppliers and buyers, the developed natural gas pipeline network system and storage facilities, and well-developed financial markets.

In recent years, US shale gas production has led to the decoupling of the gas price and the oil price. Furthermore, the development and wide application of LNG technologies has enabled more and more natural gas to be transported across continents, weakening the boundaries between markets. The confluence of the LNG technologies and the excess



shale gas available in North America creates the opportunity for the two different pricing systems to 'collide' in Asia. Wherever this happens, it means that the risk of natural gas prices being affected by the volatility of international oil prices can be moderated by North American gas prices. Although this change has just begun, and it is not known how it will

ultimately be realized, it is certain that it will help reduce the volatility of the price of natural gas imports in the gas importing countries in Asia, including China.

In conclusion, the US shale gas revolution provides a great opportunity for China to improve its energy security for natural gas imports. China

should seize the market opportunity and actively explore the international market for natural gas imports, to ensure both energy and environmental security.

*The views in this article are those of the authors and do not represent the views of any other individuals or the organizations the authors work for.*



## Sino-Russian energy cooperation

Keun-Wook Paik

Sino-Russian energy cooperation during the last two decades has witnessed many ups and downs. The preparation process that started during the 1990s to build the groundwork for bilateral energy cooperation continued until the first half of the 2000s, but Sino-Russian oil and gas cooperation during this period produced very few concrete results. The most tangible achievement was the completion of the first section of the Eastern Siberia Pacific Ocean Oil (ESPO) pipeline at the end of 2009, along with the spur pipeline to China at the end of August 2010. The second stage of the line was completed at the end of 2012.

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**'SINO-RUSSIAN ENERGY COOPERATION DURING THE LAST TWO DECADES HAS WITNESSED MANY UPS AND DOWNS.'**  
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### Exports of Russian oil

Even if Russia manages to secure 50 mt/y crude supply for ESPO, there was no guarantee that China would get a higher allocation of Russian oil exports from Kozmino (the ESPO's crude export port) because other north-east Asian consumers such as Japan and South Korea are anxious to secure bigger volumes of Russian supply. Surprisingly, the Sino-Russian

summit in March 2013 and the subsequent meeting in St Petersburg in June 2013 gave the highest priority to the increase of crude supply to China. Why?

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**'... CHINA HAD NO CHOICE BUT TO ENTER INTO NEGOTIATION ON CRUDE OIL IMPORTS FROM RUSSIA DUE TO A SHARP DECLINE IN PRODUCTION AT THE DAQING OIL FIELD.'**  
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Two factors have helped oil sector cooperation receive the highest priority in Sino-Russian energy relations. First, China had no choice but to enter into negotiation on crude oil imports from Russia due to a sharp decline in production at the Daqing oil field. Even though the decline in the production rate has not been as severe as the early projections, Beijing planners had to find an alternative supply source and Russian crude supply by pipeline was an ideal option. Second, the price negotiation on the crude deal between China and Russia did not pose any major obstacles (even though there was a renegotiation of the original price agreement in the wake of the crude oil price increase). From the Chinese leadership's viewpoint, the reliability of crude supply was the top

priority and Beijing was ready to take any steps necessary to increase the volume of imports from Russia. That is, Sino-Russian oil cooperation was driven by China's need to secure its crude supply from Russia. This will remain a very strong motivation for cooperation in coming decades.

### Exports of Russian natural gas

Unlike Sino-Russian oil cooperation, cooperation in the natural gas sector has shown very few tangible advances; some announcements during the second part of the decade turned out to be overly optimistic. Gazprom prioritized Altai (West Siberian) gas export to west China. The development of exports from Altai was not regarded very positively by the Beijing authorities since they had given a much higher priority to the supply of East Siberian gas to north-eastern China. However, even though it was not its most favoured supply option, Beijing would not have hesitated to allocate Altai gas to the West-East Gas Pipeline (WEP) III, if the first Altai initiative had been sufficiently convincing and attractive. But since China decided to prioritize Central Asian (in particular Turkmenistan) gas as an equity supply source,

Altai gas is no longer a 'must-have' option for China. The main obstacle to Sino-Russian gas cooperation has been the price. While Gazprom was seeking the European border price for its gas exports to China, China National Petroleum Corp (CNPC) was responding that China would not accept the European oil-related border price. Chinese planners find Gazprom's demands excessive, arguing that CNPC cannot increase domestic gas prices, which are strictly controlled by the National Development and Reform Commission (NDRC)'s price department. As soon as it became clear that the gas pricing stalemate would continue, Beijing made the final decision to construct the WEP II pipeline in order to bring gas from Central Asia. The equity gas option offered by the Turkmenistan authorities was enough to compensate for the burden of the high border price for imports.

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**'THE MAIN OBSTACLE TO SINO-RUSSIAN GAS COOPERATION HAS BEEN THE PRICE.'**

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The Chinese authorities were fully aware of the risks involved in Gazprom's strategy of prioritizing Altai rather than East Siberian gas exports and they were very uncomfortable with Gazprom's 'swing supplier' strategy. After the 2008 global financial crisis, the EU's appetite for Russian gas contracted; this drove Gazprom to a more aggressive Asian gas export policy. China had not bargained for a gas supply which was shared with the European gas market in accordance with Gazprom tactics. As long as East Siberia remained without a developed pipeline structure, however, Altai gas exports would have fitted neatly into Gazprom's strategy of switching its European gas exports to China. The concept is similar to that of ESPO, which allowed Russia to export its

crude oil to the Asian market directly and not just depend on European buyers.

The Chinese planners did not want be blamed for 'robbing' the Europeans of their gas, when in fact they would have preferred to buy Russian gas not from Altai but from East Siberia. The key point is that China does not need Altai for the WEP system to work because they can obtain Central Asian gas. They need East Siberian gas because regional gas capacity in the three north-eastern provinces of China is relatively small and, without access to East Siberia or Sakhalin, the alternative is large-scale LNG imports. As discussed later, the Sino-Russian summit between Xi Jinping and Putin in March 2013 confirmed that Russia's gas exports to China will be based on the eastern export route first.

In short, Sino-Russian gas cooperation in the first decade of the century was very limited because Russia tried to replicate its oil export strategy in natural gas but found China unwilling to agree. This unwillingness was due to four main factors: first, Russia refused to allow equity in fields or pipeline projects, and therefore refused to give China any control in the value chain; second, Russia demanded unattractively high prices; third, China had alternative import options (the Central Asian Republics, Myanmar, and LNG imports) as well as the potential to expand domestic production; and, fourth, there was a lack of trust on both sides. Russia did not want to completely depend on the Chinese market, while China wanted to avoid over-dependence on Russia as a source of supply. The failure of the price negotiations between the two countries is a reflection of all of these problems. Sino-Russian energy cooperation during the 2000s can be summarized as 'half-full and half-empty'.

### **Sino-Russian oil and gas cooperation in the 2010s**

Since the announcement of gas supply to China of up to 68 billion cubic metres per year (Bcm/year) in spring 2006, the most important attempt to agree the gas price deal was made during the St Petersburg Investment Forum in June 2011. However, the two parties failed to narrow the gap. Immediately after the Russian presidential election in March 2012, Putin urged Gazprom not to ignore the exploration and development of gas resources in East Siberia and Russia's Far East, and said that Russia should try to gain a significant share of the global LNG market, focusing first on supplies to promising Asian markets. Accordingly, Gazprom stated that it planned to draw up an investment study for Vladivostok LNG in the first quarter of 2013, and considered 2017–20 as the 'most favourable period' to target Asia.

During the World Gas Conference held at Kuala Lumpur, Malaysia, during 4–8 June, 2012, Gazprom Export Director General, Alexander Medvedev, said:

*... in an attempt to find a solution, the Chinese side has proposed an integrated approach – to consider the possibility of jointly transporting gas to target markets and marketing together. We have agreed to consider whether it will somehow bring in additional revenue, adding that work on the markets of end consumers is part of our strategy.*

This followed an indirect confirmation that China would offer a very large upfront payment without interest to narrow the target border price gap. The big surprise came in autumn 2012: on 29 October 2012, Gazprom CEO Miller informed President Putin that Gazprom had set itself the task of starting the



second stage of the Eastern Gas Program and had established new gas production centres. In early December, Deputy Premier Arkardy Dvorkovich officially confirmed that Russia was reviewing the Chinese proposals on advance payments under contracts.

**The March 2013 China–Russia summit**

The new Chinese leadership signalled a big change in strategy. On 22 March 2013, Xi Jinping arrived in Russia on the first stop of his maiden overseas tour as president of China. The result of the March 2013 China–Russia summit went well beyond expectations in terms of the extent of collaboration. The summit set the stage for dramatically increasing flows of oil, natural gas, and coal from Russia to China. First, Rosneft pledged to triple its oil deliveries to China from 300,000 barrels per day (b/d) to as much as one million b/d, which is double the amount of oil that Russia exported to China in 2012. Second, Gazprom and CNPC signed a memorandum of understanding for the delivery of 38 Bcm/year of natural gas to China over a period of 30 years starting in 2018, with the option of expanding deliveries to 60 Bcm/year. Third, China’s Shenhua Group and Russia’s EN+ Group agreed to develop coal resources and related infrastructure in East Siberia and the Russian Far East, with an eye to expanding Russian coal exports to China. The two most important points that should be highlighted from the March 2013 summit are as follows. First, Russia agreed to allocate maximum crude supplies for China, which will affect the role of ESPO crude in the Asian market – to satisfy the committed export volume to both China and Asian buyers, the diversion of western Siberian crude to Asia will be inevitable. Second, Russia accepted China’s

preference of eastern route gas supply, even though the Russian preference was the Altai route.

