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China's political economy of coal

Drivers and challenges to restructuring China's energy system

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Abstract

This report presents an overview of Chinese policies and policy drivers that signal a potential discontinuation of the golden age of continued coal growth in China. It also briefly discusses the counterforces and challenges facing China in shifting its energy system from coal to low-carbon solutions. The coal industry has proven its long-lasting significance by contributing to the national economy, to local opportunities and livelihoods, to poverty alleviation and employment. Forces at the central and local governance levels, as well as many other political and socio-economic factors, need to be carefully taken into account when analysing whether or when China will reach a peak point in its coal consumption, an issue currently subject to considerable debate.

Structural developments in 2014 are interesting. In that year, China had its slowest growth rate of overall energy consumption since the turn of the century, due largely to the significant decrease in energy intensity since 2009. China also witnessed a milestone drop in coal consumption, together with a decline in domestic production and import. Further, 2014 was a year of exciting growth in alternative energy sources. The Chinese government declared its ambition of a 15% target of non-fossil fuel sources by 2020 and 20% by 2030. With its investment in renewable energy rising China signalled its leadership regarding a low-carbon energy future. Developments in 2014, specifically the decline in coal consumption (continuing in 2015), were the combined result of policy efforts made by the Chinese government aimed at reducing its energy consumption and shift its energy system, while continuing to secure high economic growth, urbanize the economy, improve people's livelihoods and deal with the turbulence in international energy markets.

Key Words

energy policy, structural change, climate policy, China

About the Report

This report summarizes documentation on China's coal industry and sustainable electricity, with a focus on political economy. It has been prepared by the Fridtjof Nansen Institute (FNI), in order to evaluate key aspects of China's coal use and the extent to which the country's coal industry is an obstacle to the transition to a sustainable electricity system and renewable energy. This report forms part of the project *Renewable Energy or Coal? China's Future Electricity*, developed in collaboration between FNI, the International Institute for Sustainable Development (IISD), and the China National Renewable Energy Center.

This report has been co-authored by FNI consultant Han Cheng, and Per Ove Eikeland, FNI Senior Research Fellow and project manager. Inputs have been provided by Dr Goerild Heggelund, Senior Research Fellow and China Representative FNI as well as Country Director, China, and Head of Energy and Climate Policy INTASAVE Asia-Pacific.

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Questions and comments on the report are welcomed, in English, Norwegian or Chinese, to Han Cheng and Per Ove Eikeland, respectively, at chenghan528@gmail.com and per-ove.eikeland@fni.no.

Executive Summary

Ahead of the historical international climate negotiations in Paris, China has pledged to invest as much as over USD 6,600 billion, or roughly RMB 41,000 billion – equivalent to 70% of its 2014 GDP – in the period 2020–2030, in order to deliver on its agreed climate-mitigation targets.[1] It has set out to achieve this by changing its energy structure, triggering green manufacturing, upgrading low-carbon industry, improving public health, enhancing environmental quality, and increasing green employment. The world's largest GHG emitter has embarked on a path of unprecedented green aspirations, with enormous impact on its domestic smart growth and global development ambitions.

A major climate-policy challenge for China is the high dependency of its energy system on fossil fuels. Some 90% of China's carbon emissions come from the consumption of fossil fuels, 68% of which can be attributed to coal combustion alone.[2] It is the world's largest coal consumer, responsible for about half of global consumption and with a share of coal in its energy structure considerably higher than world average.

Given the heightened focus on climate change in Chinese politics, we would expect to see new policies crafted to reduce the booming growth in coal consumption of recent years. This report presents an overview of Chinese policies and policy drivers that signal a potential discontinuation of the golden age of continued coal growth in China. It also briefly discusses the counterforces and challenges facing China in shifting its energy system from coal to low-carbon solutions. The coal industry has proven its long-lasting significance by contributing to the national economy, to local opportunities and livelihoods, to poverty alleviation and employment. Forces at the central and local governance levels, as well as many other political and socio-economic factors, need to be carefully taken into account when analysing whether or when China will reach a peak point in its coal consumption, an issue currently subject to considerable debate.

Structural developments in 2014 are interesting. In that year, China had its slowest growth rate of overall energy consumption since the turn of the century, due largely to the significant decrease in energy intensity since 2009. China also witnessed a milestone drop in coal consumption, together with a decline in domestic production and import. Further, 2014 was a year of exciting growth in alternative energy sources. The Chinese government declared its ambition of a 15% target of non-fossil fuel sources by 2020 and 20% by 2030. With its investment in renewable energy rising to USD 89.5 billion, about 73% higher than that of the USA,[3] China signalled its leadership regarding a low-carbon energy future. Developments in 2014, specifically the decline in coal consumption (continuing in 2015), were the combined result of policy efforts made by the Chinese government aimed at reducing its energy consumption and shift its energy system, while continuing to secure high economic growth, urbanize the economy, improve people's livelihoods and deal with the turbulence in international energy markets.