**The June 2013 deal**

Based on its massive foreign reserves (as of June 2013, US\$3.5 trillion), China exercised the money card very skilfully and effectively. On 21 June, Rosneft agreed on a \$270 billion deal to double oil supplies to China. The deal, one of the biggest ever in the history of the global oil industry, will bring Rosneft US\$60–70 billion in upfront pre-payments from China. According to Standard and Poor’s, Rosneft faces debt maturities in 2013, 2014, and 2015 of \$6.6 billion, \$15.9 billion, and \$16.2 billion, respectively. Pre-payment from China would allow Rosneft to lighten the burden on its balance sheet by reducing debts to banks.

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**‘... IN MARCH 2012 PUTIN ... SAID THAT RUSSIA SHOULD TRY TO GAIN A SIGNIFICANT SHARE OF THE GLOBAL LNG MARKET, FOCUSING FIRST ON SUPPLIES TO PROMISING ASIAN MARKETS.’**  
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On the same day, President Putin announced the gradual end of state-controlled Gazprom’s monopoly on exports of natural gas, which opened the way for rivals Novatek and Rosneft to compete for huge new Asian markets. Immediately after that announcement, Novatek signed a deal to supply at least 3 million tonnes of LNG annually to China. CNPC also agreed to buy a 20 per cent stake in Novatek’s \$20 billion Yamal-LNG project in north-west Siberia. This was a potentially fatal blow to Gazprom.

**Events following the G20 meeting in September 2013**

Right after the G20 meeting in early September 2013, the Gazprom

website announced:

*Alexey Miller, Gazprom chairman and Zhou Jiping CNPC chairman signed, in Saint Petersburg, an Agreement outlining the major terms and conditions of pipeline gas supply from Russia to China via the eastern route in accordance with the accords reached previously. The document is legally binding ... The price conditions will not be linked to the Henry Hub index.*

However, the announcement has hidden the failure of the Sino-Russian gas price deal. The Novatek deal does not replace the proposed Gazprom exports and Gazprom is still trying to agree a price deal for those exports. Nevertheless, a day earlier, the Russian business daily *Vedomosti* reported: ‘Gazprom delayed the start of the construction of its Power of Siberia gas pipeline to transport gas to China from November [2013] to the first quarter of 2014.’ It cited sources close to Gazprom and its affiliates. China’s influential monthly *Caijing* also reported that the gas deal announcement had no bearing on the price. In October 2013 Russian government top officials and Gazprom strongly indicated that the gas price deal would be finalized by the end of 2013. However, the deal has still not been agreed.

The current outlook is that much of the oil potential will be fulfilled, but this will not make a huge difference to China or to the global oil market. However, the massive gas potential was and still is the hostage of the gas price deal. The first half of 2014 will decide the fate of the Sino-Russian gas deal. If it is agreed, the impact on China’s domestic gas market, and on regional and global trading, will be substantial and well beyond previous expectations. If there is no deal, Russia will have a hard time carving out a lucrative slice of the Asian gas market in coming years.



## Addressing climate change: China's status and policies

Li Junfeng, Yang Xiu, and Zhang Minsi

As a developing country, China faces many challenges and, in particular, must balance the requirements for economic development. This naturally leads to a debate about balancing economic growth with environmental protection and carbon emission control. There has been a gradual change in how China defines the suitable balance, with increasing emphasis being given to sustainable development and environmental protection. To some extent this change reflects the fact that, in spite of significant economic progress over the past 30 years, mistakes have been made with respect to environmental protection, resulting in serious pollution.

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**'THIS NATURALLY LEADS TO A DEBATE ABOUT BALANCING ECONOMIC GROWTH WITH ENVIRONMENTAL PROTECTION AND CARBON EMISSION CONTROL.'**

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This has implications for China's policies on greenhouse gas emissions (GHG). For example, there is a debate about whether China should set a GHG emission peak and, if so, when to reach it. Those in favour argue that a clearly defined GHG emission peak and a date for reaching it could promote energy structure adjustment and economic restructuring. Opponents argue that China should take natural steps to reach the peak. The latter approach emphasizes that no other countries took administrative measures to achieve a GHG emission peak before they had completed the process of industrialization and urbanization, and that setting such a peak would negatively affect China's economic development.

This article discusses the background and reasons for the controversy and then identifies policies that reflect the increasing emphasis on environmental protection and climate change, before commenting on China's low-carbon pathway. It then discusses the challenge of addressing climate change, before returning to discuss the appropriate balance between economic growth, environmental protection, and carbon emission control.

### Overview of China's development

China is the largest developing country in the world with a population in 2012 of 1.35 billion – about a fifth of the world's total. China's economy has grown rapidly since the late 1970s, with GDP increasing from 454.56 billion Yuan in 1980 to 51.9 trillion Yuan in 2012. China has become the world's second largest economy, with a per capita GDP of about US\$6,000 in 2012, ranking 87th in the world.

Continuous and rapid economic development has accelerated the process of industrialization and urbanization, while increasing the sophistication of domestic consumption and the level of energy demand. From 1981 to 2000, China's energy consumption increased from 590 Mtce (Million tonnes of coal equivalent) to 1460 Mtce. Since then, China's energy consumption has grown at an annual average rate of 9.3 per cent, reaching 3620 Mtce in 2012, two and a half times the level in 2000.

China is the world's largest coal producer and consumer. Coal accounts for about 70 per cent of China's primary energy consumption; oil is the next most important source of energy consumption, with natural gas

and non-fossil fuels being relatively unimportant, but growing quickly. China's GHG emissions are driven by the very fast growth of coal and oil consumption, with emissions rising from 3.65 billion tonnes of CO<sub>2</sub>e in 1994 to 7.47 billion tonnes of CO<sub>2</sub>e in 2005, and reaching about 10 billion tonnes of CO<sub>2</sub>e at present. Since 2007, China has replaced the USA as the world's largest emitter of GHG.

### Policies and actions for addressing climate change

China has been playing a positive role in international climate change negotiations since the 1990s, promoting a fair and reasonable international mechanism for addressing climate change. China adheres to the UNFCCC and the Kyoto Protocol as the basic framework, and plays an active role in the main channel of international climate change negotiations within the UN framework. China upholds the principles of 'common but differentiated responsibilities', along with fairness and respective capabilities. It abides by the principles of openness and transparency, extensive participation, signatory leadership, and consensus through consultation and insists on the coordination of mitigation, adaptation, funding, and technology issues.

Domestically, there is growing popular support for green and sustainable development, while the central government has strengthened its efforts to tackle climate change. The actions could be summarized into: deepening thinking about sustainable development, introducing increasingly stringent emission targets, and improving top-level planning, systems, and mechanisms.



*Gradually deepening thinking on sustainable development*

For many years, Chinese political leaders have been emphasizing the growing importance of environmental protection as an integral part of development. For instance, in 2010, 'green development' was introduced into the Twelfth Five Year Plan for National Economic and Social Development (12th FYP) as a separate chapter. In 2011 the report of the Eighteenth Party Congress proposed incorporating 'ecological civilization' as a central part of the process of achieving economic, political, cultural, and social progress. The awareness of ecological progress and sustainable development has gradually deepened.

*Increasingly stringent targets*

In 2009, China introduced the goal of reducing GHG emissions per unit of GDP by 40–45 per cent in 2020 in comparison to 2005. In 2011 the 12th FYP adopted the following intensity targets: energy per unit of GDP to fall by 16 per cent, and GHG emissions per unit of GDP to fall by 17 per cent, in both cases comparing 2015 with 2010. The same plan also targeted non-fossil energy to rise to 11.4 per cent of total primary energy by 2015, compared to 8.6 per cent in 2010. In addition to tightening intensity targets, China has been setting targets for the absolute levels of coal and energy consumption. In 2012 the 'Development Plan for the Coal Industry' defined a target of 3.9 billion tonnes of coal consumption in 2015, compared to 3.1 billion tonnes in 2010. In 2013 the 'Development Plan for Energy' adopted a target of 4.0 billion tce of primary energy consumption in 2015, compared to 3.3 billion tce in 2010. The Chinese government also issued an action plan for the prevention and control of atmospheric pollution in 2013, which set the target of reducing the concentration of inhalable particles

in 2017 by more than 10 per cent compared to that in 2012.

*Improving top-level planning, systems and mechanism*

China has carried out major strategic studies and strengthened top-level planning for addressing climate change, and further improved its related management systems and working mechanisms. For instance, China has built a 'Carbon Reduction Target Accountability System', which is a management system under which 'carbon reduction agreements' are signed between upper and lower-levels of government, between governments and enterprises, and between management teams and implementation teams within enterprises. The government has also organized the compilation of the National Plan for Addressing Climate Change (2013–20) and promoted legislation on climate change. China is in the process of adjusting its industrial structure, including transforming and upgrading traditional industries, supporting the development of strategic and newly emerging industries, developing the service industry, as well as speeding up the elimination of inefficient production capacity.

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**'CHINA HAS BEEN PLAYING A POSITIVE ROLE IN INTERNATIONAL CLIMATE CHANGE NEGOTIATIONS SINCE THE 1990S ...'**  
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Meanwhile China is improving its energy structure, including promoting the clean utilization of fossil fuel, and developing non-fossil fuel sources and applications. China is promoting energy conservation and improved energy efficiency, by enhancing the evaluation of energy saving initiatives, implementing key energy conservation projects, and improving energy efficiency standards and labelling.

China also devotes attention to forest carbon sinks and controlling emissions in other areas. It has also taken positive action to enhance its capability across major sectors to enable it to adapt to climate change and respond to extreme weather and climate-related events.

**China's low-carbon future**

Two groups of low-carbon pilot projects in 42 provinces and cities, along with carbon emission trading pilot programs in seven provinces and cities have been implemented. These pilot programs aim to explore low-carbon pathways from the bottom up, offering economic incentives for low-carbon innovation.

As a result of the policies undertaken by China since 2005, the country's energy consumption per unit of GDP has decreased by 26.4 per cent, and its carbon emission intensity per unit of GDP has decreased by 28 per cent, while the proportion of non-fossil energy has increased to 9.1 per cent. China has also increased its forest resources by 1,723 million cubic metres compared to the original 12,456 million cubic metres.

Although China still has a long way to go before it succeeds in controlling total energy consumption, protecting the environment, and promoting low-carbon development, it is fair to say that China has already reached a consensus concerning the development pathway. Top-level decision makers have identified 'sustainable growth' as growth that balances quality and efficiency, realizes a low-carbon transition, and strictly controls energy consumption, especially in relation to coal.

**Challenges for addressing climate change**

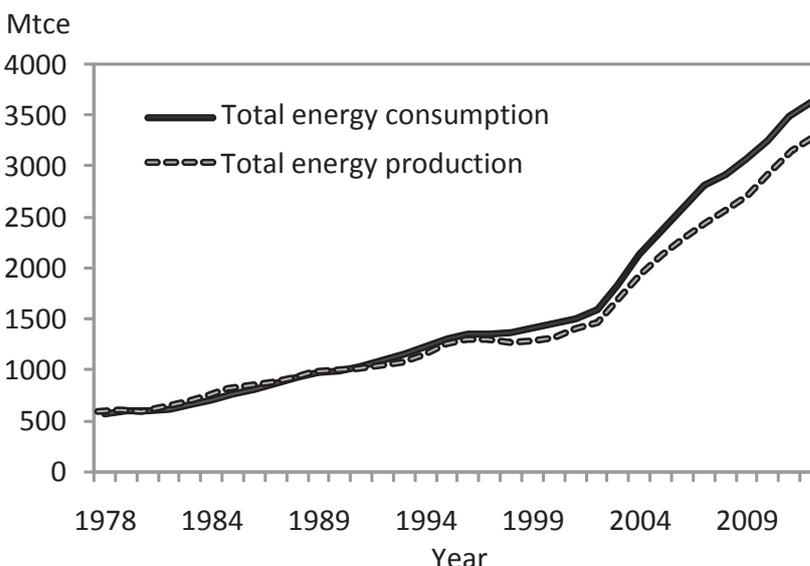
As a developing country in the process of industrialization and urbanization, China is still facing many challenges,

including continued economic development, environmental protection, and addressing climate change. All relevant policies need to be developed on the basis of China's national realities.

*First*, there are economic imbalances between China's east and west regions, and between urban and rural areas. On the one hand, the eastern coastal cities such as Shanghai, Beijing, and Shenzhen are well ahead on economic development, with per capita GDP exceeding \$10,000, close to the middle level of developed countries. Meanwhile, economic development in western regions is relatively backward. According to the United Nations standard, there are still 130 million people in China living below the poverty line. Solving the problems of adequate food and clothing is still a major challenge in these regions. On the other hand, per capita disposable income of China's urban residents is three times that of rural residents, while basic public services and social development in rural areas are much weaker than in urban areas. Most people in rural areas expect an improvement in living standards and economic conditions.

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**'CHINA SHOULD TACKLE CLIMATE CHANGE IN CONJUNCTION WITH ENVIRONMENTAL PROTECTION ..., ENERGY STRUCTURE ADJUSTMENT, AND THROUGH THE PROMOTION OF ECONOMIC TRANSFORMATION.'**  
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This creates controversy with respect to balancing economic development and addressing climate change, and there are quite different views on climate change. For example, Academician Ding Zhongli proposed that the phenomenon of climate change should be questioned because of its uncertainty. Furthermore, a considerable number of academics



**China's total energy consumption and production during 1978–2012**

and government officials are sceptical and often associate climate change with an international conspiracy. They maintain that climate change is related to international politics, economics, and diplomacy, and that China should deal very carefully indeed with this issue for that reason.

*Second*, energy is still an important factor restricting China's economic development. Since the reforms of the late 1970's, energy consumption has grown faster than energy production. Domestic energy supply insufficiency is an increasingly serious concern. As shown in the figure 'China's total energy consumption and production during 1978–2012', China had a surplus of domestic energy production over domestic consumption in 1978. From 1992, China has been a net importer of energy. In 2012, China imported about 300 Mtce to meet domestic energy consumption, which was more than the UK's 2012 total energy consumption. Meanwhile, China's power generation capacity has increased steeply. In most years since 2000, generation output growth exceeded 10 per cent and the elasticity of electricity production

(the ratio of electricity production growth rate and the GDP growth rate) exceeded 1, as shown in the table 'Growth of China's electricity'. It is expected that China's total power generation capacity will exceed 1.2 TW in 2013 and that total capacity will reach nearly 2 TW by 2020, significantly more than US generation capacity of about 1.1 TW.

*Third*, environmental problems such as air pollution are becoming more and more acute in China. These problems are related to the rapid growth of energy consumption and the coal-dominated energy structure. For example, at the end of 2012 and in early 2013, serious haze pollution covered over one million square kilometres of the middle and eastern region of China, affecting hundreds of millions of people. The PM<sub>2.5</sub> (fine particles, less than 2.5 micrometres in diameter) concentrations in the affected regions exceeded the World Health Organization standard by tens of times (75 ppm in the interim target), in some areas even reaching 1000 ppm, causing serious harm to people's health and safety. Reviewing the economic development path over



<b>Growth of China's electricity production</b>		
<i>Year</i>	<i>Growth rate of electricity production over preceding year (%)</i>	<i>Elasticity ratio of energy production</i>
2000	9.4	1.12
2001	9.2	1.11
2002	11.7	1.29
2003	15.5	1.55
2004	15.3	1.51
2005	13.5	1.19
2006	14.6	1.15
2007	14.5	1.02
2008	5.6	0.58
2009	7.1	0.78
2010	13.3	1.28
2011	12.0	1.29

the past three decades, China still has the extensive growth characteristics consistent with 'sacrificing the environment for economic growth'. The relative shortage of resources and the limited government capacity to deal with the environmental challenges have become basic realities for China. Former premier Wen Jiabao pointed out that China was facing unbalanced, uncoordinated, and unsustainable development problems. It is fair to say that both the problems of environmental pollution and of economic development are urgent and that it is difficult to solve them together in the short term.

Faced with these challenges, there are controversies in China related to climate change. Although the trend towards addressing climate change has gradually become more influential, some of the public and local government officials still consider economic growth to be the priority. Support for growth as the priority can be explained by: economic imbalances between China's different regions, and between urban and rural areas; the different views of scientific knowledge still to be found on climate change issues; and because

the idea that 'development is the absolute principle' has long been ingrained and many people believe that economic development will solve most social problems.

**The balance between economic growth, environmental protection, and carbon emission control**

There are important debates in China concerning the appropriate balance between economic growth, environmental protection, and carbon emission control. China is the world's largest developing country, in the process of rapid industrialization and urbanization and facing many development challenges. Controlling local environmental pollution and promoting domestic economic development are both priorities, and will influence the way in which China addresses climate change and low-carbon development. China should tackle climate change in conjunction with environmental protection (especially haze governance), energy structure adjustment, and through the promotion of economic transformation. As with the control of environmental pollution, controlling GHG emissions is

a long-term process which must be seen in the context of achieving low-carbon development in China's current development stage and national conditions.

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**'CHINA HAS TO COMPLETE ITS INDUSTRIALIZATION AND URBANIZATION AND TO ACHIEVE LOW-CARBON DEVELOPMENT IN THE CONTEXT OF ITS ENERGY CONSTRAINTS AND EMISSION LIMITS.'**  
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China's decision-makers have shown determination and a positive attitude to addressing climate change and promoting sustainable development, with emissions targets becoming stricter and domestic policies increasingly emphasizing low-carbon development. China will achieve low-carbon development through continued efforts over decades, with the process occurring in three steps: first, some developed cities and regions will reach a GHG peak; second, the government will achieve effective GHG emissions management at a national level; and finally, there will be absolute GHG emissions reduction. It still remains to be seen whether China will establish an official GHG emissions peak and, if so, when and what that peak will be.

China has to complete its industrialization and urbanization and to achieve low-carbon development in the context of its energy constraints and emission limits. This is an unprecedented endeavour, which needs China's persistence and determination in facing difficulties, as well as international cooperation and exchanges and the help of the international community. In this way, through its successful development of a sustainable low-carbon energy system, China will make its own contribution to the international community.



# Power system development and carbon dioxide emission reduction in China

Li Ji

## Power sector is the major contributor to CO<sub>2</sub> emissions

With China's rapid economic development, energy and electricity consumption are growing very fast. From 2001 to 2012, the annual average growth rate of energy consumption and electricity consumption were 7.9 per cent and 11.5 per cent respectively. This in turn led to a significant increase in China's CO<sub>2</sub> emissions. In 2000, China's CO<sub>2</sub> emissions were about half the US level and per capita CO<sub>2</sub> emissions were two-thirds the average global level. However, in 2008, China became the world's largest emitter of CO<sub>2</sub>. In 2010, China's CO<sub>2</sub> emissions from energy combustion were 7.12 billion tonnes, accounting for over a fifth of global CO<sub>2</sub> emissions, and per capita emissions surpassed the world average level. Between 2000 and 2010, China contributed 60 per cent of the increase in global CO<sub>2</sub> emissions.