The report is structured in five sections. Section one presents data showing long-term and recent developments in the Chinese energy structure, with main focus placed on the shifting role of coal. Section two presents main recent policies and policy drivers behind this development. It shows that the government has plenty of reasons to act on coal. Not least, widespread discontent with worsening air quality and resultant public health concerns has shown how public opinion can succeed in influencing central-level policies, pushing the government to declare its 'battle against smog'. Section three looks into some main challenges that China has witnessed and will face concerning energy industry restructuring, focusing on key governance issues related to the coal industry. As the world's largest coal producer and home to some of the most extensive reserves, China has unsurprisingly been deeply involved in the industry, particularly as regards its contribution to employment and regional development. Study of overall resource availability, regional distribution, contribution to employment, and development of the mines, among other indicators, makes evident the significance of the coal industry. Section four briefly turns attention to the corporate level, acknowledging observed corporate strategy as an important indicator of corporate response to government regulation and market changes. We here look into initiatives taken by Shenhua, a Chinese central state-owned enterprise (SOE) and the world's largest coal supplier, to manage business risks and new economic opportunities by diversifying its business portfolios and implementing new corporate environmental strategies. The case of Shenhua is taken up here not as a role model, but to shed light on some of the business-level transition under the broader, intense structural shifts underway in China. Section five draws up some main conclusions of the study.

Being a 'desk study', our investigation is a preliminary one, collating relevant information available from the web. Sources of information include government publications, industry sustainability reports, newspaper and newsletter articles, consultancy reports and research articles. While acknowledging the limitations of a desk study, we hope that the combination and structuring of the information presented here can offer a picture of current Chinese energy policy and the drivers crucial to understanding how policy is likely to develop in the near future.

Acronyms

AUD – Australian dollar

CAE – Chinese Academy of Engineering

CBM – coalbed methane

CCS – Carbon capture and storage

CNCA – China National Coal Association

CO_2 – carbon dioxide

COD – Chemical oxygen demand

CSR – Corporate social responsibility

FYP – Five-Year Plan

GDP – gross domestic product

GHG – greenhouse gas(es)

INDC – Intended Nationally Determined Contributions

MEP – Ministry of Environmental Protection

MIIT – Ministry of Industry and Information Technology

MoF – Ministry of Finance

Mtoe – million tonnes of oil equivalent

NBS – National Bureau of Statistics

NDRC – National Development and Reform Commission

NEA – National Energy Administration

NOx – nitrogen oxides

RMB – Renminbi

SASAC – State-owned Assets Supervision and Administration Commission

SAT – State Administration of Taxation

SO_2 – sulphur dioxide

SOE – state-owned enterprise

USD – US dollars

Contents

1 Chinese coal industry trends

China[4] is the world's largest coal producer and consumer.[5] In 2013, the share of coal in China's energy consumption was 67.5%, significantly higher than the global average of 30%.[6] This makes clear the extreme reliance on coal – with oil, another heavy polluter, standing at 17.8%. In the past two decades, electricity has become the country's most rapidly growing energy carrier. Given the coal-based electricity-generating structure, coal power is the dominant force in China's electricity supply. By the end of 2013, it was responsible for over 78% of China's total power generation.[7]

By 2014, the dramatic drop in oil prices and unprecedented pressures for a low-carbon future significantly challenged the competitiveness of coal. Figures for that year show that China's coal consumption was down for the first year in current century. Official Chinese statistics indicated 2.9% lower consumption in 2014 than the 2013 level.[9] While later revisions of historical data showed higher past consumption, the new data still confirms the dip in 2014.[8] The share of coal in total energy consumption was down to 66%. In addition to coal for electricity, industrial coal consumption accounted for about half of consumption, with coking, industrial furnaces, coal chemicals, and industrial boilers as the four main areas.