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**'BETWEEN 2000 AND 2010, CHINA CONTRIBUTED 60 PER CENT OF THE INCREASE IN GLOBAL CO<sub>2</sub> EMISSIONS.'**  
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The power sector is one of the largest emitters of CO<sub>2</sub> in China because coal is the major energy resource used for power generation. Currently, the total quantity of CO<sub>2</sub> emissions is still accelerating, reflecting the growth of thermal generation. In 2011, China's total generation capacity reached 1,063 GW, of which thermal power capacity stood at 72.3 per cent. Power generation accounts for 51.2 per cent of coal consumption. In 2005, CO<sub>2</sub> emissions from the power sector in China were 1.99 billion tonnes and accounted for 36.8 per cent

of total CO<sub>2</sub> emissions; by 2011, these two figures had risen to 3.42 billion tonnes and 44.1 per cent, respectively.

Global climate change receives significant attention from the Chinese Government. The government issued China's National Climate Change Program (CNCCP) in 2007. It defines a variety of climate change-related targets for China and proposes several solutions such as: reforming the pattern of development, adjusting the country's energy structure, and increasing energy efficiency. In 2009, the government committed to the following targets: reducing CO<sub>2</sub> emission intensity (per unit of GDP) by 40–50 per cent in 2020 compared to 2005; and raising to 15 per cent the share of primary energy consumption coming from non-fossil energy by 2020, compared to 8.6 per cent in 2010. CO<sub>2</sub> emission reduction in the power sector is a critical part of the government's strategy for meeting the targets.

## CO<sub>2</sub> emission reduction in power sector

The major measures adopted to reduce CO<sub>2</sub> emissions in China are: improved efficiency of coal-based generation, developing non-fossil energy power generation, and reducing transmission losses. Following the introduction of these measures, the quantity of CO<sub>2</sub> emissions from the power sector increased from 1.99 billion tonnes in 2005 to 3.42 billion tonnes in 2011, but had these measures not been introduced, CO<sub>2</sub> emissions would have increased to 4.2 billion tonnes; in other words, they helped to avoid an additional 780 million tonnes per year compared

to what would have occurred in the absence of these measures.

From 2006 to 2010, China implemented the Small Thermal Power Replacement Policy to shut down 76.83 GW of small and inefficient thermal power plants. In 2005, the average thermal plant capacity was about 60 MW, and 47 per cent of thermal power capacity had a single unit capacity below 300 MW. In 2011, 39 per cent of thermal capacity was greater than 600 MW and 36 per cent had capacity between 300–600 MW. This increased scale and efficiency helped to reduce coal consumption from 370 grams of coal equivalent (gce)/kWh in 2005 to 329gce/kWh in 2011, contributing 48.9 per cent of China's avoided CO<sub>2</sub> emissions.

Meanwhile, the government promoted the development of non-fossil power and reformed the power sector, thereby helping to reduce coal consumption. The total capacity of power from non-fossil sources – such as hydro, nuclear, and wind – increased from 126GW in 2005 to 294GW in 2011, and the share of non-fossil energy capacity rose from 24.3 per cent to 27.7 per cent. This translated into the avoidance of about 180 million tonnes of coal consumption and contributed 44.2 per cent of the avoided CO<sub>2</sub> emissions in the power sector.

Further energy and CO<sub>2</sub> savings are related to lower electricity losses resulting from building the transmission network, upgrading voltage levels, and improving transmission capacity. Large-scale rural and urban grid reconstruction also reduced transmission losses and increased the distribution efficiency of the grid. Line



losses declined from 7.21 per cent in 2005 to 6.52 per cent in 2011 and contributed 3.4 per cent of the avoided CO<sub>2</sub> emission in the sector.

**Outlook for future power demand**

China has become a middle-income country as a result of rapid industrialization and urbanization. The Eighteenth National Congress of the Communist Party of China (CPC) declared the following economic growth target: to double GDP by 2020 compared to 2010. Faced with the pressures and limitations of domestic energy supplies and other natural resources, the environment, and climate change, China’s policies will focus on changing the development model, adjusting the structure of the economy, and controlling total energy consumption.

In 2012, China’s total electricity consumption reached 4,959.1 TWh. Even taking into consideration technological improvements, industrial structure adjustment, energy conservation, and emission reduction efforts, power demand will continue to grow. Electric power demand in 2020 is forecast to reach 8,200 TWh, almost double the level of 2010. It is expected that CO<sub>2</sub> emissions from the power sector will reach 4.64 billion tonnes in 2020.

**Future CO<sub>2</sub> emission reduction in the power sector**

Carbon sinks and carbon capture and storage (CCS) are, in principle, the main technical solutions to the problem of limiting CO<sub>2</sub> emissions. However, carbon sinks will be restricted by the high cost of land utilization. Furthermore, CCS is still an immature technology with high costs, and one that cannot yet be applied at large scale. For these reasons, CO<sub>2</sub> emission control depends mainly on reducing

fossil energy consumption before 2020. The high level of energy efficiency of coal power stations and the low level of line losses leave little room for a further improvement on these fronts. From 2011 to 2020, the consumption of coal plants may fall by 15gce/kWh, while transmission losses might fall by 0.4 per cent. CO<sub>2</sub> emission reduction will therefore depend primarily on the development of non-fossil power generation.

China faces critical environmental restraints and severe air pollution, and is eager to push the development of clean energy. The outlook of the power sector in the next decade can be predicted by reference to the Renewable Energy Twelfth Five Year Development Plan and other development policies. They call for a significant increase in hydro, wind, and solar power in China. Hydro power still has huge potential and the capacity could reach 400 GW by 2020. The government has also been promoting other renewables, notably wind power. In 2011, China accounted for 40 per cent of the world’s new wind power capacity. Total wind power capacity in China could reach 200 GW by 2020. With strong policy support, the solar PV industry has also developed quickly, and installed capacity may reach 85 GW by 2020. The Fukushima accident did not affect the determination of

the Chinese government to develop nuclear power, but it did lead to a greater emphasis on safety. The capacity of nuclear power by 2020 will reach 60 GW. In total, the non-fossil energy power capacity could reach 775 GW, accounting for 40 per cent of capacity. Furthermore, coal-based generation will be strictly restricted, allowing for a gradual increase in the role of natural gas power. Based on natural gas supply and other economic considerations, natural gas capacity could reach 100 GW by 2020.

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**‘CHINA FACES CRITICAL ENVIRONMENTAL RESTRAINTS AND SEVERE AIR POLLUTION, AND IS EAGER TO PUSH THE DEVELOPMENT OF CLEAN ENERGY.’**  
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China is still in the process of industrialization and urbanization. Because China is rich in coal, poor in oil, and lacks conventional natural gas, the utilization of coal and the resulting CO<sub>2</sub> emissions associated with growth are still unavoidable. It is predicted for 2020 that coal consumption for power generation will reach 2.38 billion tonnes, natural gas consumption for power generation will reach 70 Bcm, and CO<sub>2</sub> emissions in the power sector will be 4.64 billion tonnes, about 154 per cent higher than in 2010.

<b>China’s electricity generation capacity and CO<sub>2</sub> emissions: 2005–20</b>				
	2005	2010	2011	2020
Capacity (GW)	517.2	967.0	1064.0	1912.7
<i>of which</i>				
Hydropower	117.4	216.1	233.0	400.0
Nuclear	6.8	10.8	12.6	60.0
Wind	1.1	29.6	46.2	200.0
Solar	0.1	0.9	3.5	85.0
Coal	380.9	683.3	734.2	1037.7
Natural gas	8.0	26.4	34.2	100.0
CO <sub>2</sub> emissions (billion tonnes)	2.0	3.0	3.4	4.6

Although CO<sub>2</sub> emissions from the power sector will increase, effective measures can reduce the growth rate of CO<sub>2</sub> emissions, thereby avoiding additional emissions. It is estimated that the avoided CO<sub>2</sub> emissions in 2020 will be 783 million tonnes compared to the level that would have been emitted without these measures. Of the avoided emissions, non-fossil energy power

generation will contribute over 82 per cent, reduced coal consumption in power supply and transmission losses will contribute 10 per cent, and another 8 per cent will come from natural gas generation.

As the largest developing country in the world, China has made significant efforts to reduce its dependence on

fossil energy. During the accelerated period of industrialization and urbanization, economic development has relied heavily on power, so that CO<sub>2</sub> reduction in the power sector is extremely challenging. In these circumstances, the government's firm determination, together with multiple policies, is required to meet the emission reduction targets.



## EU–China solar dispute reveals flaws in global trade system

Renfeng Zhao

Last year's EU–China trade dispute over solar products revealed the lack of trust between the two sides in combating the global threat of climate change.

Trade issues were manipulated for political reasons, and many solar companies in China and Europe have suffered as a result, highlighting the fact that the intrinsic flaws of the existing international trade infrastructure need to be fixed as global economic, social, and environmental integration accelerates.

The trade saga was heavily politicized. Its dramatic negotiation process was hijacked by trade protectionists. And the conflicting policy directions sent the wrong message to consumers.

Although an 'amicable' (as claimed by the EU trade commissioner, Mr Karel de Gucht) solution – agreement on a price floor for the Chinese imports into the EU – was reached in the end, the trade row casts a heavy shadow over political and economic relations between the EU and China.

It will take a long time to rebuild investor confidence in the future of the global solar industry; most importantly, it will make it an even

more difficult task for the EU and China to establish mutual trust and reach a consensus in tackling the global issues of energy security and climate change.

### Emergence of the solar industry

The development of solar power was stimulated by the global demand for sustainable energy sources to fight against climate change, with a widely shared perception that solar is set to play a bigger role in the global energy mix in the coming years.

According to the UNEP/Bloomberg New Energy Finance report 'Global Trends in Renewable Energy Investment 2013', annual global new investment in solar rose from \$12.3 billion in 2004 to \$140.4 billion in 2012 with a compound annual growth rate of 36 per cent. Solar has attracted more investment than any other new renewable source, such as wind and biofuel.

Solar's share in the overall energy mix may be still small in comparison to traditional energy sources, but the role of solar in the future, along with other renewables (and also innovative technologies such as the smart grid, energy storage, and electric

vehicles), may act as a catalyst to not only revolutionize the power industry, but also to make a significant impact on other businesses, as consumers will in the future also have the option of generating power and selling spare energy back to the grid.

### China's involvement in solar power

Viewing the solar industry's promising growth potential, the Chinese government considered solar one of its long-term strategic industries and included its development in its Five Year Plans since 2001. However, as often happens in China, the initial policy promoted by the central government made good sense from a strategic point of view, but local practices, aided by local governments and banks, did not comply with the original plan.

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**'... THE CHINESE GOVERNMENT CONSIDERED SOLAR ONE OF ITS LONG-TERM STRATEGIC INDUSTRIES ...'**  
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Attracting huge investments both from Chinese banks and international financial markets via stock listings, the number of Chinese companies manufacturing solar products started



to mushroom across the country. China's solar industry grew over 100 per cent a year between 2007 and 2010. A large number of small Chinese companies, and a few big ones, squeezed into this sector eyeing lucrative returns, as many countries around the world announced favourable feed-in tariff policies to support the development of solar energy.

**Overexpansion of China's solar industry**

By 2012, China's solar manufacturing capacity was already more than double the total of the rest of world, far exceeding the global demand for solar products, leading to massive short-term industry overcapacity.

As a result, Chinese PV companies had to compete by cutting export prices, which forced many companies in China, as well as in Europe and the USA, out of the business. Lower prices are, in theory, good for the promotion of renewable energies, but there is a danger that very low prices may introduce market distortions that undermine investment and the industry's longer-term development.

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**'BY 2012, CHINA'S SOLAR MANUFACTURING CAPACITY WAS ALREADY MORE THAN DOUBLE THE TOTAL OF THE REST OF WORLD ...'**  
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In five years (2007–12), solar panel costs dropped by about 80 per cent, increasing tensions between Chinese companies and their competitors in Europe and the USA. The financial crisis and subsequent Euro crisis stalled many European countries' original investment plans in the solar industry. As feed-in tariff schemes were suddenly halted and retroactive taxes were charged in some European countries, the solar industry's rapid growth slowed, bringing those solar

companies relying largely on the support of subsidies to the brink.

The problems in the Chinese solar industry may be seen as a reflection of many of the troubles afflicting China's economy as a whole such as: government encouraged over-investment, inefficient capital markets, and a problematic borrowing system, coupled with intricate and opaque relationships between local governments, banks, and enterprises, and the conflicting agendas of central and local governments. However, on the positive side, competition in the Chinese solar sector also drove down the cost of solar products, especially at a time when there was a lack of global investment for renewables.

**EU-China trade dispute reveals a lack of trust – accusations of 'dumping'**

The credit crunch in the financial markets and the financial crisis left many governments at a crossroads with respect to their environmental policies. EU trade officials thought the state of the solar industry provided an opportunity for them to take the first step of their long-planned strategy to correct the 'Chinese government-supported trade manipulation', as seen from an EU perspective.

More than just the solar industry, Brussels really aimed to pressure Beijing to dismantle what they believed to be 'a system of illegal government subsidies', as mentioned in a few articles on this topic in the *Financial Times*. EU trade officials believed the EU was losing ground to Chinese manufacturers because Chinese companies received illegal subsidies from the Chinese government and cheap loans from State-owned banks in many sectors, through various channels. They also believed EU companies were not given equal access to the Chinese

market in general, whereas Chinese companies enjoyed much better access to European markets.

In September 2012, accusing Chinese solar companies of illegal practices, the EU authorities launched their anti-dumping investigations into Chinese solar exports as the first step in their strategic game plan to pressure China into making changes. Worth €22bn a year – approximately 5–7 per cent of the annual trade relationship between China and the EU – this was the biggest trade investigation in history between the two sides.

Stakes were very high, but EU trade officials considered this was a strategic move. EU trade officials may have rightfully spotted the serious problems associated with the rapid development of the Chinese solar industry, but in adopting anti-dumping measures they picked the wrong battle because they overlooked the unique global nature of the solar industry.

**Effects of the trade dispute on solar free trade**

Unlike almost all other traditional energy sources, the source of solar energy is truly global and abundant. It can be harnessed in most parts of the world. As a new industry, a global value chain has also formed from upstream to downstream solar companies. Free trade forms a foundation for a functional and competitive solar industry.

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**'UNLIKE ALMOST ALL OTHER TRADITIONAL ENERGY SOURCES, THE SOURCE OF SOLAR ENERGY IS TRULY GLOBAL AND ABUNDANT.'**  
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The solar PV sector has attracted significant interest, from local governments to financial investors. Governments around the world,

responding to the imminent challenge of climate change, have launched incentive policies and subsidies to promote the development of the PV industry and many, like China, have included the solar industry in their national development plans, considering it a strategic industry.

The EU anti-dumping case was destined to have no winners because globalization has distributed the solar supply chain around the world. Companies along the supply chain of solar products – from manufacturing the key raw material, polysilicon, to the production of solar modules, to logistics and installation services – are spread around the world. While Chinese companies dominate the mid-stream manufacturing parts of the chain, companies dominating the upstream and downstream of this global supply chain are mostly based in Europe and the USA.

When higher tariffs are charged for the made-in-China midstream products (cells and modules), the costs for downstream companies in Europe and elsewhere rise. The Chinese retaliate by charging tariffs on upstream products such as polysilicon, which are mostly produced outside China. Eventually everybody loses.

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**‘THE EU ANTI-DUMPING CASE WAS DESTINED TO HAVE NO WINNERS BECAUSE GLOBALIZATION HAS DISTRIBUTED THE SOLAR SUPPLY CHAIN AROUND THE WORLD.’**  
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It should have been a common aim of nations around the world to bring down the costs (and prices) of solar, wind, and other clean energy producers to accelerate decarbonization. But EU officials chose an approach that increased the costs of solar for European solar distributors and installers – and in the end for European consumers.

While the entire world benefits from cheaper solar panels manufactured in China (or elsewhere) and the solar industry saw the possibility of reaching grid parity – the point at which the cost of solar power matches that of grid electricity – the EU authorities moved to halt that trend.

For Brussels, the solar case has always been about more than just the future of the solar industry. The EU has targeted the perceived ‘state capitalist system’ in China.

The anti-dumping measure, though counter-productive, can still be employed under the current international trade mechanism.

In the normal economic definition of dumping as an anticompetitive practice, companies sell goods at below-cost prices in order to drive their competitors out of business, at which point they raise their prices to gain profits. But this theory does not apply to the solar case, as existing Chinese solar companies won’t be able to raise prices again; entry barriers are low and technological innovation is very significant in many countries. Competition within China, and from new manufacturers elsewhere, is simply too fierce.

It has always been the EU’s objective to unite Member States to defend the union’s interest in the face of external pressure/threat, but this time around, EU trade officials, by following a different agenda from their EU environmental peers, protected the interests of nobody but a few failing EU solar companies.

**Member States unite to counteract EU duties on Chinese solar panels**

In May 2013, EU Member States overwhelmingly voted against the EU proposal to impose provisional duties on Chinese solar panels – 18 Member States voted against, four in favour and

five abstained. Although the vote was non-binding on the EU’s final decision, EU trade officials suffered a major blow to their agenda, but more importantly the cost of solar energy in the EU had risen.

It may not have been the EU’s original plan, but the trade dispute forced Chinese solar companies to consolidate and this industry shake-up will promote a more sustainable development of the industry. China has announced plans to increase its domestic demand for solar products, making the country the largest solar market in the world in the near future.

The European PV market is, however, shrinking. The EPIA (European Photovoltaic Industry Association) said in its outlook report that ‘... it is clear from the results of 2012 and the forecast for the coming years that Europe’s leading role in the PV market is coming to an end.’ In 2011, Europe accounted for 74 per cent of the world’s new PV installations; according to EPIA, in 2012 this number was around 55 per cent.

It would be ideal if the world’s leaders could put aside narrow national or EU interests and look for solutions to common global challenges. But in reality, even facing the common threat of climate change, few are willing to unite and work in partnership. Protectionist strategies are becoming increasingly subtle and less transparent. The old global institutional balance in which the USA and Europe managed the world is being tested and challenged with the rise of emerging powers like China. However, the rules of the international trade system still follow the old-school zero-sum game approach designed to solve bilateral disputes rather than promote mutual prosperity.

Mutual trust is still up in the air.