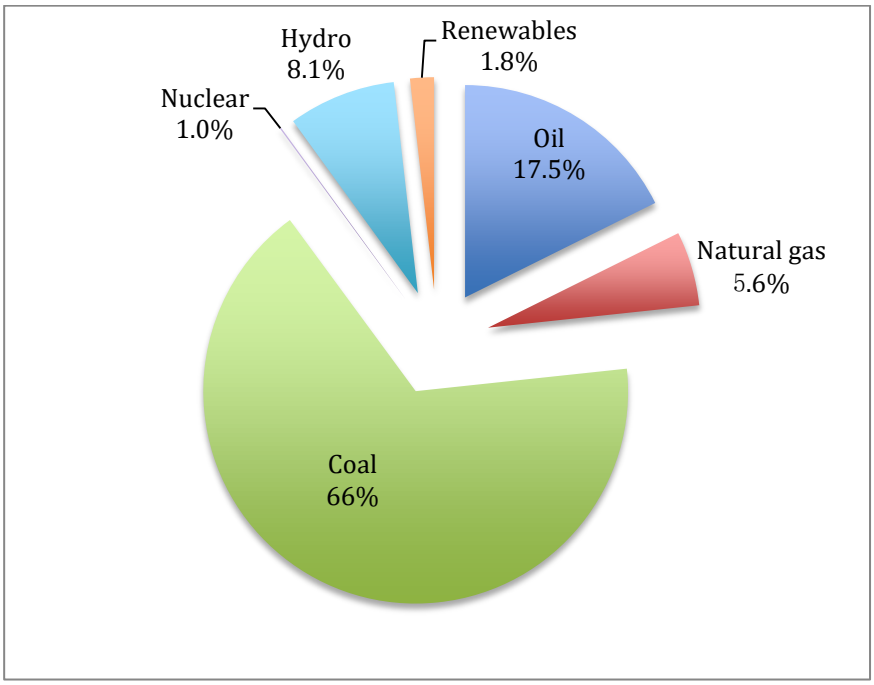

Figure 1. China: structure of primary energy consumption, 2014

Source: *BP Statistical Review of World Energy 2014*

Consumption of crude oil grew by 5.9%, natural gas consumption by 8.6%, and electricity consumption by 3.8%. As regards cleaner energies, the share of hydropower, wind power, nuclear power, natural gas and other types of 'clean energy' rose to 16.9%.[9] Hydropower is China's third largest source of energy consumption, after coal and oil. In recent years, with an increase in installed capacity, hydropower volume has shown impressive growth, becoming the flag-ship of the country's rapid development of clean energy.

Total energy consumption in China in 2014 amounted to 4.26 billion tonnes of standard coal,[9] slightly less than a 2.2% increase from the previous year of 4.17 billion tonnes[10] – the smallest increase since 2000, although higher than the 2015 ceiling set by the National Energy Administration (NEA) – 4.2 billion tonnes.[11] The overall slow-down is attributed largely to the substantial decline in the country's energy intensity. In 2014, energy intensity fell by 4.8%, the largest decline since 2009.[9] However, a gap still remains between China's energy intensity and energy consumption of major industrial products and the world's advanced levels, especially as regards energy conservation and new energy technology innovation. Therefore, Premier Li's government report singled out energy intensity for special attention, with a target of over 3.1% reduction in energy intensity in 2015, in addition to a continuing decrease in emissions of major pollutants.[12]

Table 1 shows the development in consumption of various energy sources in the period 2003–2014 based on data collected from BP Statistical Review of World Energy. Unlike the data presented by the National Bureau of Statistics, this Table does not show a drop in coal consumption in 2014, which may reflect the fact that coal converted to liquid and gaseous fuels has not been included. Nevertheless, it should provide a good picture of long-term trends in Chinese energy consumption.

Energy-system development is currently at a critical turning point, with the focus on replacing coal with oil and gas, and prioritizing non-fossil energy over fossil energy sources. The critical goal is to develop non-fossil energy sources substantially, to around 15% by 2020 and around 20% by 2030, as the State Council has proposed for its domestic plan and international climate negotiations.

However, under mounting pressure for reducing air pollution and the imperative of proactively promoting clean energy, the Chinese central government is expected to phase down the share of coal in the country's energy structure already in the next few years.

Table 1. China's primary energy consumption, 2003 to 2014, in Mtoe

	Oil	Natural gas	Coal	Nuclear energy	Hydro-electricity	Other renewables	Total
2003	266.4	29.5	834.7	9.9	63.7	NA	1204.2
2004	318.9	35.1	978.2	11.4	80.0	NA	1423.5
2005	327.8	41.2	1095.9	12.0	89.9	NA	1566.7
2006	353.2	50.5	1215.0	12.4	98.6	NA	1729.8
2007	362.8	62.6	1313.6	14.1	109.8	NA	1862.8
2008	375.7	72.6	1406.3	15.5	132.4	NA	2002.5
2009	388.2	80.6	1556.8	15.9	139.3	6.9	2187.7
2010	428.6	98.1	1713.5	16.7	163.1	12.1	2432.2
2011	461.8	117.6	1839.4	19.5	157	17.7	2613.2
2012	483.7	129.5	1873.3	22	194.8	31.9	2735.2
2013	503.5	153.7	1961.2	25.3	208.2	46.1	2898.1
2014	520.3	166.9	1962.4[a]	28.6	240.8	53.1	2972.1

[a] *Commercial solid fuels only, i.e. bituminous coal and anthracite (hard coal), lignite and brown (sub-bituminous) coal, and other commercial solid fuels. Excludes coal converted to liquid or gaseous fuels, but includes coal consumed in transformation processes. This may explain why a decline in total coal consumption is not shown in the data.*

Source: *BP Statistical Review of World Energy*

1.1 Imports, consumption and own production

In its 2014 annual report, the National Bureau of Statistics (NBS) presents a well-informed picture of China's coal industry in 2014 and comparison with 2013:

- own production: 3.87 billion tonnes, 2.5% drop
- import: 291 million tonnes, 10.9% drop
- consumption: 3.51 billion tonnes, 2.9% drop

Growth in the coal industry often shows a highly positive correlation with overall economic wellbeing; however, in the case of China, diverging shifts are becoming evident: negative consumption growth in 2014 against the 7.4% GDP growth rate. According to an analysis prepared by Greenpeace, the growth rate of China's coal consumption has declined substantially since 2012: from an average 6.1% for 2007 to 2011 to less than 1% for 2012 to 2014; during the same period, the country's GDP growth rate slowed down only moderately, from 10.6% to 7.8%.[13]