# China starts trading carbon

Christian Ellermann and Constanze Böning

China has been the world's largest emitter of greenhouse gases (GHGs) for several years now, per capita emissions have almost reached the European average, and its share of global energy use and GHG emissions keeps rising steadily. By introducing emissions trading scheme (ETS) pilots in five cities and two provinces, China has been indicating bold reforms in its governance of energy and the environment. Handing over the allocation of greenhouse gas pollution rights to markets, the government of China is signalling to the international community that it intends to be compared to Europe and progressive regions in North America when it comes to adjusting its economy to a carbon-constrained future. Domestically, the move indicates openness to reducing the grip of the state over the distribution of energy and a genuine concern over pollution related to energy conversion. Taking note of the recent ETS policy implementation in the pilot regions, this article assesses the significance of this development in the light of Chinese international and domestic climate and energy policy. Notwithstanding the attention and positive appraisal that the introduction of emission trading schemes in China has rightly received, policy implementation shows that a possible transition to a more important role for markets in the area of energy and the environment is still in its very early stages.

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**'BY INTRODUCING ETS PILOTS ..., CHINA HAS BEEN INDICATING BOLD REFORMS IN ITS GOVERNANCE OF ENERGY AND THE ENVIRONMENT.'**  
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Chinese policymakers are far from oblivious to the challenges that

increasing energy consumption and emissions pose to its energy security, local pollution levels, and vulnerability to climate change impacts. For the past decade or so, they have developed and implemented a range of policies to reduce the growth of energy consumption and limit ever-increasing GHG emissions, mostly through centrally administered command and control approaches. In a nutshell, starting in 2011 all Chinese provinces received intensity caps (related to economic output) for their energy-related CO<sub>2</sub> emissions and their energy consumption, based on the national target of 17 per cent and 16 per cent reductions respectively over the period of the current Five Year Plan (FYP) (2011 to 2015). The provinces have, in turn, divided these targets up and allocated them to cities and counties. These and similar earlier energy targets (for example under the previous FYP) have been implemented and largely achieved by a mix of government mandates to state-owned enterprises (SOEs), obligations for utilities to expand the use of renewable energy sources, and support for energy efficiency measures.

## The world's second largest cap and trade scheme

The National Development and Reform Commission (NDRC) – a kind of super ministry which is responsible for economic policy and planning and which oversees energy and climate policy matters – has been floating the idea of a new approach to administering GHG emissions since late 2010. In November 2011 it officially ordered the seven regions to begin preparations for piloting ETS, officially leaving considerable space to the municipal and provincial governments to experiment with policy development and implementation. The pilot areas – the cities of Beijing, Shanghai, Tianjin, Chongqing, and Shenzhen, and the provinces of Guangdong and Hubei – cover a substantial share of China in terms of population, energy usage, GHG emissions, and their share of the economy. The cumulative amount of the initial allowances of the active ETS pilots is about 750 million tonnes, which already makes China the second biggest carbon market after the EU ETS.

The regions piloting ETS			
Region	Population (million)	GDP (billion RMB)	Energy consumption (Mtce)
Beijing	19.6	1,411.4	30.7
Tianjin	13.0	922.4	38.0
Shanghai	23.0	1,716.6	53.3
Chongqing	28.9	792.6	33.4
Guangdong*	104.4	4,601.3	99.4
Hubei	57.3	1,596.8	86.5
<b>Total</b>	<b>246.2</b>	<b>11,041.0</b>	<b>341.3</b>
Share of national	18%	28%	16%

\* Guangdong province includes data for Shenzhen

Originally the ETS pilot phase was planned for the three years from 2013 to 2015, followed by the gradual establishment of a national scheme starting in 2016. More realistic planning now foresees a longer pilot phase as not all pilots started in 2013. A gradual establishment of the national scheme within the period of the Thirteenth FYP (2016 to 2020) is planned. Through 2012 and 2013, a veritable competition to become one of the first to start carbon trading took place between the more advanced of the regions. Shenzhen launched its ETS in June; Shanghai, Beijing, Guangdong, and Tianjin followed in November and December 2013. Hubei is expected to start in the first half of 2014; Chongqing is lagging behind.

Strikingly, none of the pilots adopted an absolute emission cap, but instead stuck to intensity targets, based on GDP, which then will be translated into an absolute number of allowances. The concern for a possible negative impact on economic growth in the regions dominates the design of the trading schemes.

Currently, Guangdong is the only pilot that includes mandatory auctioning in its scheme (3 per cent of the allowances in 2013 and 2014, rising to 10 per cent in 2015). The other regions opted for free allocation in the first phase. However, in addition to the intensity caps based on the emissions per unit of GDP, all regions included measures to react to possible economic up- or downturns, allowing for *ex post* interventions in either direction in case of over or under supply of allowances. As understandable as this approach is – especially given the European experience – it decreases transparency and dependability of the allowance allocation, and in turn increases the insecurity for enterprises significantly. As a result of this insecurity, there is no real price signal coming from the

market to date as only a few (and as anecdotes suggest, these are most likely politically initiated) transactions take place. The ETS is used more often by the pilot regions as an instrument to incentivize certain measures in energy efficiency and decarbonization than as a free market mechanism which would give market players an incentive to find the best places to take the most cost-effective actions.

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**'STRIKINGLY, NONE OF THE PILOTS  
 ADOPTED AN ABSOLUTE EMISSION CAP,  
 BUT INSTEAD STUCK TO INTENSITY  
 TARGETS, BASED ON GDP ...'**  
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Carbon prices in the pilots have seen wide variation. With the exception of Beijing, the pilots only accept transactions via their local exchanges, allowing for a tighter control over trading. Also, due to Chinese national stock exchange regulations, no trading of futures is allowed, only spot market trading. Shenzhen – the longest running scheme – saw prices of 28–32 RMB (€3.36–€3.84) per tonne on the launch date of 18 June 2013. No further transactions took place until 4 August, but prices bounced up after that, reaching an all-time high of 143.99 RMB (€17.30) on 18 October 2013 (the reasons for the price jump in October are unclear) and are now (in the first month of 2014), relatively stable between 68 RMB (€8.17) and 73 RMB (€8.77 ER) per tonne with few transactions and only 8,296 tonnes traded in January 2014. The total volume traded in Shenzhen since June 2013 is 205,624 tonnes of CO<sub>2</sub>.

Guangdong province, the largest carbon market among the pilots, only saw transactions on its launch date of 19 December 2013 and the day after, with a high of 61 RMB (€7.33). Shanghai and Tianjin saw prices of 29 RMB (€3.48) on their launch dates of 26 November and 26 December 2013

respectively, with a small increase to 33 RMB (€3.96) in Shanghai and a decrease to 25 RMB (€3.00) in Tianjin up to the end of January. Beijing prices started at 55 RMB (€6.60) on the launch day (29 November 2013) and fell to 51 RMB (€6.13).

The total volume traded in the pilots is still relatively small due to the above-mentioned uncertainties in regulations and the final number of allowance allocated to the enterprises. Observers expect the market to become more active once the first compliance cycle is concluded in the second and third quarters of 2014 and companies know the final number of certificates they need to surrender.

So far, only Tianjin does not levy penalties for non-compliance. Guangdong and Shenzhen set the penalty at three times the average market price, whereas Shanghai and Beijing cap the penalty at 100,000 RMB (€12,012) and 50,000 RMB (€6,006) respectively. It will be interesting to see how these penalties will be handled in practice.

**What do the ETS pilots signal in terms of climate policy?**

Since the announcement that the country would roll out ETS pilots, and possibly a national cap and trade system a few years later, the global carbon trading community has focused much attention on China. With the EU ETS being plagued by insignificance, other countries having withdrawn their support for the Kyoto process, and business in the Clean Development Mechanism becoming less interesting in China, this was a very welcome turn of events. Numerous donors have been sending their experts (and money) to China, even hoping for a new global momentum for carbon markets. Implementing the ETS pilots has helped generate a lot of goodwill for China, and the country has been



## Conclusions

On the one hand, the reluctance of companies that are covered by the ETS pilots to trade their allowances or to base investment decisions on the price of carbon emissions is explained by a natural learning curve, which is just at its starting point. On the other hand the ETS, as it is tested in the pilots currently, could hardly be called a free market mechanism. It is, rather, a 'flexible administrative instrument' for a relatively known constraint on energy usage and related

emissions, and is perhaps seen as not immediately requiring changes in planning by companies. However, foreign companies based in China and covered by one of the ETS pilots would be well advised to have a China ETS strategy in place, as they have traditionally been primary targets for government scrutiny regarding environmental target compliance in China.

Trust by Chinese political decision makers in transparent market mechanisms for energy and

environmental regulation is still limited, and the urge to control important (economic) parameters is clear. As the national imperative of economic growth is increasingly complemented by the public's demand for action in environmental and climate protection, the pressure to introduce new instruments increases. The ETS pilots with which China is now experimenting pave the way for market instruments in the future, and they already send a strong political signal internationally and domestically.



# Decoding the changes of China's foreign energy policy after the Third Plenary Session of the Chinese Communist Party: from national to international

Xu Qinhu

China first began to import oil products in 1993 and has since become increasingly reliant on oil imports. China's energy policy in this period has involved a process of 'going out'. In other words, it has been internationalized, relying increasingly on 'overseas' fuel markets as well as domestic resources. China's national oil companies (NOCs) and private companies have been encouraged to become more international in their activities. Through a form of energy diplomacy, involving good diplomatic relations with resource-rich countries and energy cooperation agreements, China's government and the NOCs have acquired access to the oil and gas resources needed to fill the growing gap between China's domestic production and its consumption. Due to significant domestic coal production, China still has a relatively low level of dependence on foreign hydrocarbons (11 per cent), but its reliance on imported oil (58.9 per cent) is

significant and growing, and has become China's Achilles Heel.