In other words, China's coal consumption growth is increasingly less linked with its economic growth. This growth is now slower, but China still hosts some of the most thriving industries worldwide. In 2014, Chinese industrial enterprises above a designated size delivered total profits of RMB 6471.5 billion, a 3.3% increase from 2013.[14]

The coal industry, however, certainly did not follow suit, emerging second-last in terms of profit. The breakdown of a total of 41 sectors shows that coal mining and processing was among the 11 sectors in decline, its 46.2% drop exceeded only by the categories of oil refining, coking and nuclear fuel processing (79.2%).[14]

In the first 11 months of 2014, the industry witnessed a 44.4% drop of profit in coal enterprises above designated size, and heavy losses of RMB 68.3 billion – a 61.6% annual increase that covers over 70% of the entire sector. It is not difficult to imagine the massive hardships confronting China's coal industry today.

Besides consumption, other two indicators reinforce this picture. China's own production of coal in 2014 experienced the first-ever decline, after 14 years of increase. The earliest historical data on own production show 1.25 billion tonnes in 1998, with the figure continuing to rise every year since then, until 2014.[15] Total imports of coal in 2014 fell heavily, from 327 million tonnes in 2013. China became a net coal importer in 2009, with import dependency increasing ever since, up to 8.13% in 2013.[16]

'The fact that China's coal consumption finally starts to decouple from its GDP growth shows that a peak in coal use is within reach. With political determination on an energy revolution, and strong targets and measures, the peak can be realized well before 2020. This is not only critical for China to win the battle against air pollution, but will also speed us towards a global CO_2 emissions peak.' – Fang Yuan, Greenpeace.[13]

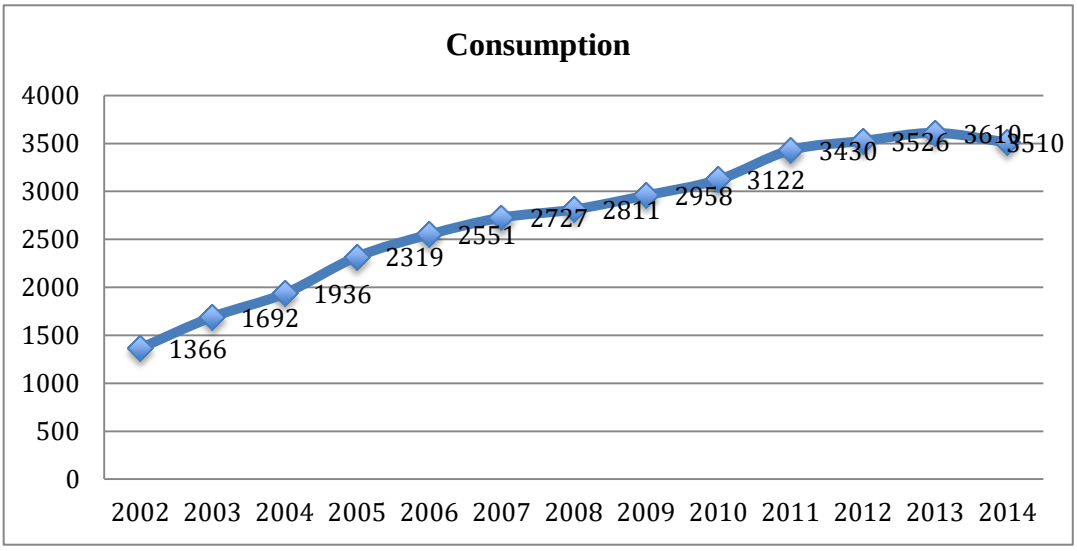

Figure 2. China: coal consumption, 2002–2014, in million tonnes of standard coal

Source: *Statistical Communiqué on China National Economic and Social Development*