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**'... ITS RELIANCE ON IMPORTED OIL (58.9 PER CENT) IS SIGNIFICANT AND GROWING, AND HAS BECOME CHINA'S ACHILLES HEEL.'**  
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Through their recent trips to Russia, the USA, Central Asia, and south-east Asia, and their clear strategic recognition of the New Silk Road Economic Belt and the Sea Silk Road, the new government of Xi and Li have demonstrated that China's energy policy is no longer just about energy diplomacy. We can now see the embryo of China's foreign energy policy. There are four clues to understanding this policy.

### A market-driven approach to energy

Energy foreign policy has become foreign energy policy. Previously, China's energy foreign policy was a government-led strategy used to help meet China's energy shortages with

imports. Today, and increasingly in the future, China's foreign energy policy means that many different state-owned, private, joint venture, and collective companies are the actors, and they often move faster than the government. These companies will connect foreign and Chinese energy markets. With the forthcoming deregulation of crude oil imports following the Third Plenary Session of the Chinese Communist Party held from 9–12 November in Beijing, increasing amounts of private capital will be flowing out of China to upstream oil markets overseas. Meanwhile, government policy implementation will not be for energy alone, but rather to realize China's broader foreign policy objectives.

### Opening up to foreign investment and technology

'Going out' also means opening up the midstream energy industry to private, foreign capital, and opening up the downstream as well, especially to foreign technology that improves



energy efficiency and environmental protection on the consumption side. Furthermore, the decisions on whether and how much energy to import will depend increasingly on market prices (affordability) and transportation (accessibility), not on the aim of seeking self-sufficiency. We can therefore expect coastal provinces to favour importing LNG and coal when the prices are attractive.

**Increased reliance on multilateral cooperation**

China's conception of energy security has moved away from international political realism, with its emphasis on self-reliance, bilateral relationships, and zero sum strategic games, to a new policy of liberal institutionalism, where multilateral relations that are beneficial for all parties are stressed. Perhaps this shift has resulted from the shale-gas development in North America, which shocked traditional energy planners in China. It is also the result of over 20 years of international energy cooperation; this has made China more aware that all countries are interdependent in matters of energy security, and that efficient and open international energy markets are an important part of China's own energy security.

**The need for a low-carbon energy mix**

China is increasingly supportive of low-carbon development, partly in response to global climate change

concerns, but also in order to meet the serious challenge of environmental pollution in China. This involves reducing the share of coal in the energy mix, while increasing the role of natural gas and renewable energy. This is an important departure from previous Five Year Plans (from the Eighth to the Eleventh).

**The global energy market and the need for multilateral energy cooperation**

In sum, through the connection of its investment, energy resources, and policies with the rest of the world, China now considers herself, for the first time, to be a member of the global energy market. The country is already a heavyweight in world oil markets, as the world's largest oil importer and the second-largest energy consumer and energy producer. Apart from its critical role as a producer and consumer, China is also providing the basis for connecting energy producer and consumer countries, for example through the China–Russia oil pipeline, the China–Kazakhstan oil pipeline, the China–Myanmar oil and gas pipelines, and the China–Central Asia gas pipeline. These pipelines could have important implications for regional energy markets. For instance, it is interesting to ask what the implications of the proposed China–Russia gas pipeline would be for energy markets in north-east Asia.

However, China has relatively little

experience of multilateral energy cooperation, having emphasized mainly its bilateral relationships and having no global energy companies of the stature of companies like Exxon, Shell, or BP. Furthermore, north-east Asia has not really carried out multilateral energy cooperation, even though the region has very important energy producers, in particular Russia, and large consumers such as China, Japan, and Korea.

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**'CHINA NOW CONSIDERS HERSELF, FOR THE FIRST TIME, TO BE A MEMBER OF THE GLOBAL ENERGY MARKET.'**  
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**Conclusion**

Every country has its own energy 'culture' – the way energy is used, the levels of economic development, its approach to innovation, its institutions, the role of private and public sectors, and its approach to regional energy markets and to international collaboration. China is re-defining its own energy culture, which can be summed up by reference to the four clues described in this article: (a) a more market-driven approach to domestic and international energy; (b) opening up of the midstream and downstream oil and gas sectors in China to foreign investment and technology; (c) increased reliance on multilateral cooperation; and (d) increased emphasis on a low-carbon energy mix.



## What does America's energy revolution mean for China?

Gal Luft

Recent development in the USA of technologies for extracting oil and natural gas from shale formations are changing the global energy landscape. Thanks to hydraulic fracturing or fracking, US oil production has grown from 5.1 million barrels a day in 2006 to 8 million in 2013 and US oil imports have dropped to their lowest level in 20 years. According to the International Energy Agency the USA will become the world's number one oil producing country by 2015. In natural gas, US performance has been no less impressive. Natural gas production rose 50 per cent between 2005 and 2013, and the USA is about to assume an important role in the global market for liquefied natural gas (LNG).

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**'THIS SO-CALLED ENERGY REVOLUTION HAS BEEN RECEIVED IN CHINA WITH PERPLEXITY AND TREPIDATION.'**

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This so-called energy revolution has been received in China with perplexity and trepidation. Many Chinese officials believe that US self-sufficiency in energy, should it come to pass, would weaken US interest in the Persian Gulf, leading to a military and diplomatic withdrawal from the region. They worry that this could, in turn, compromise China's energy security, exposing it to supply disruptions due to the region's chronic instability and forcing it to assume responsibility over the security of the Persian Gulf. Some even fear that if the USA doesn't import oil from the Persian Gulf it would have, in the words of one Chinese analyst:

... greater flexibility to create problems in the Middle East, in order to prevent the rise of emerging countries.

Others see the US energy transition as a development which threatens to

de-industrialize China. According to this view, cheap energy supplies in the USA will lure industrial production from the Chinese mainland to US territory, giving American products a comparative advantage. While such concerns may be understandable, most of them are overstated. China does not need to fear the new energy architecture; reduced US imports of Persian Gulf oil are not likely to reduce its commitment to the region, and the energy revolution will benefit – rather than hurt – China in more than one way. In fact, China may be the country which could benefit from it the most.

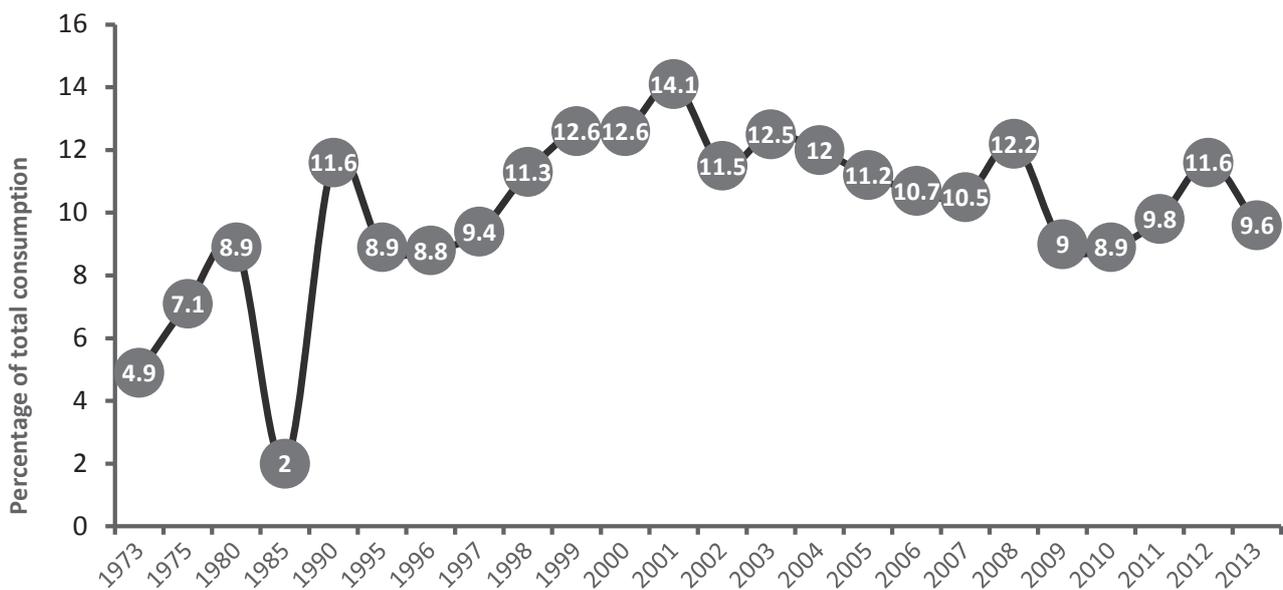
**The myth of US dependence on Middle East oil imports**

To the degree that the USA is to reduce its military and diplomatic involvement in the Middle East, the changes in its energy mix will not be the trigger for such a development. It is time to put to rest the myth that US presence in the Persian Gulf is tied to its dependence on imports of the region's oil. It isn't. In fact, it never has been. Today only nine per cent of US oil demand is met by imports from the Middle East. Indeed, imports from the Middle East have never exceeded 14 per cent of US demand. Most US oil imports originate from the western hemisphere: Canada, Mexico, and Venezuela. Mexico's recent historic energy reform is likely to increase the flow of Mexican oil to the USA and hence decrease even further US dependence on Persian Gulf crude imports.

While the USA is not dependent on the Persian Gulf for the physical supply of oil, it is dependent on the region for price stability. Oil is a global commodity with a more or less

global price so when oil prices spike, the USA is impacted regardless of how much of its crude comes from the Persian Gulf. For example, in 2011 the war in Libya caused oil prices to US consumers to spike by \$25 per barrel despite the fact that the USA imported no oil from Libya. Therefore, even if the USA miraculously became self-sufficient in oil, it would not be shielded from the world market – other countries that used to be self-sufficient at one point or another (Canada, the United Kingdom, and Norway) have seen no shielding effect.