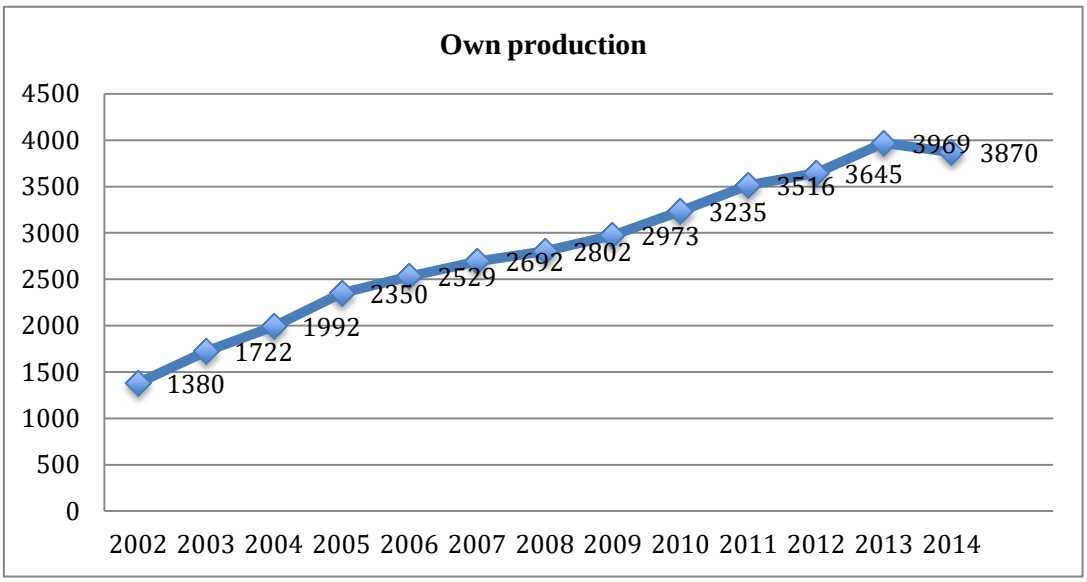

Figure 3. China: own production of coal, 2002–2014, in million tonnes of standard coal

Source: *Statistical Communiqué on China National Economic and Social Development*

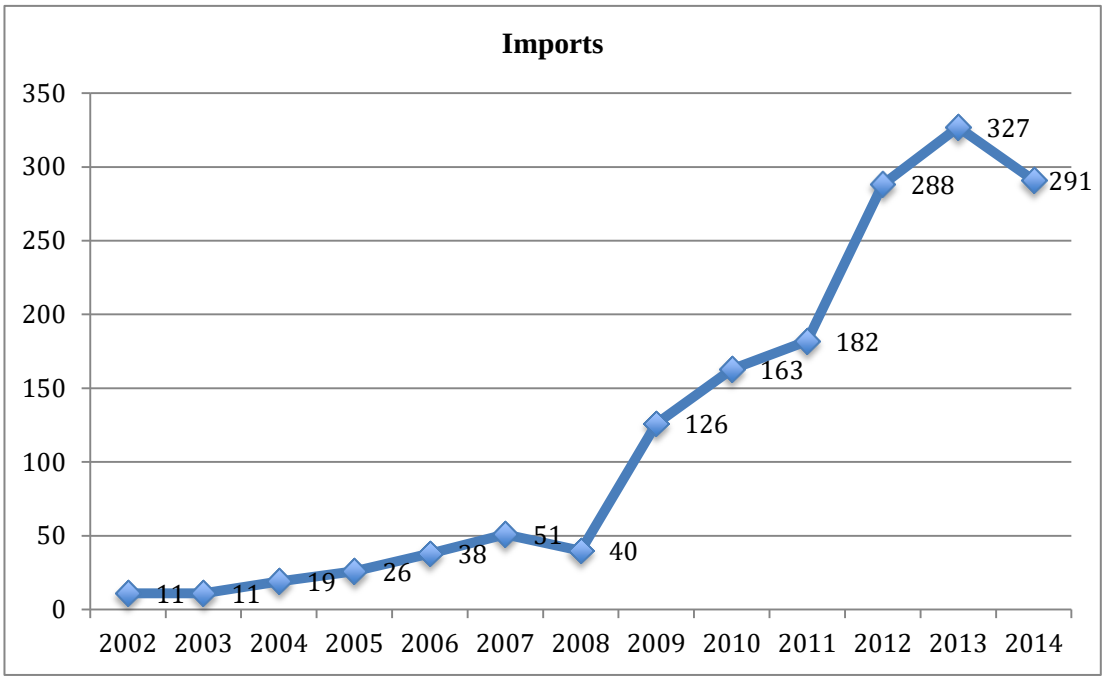

Figure 4. China: coal import, 2002–2014, in million tonnes of standard coal

Source: *Statistical Communiqué on China National Economic and Social Development*

1.2 Interpreting the trends

Three key factors are widely held to have brought about the decrease in demand for coal:

- declining consumption on the part of coal-consuming industries
- gradual change in the energy mix
- increasing energy efficiency

China's economic growth rate slowed down in 2014, as did the growth rate of major coal-consuming industrial output. The three major down-stream coal-consuming industries – electricity, steel and iron, and construction materials – experienced a decline of 3.4%, 1.4%, and 1.1%, respectively.[17] Thanks to advances in technology and further efforts in air-quality and environmental governance, energy intensity dropped by 3.7% in 2013, and by a further 4.8% in 2014[15]

The milestone decline in consumption has attracted attention from the energy and environmental protection industry, leading to intense debate as to when China's coal peak might come. Some estimates seem rather conservative. A scenario on clean coal and unconventional gas prepared by the Chinese Academy of Engineering (CAE) was released in late

2014.[18] It indicates that coal will remain China's major energy source for a fairly long time to come. Coal consumption will continue to grow, peaking at around 4.5 billion tonnes in 2030, corresponding to 55% of the country's total primary energy consumption.