On the other side of the equation the US economy is highly susceptible to spikes in oil prices. Over the past 40 years every major hike in oil prices was followed by a recession. What the USA cares about is not the origin of its oil but its price. And the global price of oil is largely affected by the political events in the Middle East. Therefore, as long as oil enjoys a virtual monopoly over the global transportation sector – the very sector that underlies the US economy – it is difficult to see how the USA could afford to withdraw from the Middle East and leave the world's largest pool of oil in the hands of unstable regimes, even if its imports from the region dropped to zero. A more likely scenario is that the North American energy boomlet will be a shot in the arm to the US economy and the harbinger of an industrial renaissance and increased prosperity relative to other parts of the industrialized world. Such an economic upturn is likely to negate the need for cuts in military budgets and make it easier for US leaders to marshal the financial resources and public support needed to address global problems, including the security of the Middle East.



### Oil imports from the Persian Gulf 1973–2013 as percentage of overall US consumption

Source: US Department of Energy/IAGS

#### Benefits to China

To be sure, cheap natural gas will revive the USA's industrial sector, particularly natural gas-intensive industries, creating new jobs and investment opportunities. Some global manufacturers have already announced their plans to set up plants in the USA, to take advantage of its cheap energy. But this is actually good news for China. Because the US and Chinese economies are deeply intertwined and because so much of China's GDP depends on US imports, a more prosperous USA means more buying power and a bigger market for Chinese goods, hence continuous growth for China.

Furthermore, since the USA is unable to utilize all of its domestic energy, it will now be able to increase energy exports to Asia. As the US electricity sector shifts from coal to natural gas, more coal will be available for export. In the past ten years US coal exports have more than tripled, and much more of this surplus of high-grade coal could be used in China, where coal demand will continue to increase at least until 2025.

The USA will also export natural gas. Last November the US Department of Energy approved the fifth LNG export terminal, enabling exports of US natural gas to Asia. Initially this gas will be directed to South Korea, India, Singapore, and Japan but one cannot rule out the possibility that some of the gas will eventually land in China (where natural gas demand could double by the end of the decade), either through direct sale or as part of a re-export arrangement. Even if no US gas reaches China, the inflow of North American gas to Asia could have a tempering effect on LNG prices, especially if Japan restarts its fleet of nuclear power plants.

US LNG exports will also improve China's price negotiation position vis-à-vis Russia, the world's number one gas exporter. The shale gas revolution will ultimately reduce Russia's share in the European natural gas market and force Russia to divert a growing portion of its gas to Asia at a competitive price. Similarly, while increased US oil production is unlikely to lower the real global price of oil – due to the

budgetary imperative of OPEC to ensure oil prices stay high – it does mean fewer barrels will have to migrate to the USA, increasing the availability of African and Middle Eastern oil to the Chinese market and reducing the risk of tension between Washington and Beijing over access to energy. In short, China will be able to enjoy more coal, gas, and oil, all necessary to its economic growth, as a result of America's energy boom.

Additionally, US energy exports are likely to boost the US dollar and hence put downward pressure on dollar-denominated oil prices while making China's exports of manufactured goods more competitive. China is the biggest foreign owner of US debt, owning \$1.3 trillion in US treasury bills, notes, and bonds. A stronger dollar means increased value of China's US debt holding.

#### Exporting America's shale gas revolution to China

Being the owner of the world's largest reserves of shale gas, China should

also recognize that it could benefit from US exports of fracking technology more than any other country. The US Energy Information Administration estimates that China has total reserves of 1,275 trillion cubic feet of shale gas, almost 50 per cent more than the 862 trillion cubic feet in the USA. And while there are many question marks about the economics and environmental attributes of China's shale gas this resource, if unlocked, has the potential to transform China's energy landscape.

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**'SWITCHING THE ELECTRICITY SECTOR FROM COAL TO CLEANER FUELS LIKE NATURAL GAS IS BECOMING A HIGH PRIORITY FOR THE REGIME ...'**  
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The twenty-first century is dubbed by many as the natural gas century. But China's natural gas sector has a lot of catching up to do. The industrialized world's average for the share of natural gas in a country's total energy portfolio is 24 per cent. In China it is less than five per cent. Along with nuclear power and renewables, natural gas is critical to strengthening China's energy security and reducing its hazardous air pollution. China is facing an all-engulfing environmental crisis today. Bouts of toxic smog lead to frequent city-wide shutdowns in China's main population centres. In 2013, life in Shanghai, Harbin, Beijing, Nanjing, and other mega-cities came to a halt due to haze, and the frequency of such disruptions is on the rise. The public pressure on the ruling Communist regime to address the problem is mounting, and if the situation is not addressed this could turn into an existential threat to the regime. Switching the electricity sector from coal to cleaner fuels like natural gas is becoming a high priority for the regime,

and the development of shale gas is a key in its effort to address the pollution challenge.

Natural gas can also alleviate China's growing dependence on oil, another major source of urban pollution. It can be used directly as an automotive fuel in the form of compressed natural gas (CNG) or LNG; it can be used to generate electricity, which can power electric vehicles; and it can be converted to the alcohol methanol – a high octane liquid fuel that can be blended with gasoline and is already widely used in several provinces in China. China's methanol is currently made from coal, but natural gas is a cheaper and cleaner feedstock for methanol production. Should China succeed in developing its shale gas resource, methanol, as well as all of the aforementioned natural gas-derived fuels, will be able to compete against petroleum over a growing portion of the transportation fuel market.

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**'THE AMERICAN SHALE REVOLUTION IS ANOTHER TESTIMONY TO THE ABILITY OF ENERGY INNOVATION TO ENLARGE THE WORLD'S ENERGY PIE.'**  
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The USA would welcome China's shift to gas, both in the transportation sector and in power generation. In 2009 China and the USA launched the USA–China Shale Gas Resource Initiative, a joint effort to enhance investment and technical cooperation aimed at accelerating shale gas development in China. Major US energy companies, such as Chevron and Conoco Phillips, have signed joint ventures with Chinese energy companies, which have been investing substantially into American shale gas leaders such as Devon Energy and Chesapeake Energy to gain technical knowhow. In October 2013 the United States Energy Security

Council, America's highest level extra governmental energy security advisory committee, recommended that the USA–China collaboration on shale gas be further expanded to include the development of new fracking techniques, safety standards, and environmental best practices. (See: [www.iags.org/fuelchoices.pdf](http://www.iags.org/fuelchoices.pdf).)

The Council also proposed the formation of a USA–China–Brazil Alcohol Fuel Alliance aimed at advancing cooperation among all alcohol fuel producing and consuming countries in all matters related to alcohol fuel blending. Such an alliance could focus on opening transportation fuel markets around the world to natural gas-derived alcohol fuels and on opening vehicles to their use. The success of such an effort could have a positive impact not only on USA–China relations but also globally. Roughly 40 per cent of the world's vehicles are manufactured in the USA and China. Thus, if the ability to blend alcohol becomes a standard feature in vehicles sold in these two markets, there is likely to be a spillover effect to the rest of the world.

The American shale revolution is another testimony to the ability of energy innovation to enlarge the world's energy pie. Energy is not a zero-sum game, as many tend to believe, but an area in which technology sharing and multinational cooperation can strengthen energy security for all. As China continues to grow and is facing difficult tradeoffs between economic development and environmental quality, US innovation in shale technology offers it a pathway to a bright energy future. It is now up to China to embrace this development, build on it, and view shale gas for what it really is: an opportunity, not a threat.



## Letter of reply

Dear Sir

In response to the surprisingly emotional article, 'New EU rules may be a fix for something that isn't broken', we would argue that it is not only regulators who are looking for a verifiable solution to benchmarking, but actually the market more generally.

We believe that price reporting has a place in less liquid markets and we continue to support the important work PRAs undertake in these markets. However, markets such as naphtha in the Mediterranean, where there are only a handful of trades a day, are different in nature to markets such as UK and European natural gas, with perhaps 5,000 trades a day going through the three leading, competing OTC broking firms, let alone the added ICE exchange publicly traded volumes. Highly liquid markets clearly offer the opportunity for objective and transparent benchmarks, based on verifiable transactions. Furthermore, several of the leading gas market participants are reluctant – (and in some cases openly refusing) – to allow their traders to communicate at any level with PRAs, thus further compromising the quality of assessment based price reporting.

The author derides the Tankard indices and draws parallels with the Libor benchmark. However it is important to note that the problem with Libor was precisely that it was a subjectively reported benchmark, not based on verifiable trades. The two are therefore not comparable. Meanwhile, for the author to raise questions about broker impartiality is a clear misunderstanding – brokers are wholly independent and regulated as such and are subject to the highest levels of regulator scrutiny.

The author's comment that Tankard produces prices very similar to the PRA assessment overlooks the basic fact that this is because the large tradeflows which Tankard collate take place before any assessment can. If anything, then, PRA assessments can only ever *follow* the Tankard expressions.

The concept of Tankard has been very well received and while the market is naturally going to take time to move away from the existing benchmarks, it is clear that regulatory, price and client pressure will bring its methodology increasingly onto the centre stage, and will recognize Tankard's trade-backed approach as an obvious opportunity to improve transparency, accountability and objectivity within the natural gas markets.

Yours faithfully

Gordon Bennett, Paul Newman, Andrew Polydor

Tankard

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