This is a somewhat typical perspective in China: instead of phasing out coal sooner and at a lower peak level, promoting the use of clean coal seems a more convenient and flexible solution. Other views are more progressive. A major study, the China Coal Consumption Cap Plan and Policy Research Project[19] (the China Coal Cap Project), has been launched by the Natural Resources Defence Council, working in partnership with over 20 cross-cutting Chinese stakeholders. In their report, issued in June 2015, the analysis team indicates that coal consumption can and should be less than 4 billion tonnes by 2020, and less than 3.5 billion tonnes by 2030.[20] That is a much tighter and more ambitious cap. Nor is this because that report is an independent study: also the government's China Energy Research Society indicated a peak of some 4.1 to 4.7 billion tonnes by 2020.[21] And in its 2012 study, the US Lawrence Berkeley National Laboratory also gave 2020 as the peak year.[22]

The coal industry is now facing unprecedented pressure under fierce environmental criticism, while declaring itself as the key to ending energy poverty. At a major international workshop in November 2014 on China's coal consumption and energy re-structuring, the two-day debate focused on the core topics of the coal peak, water scarcity and air pollution. Strong voices were heard, urging a closure on coal, sooner rather than later.[23]

Coal dominates China's energy reserves, and is expected to retain a major role in the country's energy consumption structure in the upcoming 13th Five Year Plan (FYP). In order to achieve a greener energy mix, while seeking to peak gradually in the coming decade, the government seems to have taken a stance of encouraging safe, green and highly efficient use of coal resources, so that a stable energy structure may be sustained during the transition.

> 'Treat the clean and highly efficient use of coal as equally important as developing renewable energy' – Shi Yubo, NEA[24]

Control of coal consumption will contribute not only to a more balanced energy structure: it can also bring important co-benefits on several fronts – including reduced emissions of GHGs and black carbon, significant health benefits, substantial reduction in smog conditions, as well as improved protection of water resources and ecosystems.

With the pressing climate-change agenda, the impact of China's coal industry on global carbon emissions has been attracting significant attention worldwide. In 2013, China's carbon emissions per capita had already surpassed the global average – even exceeding the European Union average. A study conducted by the Global Carbon Project shows that global CO_2 emissions hit an historical peak of approximately 36.1

billion tonnes in 2013 – of which 10 billion tonnes, or 28%, came from China.[25]

In order to limit global temperature rise to under 2^0C, the China Coal Cap Project team holds that China's CO_2 emissions should peak around 2030, and returning to the 2010 level by 2050.[20] On the other hand, an analysis from the London School of Economics indicates that China's carbon emissions will very likely start to decline by 2025.[26] This estimate is five years earlier than the official goal announced in the US–China Joint Statement on Climate Change.

Here we may note some concrete actions on the ground. After the international climate negotiations in 2009, China announced its climate mitigation target, aimed at reducing its carbon intensity by 40% to 45% by 2020, compared to 2005 levels.[27] As evaluated in the recent *Climate Change: A Risk Assessment* study[28] commissioned by the British government, through various effective efforts, including unlocking potentials from the energy system, the growth rate of China's carbon emissions has dropped since 2005, down to almost zero increase by the end of 2014. Moreover, the country's carbon intensity has dropped 33% compared to 2005 – well on track.

The International Energy Agency also found that global CO_2 emissions stalled in 2014, marking the first time in 40 years where a halt or reduction could not be linked to an economic downturn.[29] It attributed part of this to China's contribution – a decline in coal consumption, as well increases in the use of hydro, wind and solar power.

2 Policy and policy drivers for coal and competing energy technologies

2.1 Main policy drivers

China is seeking actively and critically to deal with its heavily coal-dependent energy structure. To some extent this is a result of international pressure, but internal drivers have been important as well. Internationally, the global climate-change campaign has had significant impact on the Chinese government's political will and policymaking as regards its energy and environmental ambitions. Optimizing the country's heavily fossil-based energy system is probably the quickest way to obtain the 'low-hanging fruits' of reducing GHG emissions. Domestically, there are various drivers:

- Climate change has affected China's vast territory. The resultant extreme weather has had wide socio-economic consequences: these include annual losses of over RMB 200 billion and more than two thousand deaths in the past decade,[30] as well as negative impacts on water, energy security and food safety, among other issues.

- Public discontent over worsening air, water and soil quality, with the resultant public health problems, has become a pressing driver for government and business.

- Long-term energy security has been a major concern for the Chinese authorities; with the true costs of coal becoming increasingly evident, it seeks to gain greater independence through renewables.

- New economic imperatives: China has set out to transform its economic engines from manufacturing and infrastructure-centred energy-intensive heavy industries to innovation-driven knowledge-intensive low-carbon sectors. Various low-carbon technologies have begun to prove their competitiveness and economic contribution, along with the creation of green jobs.

2.2 Policies affecting the coal industry

Based on these environmental, energy security and economic drivers, China has recently strengthened and adopted a series of new central policies that affect its coal industry. Table 2 gives an overview of main relevant policy areas and key policy stakeholders.

Table 2. Main policy stakeholders involved in China's coal-related policies

Policy stakeholders	*Policy area*
National People's Congress	Coal legislation
State Council	Action Plan on Prevention and Control of Air Pollution; regulating local officials' environmental record
NDRC	FYP; coal consumption cap in major regions; carbon trading; demand-side management; 1,000 & 10,000 Enterprise Energy Saving Action; National Climate Change Adaptation Strategy; pollutant discharge fee standard; INDC; Plan for Strengthening Energy Industry Air Pollution Prevention Work
MIIT	Clean coal; eliminating old and inefficient industrial capacity; coal consumption cap in major regions
MoF	Coal resource tax; clean coal; pollutant discharge fee standard; coal consumption cap in major regions
MEP	Environmental Protection Law; pollutant discharge fee standard; Plan for Strengthening Energy Industry Air Pollution Prevention Work; coal consumption cap in major regions
NEA	Coal chemical; clean, highly efficient use of coal; FYP for Energy Development; Energy Development Strategy Action Plan (2014–2020); FYP for Hydropower Development; FYP for Wind Power Development; Plan for Strengthening Energy Industry Air Pollution Prevention Work; coal consumption cap in major regions
SAT	Coal resource tax
SASAC	Management of coal-related SOEs

2.2.1 Air-quality policies and environmental governance

According to one analysis from the China Coal Cap Project, coal use accounts for 60% of China's contribution to PM 2.5 (fine airborne particles of 2.5 micrometres in diameter or smaller that cause toxic smog), and again stands out as the foremost cause of air pollution in China today. With the central government's 'battle against air pollution',

local governments are increasingly starting to limit their coal consumption. From 2009 to 2012, 42 provinces and municipalities participated in a countrywide low-carbon development programme.[31] These initiatives are beginning to influence other regions towards choosing alternative development models.

As a response to the worsening air quality and strong public discontent, in late 2013 the central government announced its ambitious Action Plan on Prevention and Control of Air Pollution, involving total investments of RMB 1,700 billion. It initiated a ban on new coal plants in the country's three major metropolis centres and economic engines, with targets for absolute coal consumption caps. A supporting policy was the 2014 Plan for Strengthening Energy Industry Air Pollution Prevention Work, which set a medium-term target of limiting the share of coal in total energy consumption to less than 65% by 2017. Here the aim is to achieve negative growth in the total coal consumption of the Beijing-Tianjin-Hebei area: by 2017, the reduction in coal consumption is to total 63 million tonnes: 13 million tonnes from Beijing, 10 million tonnes from Tianjin, and 40 million tonnes from Hebei.

In September 2014, the Ministry of Environmental Protection (MEP), together with NDRC and the Ministry of Finance (MoF), announced adjustments to the pollutant discharge fee standard and began to implement differentiated charge policy.[32] Following this move by the central government, Shandong province has developed an air-quality ecological compensation policy, and Hebei province has established a ladder-type fiscal reward system for pollution control. Previously, because the standard fee was set so low, companies frequently opted to pay the fine instead of dealing with the pollution. Thanks largely to the multiple measures described above, China's three major economic and urban hubs all achieved close to or over 10% decline in average PM2.5 intensity in 2014: 20%, 9.7% and 14% for the Beijing-Tianjin-Hebei area, the Yangtze River Delta area, and the Pearl River Delta area, respectively.[33]

On 14 January 2015, the NDRC, together with other administrative bodies, followed up by issuing guidelines for implementing the coal consumption cap in major regions.[20] According to these guidelines, by 2017, the accumulated coal consumption in Beijing and Tianjin municipalities and Hebei and Shandong provinces is to be reduced by at least 83 million tonnes. Jiangsu, Zhejiang and Guangdong provinces and Shanghai municipality are requested to submit their targets for a coal consumption cap. This policy covers the country's three economic hubs – Beijing-Tianjin-Hebei, Yangtze River Delta, and the Pearl River Delta, as noted above.

Potential pressure on the coal industry was added when, in April 2014, the first major amendments since the 1990s were adopted to the general Environmental Protection Law of China. These feature stronger punishment measures, environmental impact assessment, public monitoring, among other points. The NDRC and the Environment and Resource Protection Committee of the National People's Congress were in charge of the amendment process. With these amendments, local

environmental protection bureaus will be allowed to impose daily fines on polluters, instead of charging the previous one-off fixed amount. According to the MEP, in the first four months since the amended legislation came into effect, the ministry processed 160 cases of fines, amounting to over RMB 112.29 million. The highest individual case was a fine of RMB 15.8 million imposed on Shaanxi Carbonification Energy, a coal-centred energy company.

The revised law also makes it possible for NGOs to bring public interest lawsuits against polluters. On 1 January 2015, the Fujian Nanping Intermediate People's Court received a lawsuit against an illegal mining case, submitted by two local NGOs, the Friends of Nature and the Fujian Green Home – the first of its kind since the launch of the new law.

The State Council (China's cabinet) and its Deep Reform Leadership Group have also issued rules whereby the environmental record of local officials will be taken into account in performance assessments. Moreover, officials can be held responsible for environmental damage even after having left where the damage took place: 'life-long traceability'. Coal has been identified as the key to the government's high-profile 'battle against smog'. One arguably unique feature of the Chinese government's policy implementation has been its top–down authoritative effectiveness towards immediate tasks, despite various debates about its efficiency. A wide range of coal-focused public policies from relevant agencies have been issued and implemented, helping to contribute to China's decline in coal consumption in 2014.

2.2.2 Climate policy

The US–China Joint Statement on Climate Change announced in November 2014 was of unprecedented importance. This was a climate-change pact targeting both countries' carbon emissions by 2030, the first overarching carbon emissions target China had ever set for itself. One of China's promises is to increase its consumption of non-fossil fuels up to around 20% in the country's energy structure. If this goal is achieved, it will not only benefit China's domestic and global climate ambition, but also, considering the country's significant energy demand and market size, will create better scale effects, lowering the cost of non-fossil fuel technology worldwide.

China's Intended Nationally Determined Contributions (INDC) says something about its interest and ambitions. The INDC re-states the goal of reaching the CO_2 emissions peak around 2030, or earlier if at all possible, and increasing the share of non-fossil fuels to around 20% in the primary energy structure by the same year. It also aims to reduce carbon intensity by between 60% and 65%, and increase the forest stock volume by 4.5 billion cubic meters, both compared to 2005 levels.

The Chinese government has taken the initiative to establishing a nationwide carbon market, to control carbon emissions through market-based efforts. Based on the existing seven local trading infrastructure pilots in five cities and two provinces, China aims to build a national carbon market by 2017,[34] set to become one of the world's largest carbon

trading markets. China's pilot carbon trading was initiated in 2013, and the last of its seven pilot projects was initiated in Chongqing in June 2014.

Industrial enterprises dominate the piloting lists. In the first pilot project, Shenzhen, eight deals were made on 18 June 2013, involving three companies and five individuals, at a price of RMB 30 per tonne, slightly above the EU level. The over 150 enterprises in the Hubei Province pilot range from iron and steel, chemical engineering, cement, to electricity. The Shanghai pilot seems more inclusive, focused on economic structure; in addition to heavy industry, it also covers such service industries as hotels, train stations, shopping malls and commercial banks.[35] From the beginning, work on this carbon market has been supported under the 12th FYP for Controlling GHG Emissions Work Plan. Drawing on lessons learnt from the seven projects, in December 2014 the NDRC issued the Provisional Measures for the Administration of Carbon Emission Rights Trading, for the later establishment of a national market.

Taxation is another carbon price instrument under discussion. A new coal resource tax was introduced in 2014, under the Circular on Implementing the Coal Resource Tax Reform, released jointly by the MoF and the State Administration of Taxation (SAT). The motivation for this resource tax reform, launched in 2011, is broader than responding to climate and air pollution problems. It must be seen against the background of larger economic and energy reform programmes initiated in China (see below); the recent coal tax reform was preceded by similar reforms in oil and gas taxes. The coal industry has long had a high taxation burden, subject to as many as 21 taxes and 88 fees, in total 109 items.[36] The current reform promulgated by the Chinese government should be viewed as an effort aimed at simplifying this complex system by removing a series of fees and replacing the previous volume-based tax with a price-based mechanism.

Many coal taxes are local one, as is the new resource tax. While introducing national standardization, the tax maintains flexibility for local governments to determine the tax rate within the range 2–10%. Local governments highly dependent on coal for local revenues have tended to set higher tax rates – for instance, Inner Mongolia (9%), Shanxi (8%), Ningxia (6.5%), and Shaanxi (6%), all major coal-producing provinces. Against the backdrop of the economic hardships for the coal industry, some local governments have seized the opportunity to lower the total tax burden of the industry. In Shanxi, for instance, the government has removed various fees, including the compensation fee of mineral resources, the fund for coal price adjustment, as well as the fund for sustainable development of coal. Consequently, the actual burden rate of tax and fees has dropped from 10.6%[37] to the current 8%.

When launching a sub-report in March 2015, the China Coal Cap Project, together with the MoF, proposed that China should continue its tax reforms by launching an environmental protection tax in 2016 and a carbon tax at a low tax rate by around 2019. [38]

Besides the climate mitigation focus, China's National Climate Change Adaptation Strategy, launched in 2013, has impacts on the coal industry, often indirectly. Coal combustion has caused severe problems with regard to water resources, human health, ecosystems, social sectors, and various other issues, many of which overlap with climate adaptation priorities. Thus, China is sincerely seeking a substantial reduction in its reliance on fossil fuels. Internal drivers here include its economic transformation, control of air pollution, the need to ensure energy security, and avoidance of climate change-related extreme weather.

2.2.3 Policies for restructuring the national economy and energy system

China has seen its annual economic growth drop from double-digit figures in GDP in the early 2000s, lifting hundreds of million people out of poverty, to around 7% per year from 2012. Rapid growth brought many challenges, including high inequality, rapid urbanization, challenges to environmental sustainability, and external imbalances. The 12th Five-Year Plan (2011–2015) thus highlights transforming the industrial engines of growth, from manufacturing and infrastructure-centred energy-intensive heavy industries, to service industries and innovation-driven knowledge-intensive low-carbon sectors. The 12th FYP aims to increase the share of service industry to 47% by 2015, from 43% of GDP at the end of the 11th FYP. The National Climate Change Plan (2014–2020) issued in 2014 even aims at 52% by 2020. It is reasonable to expect a slow-down in coal consumption under the new economic system.

Parallel Chinese energy policies include plans that could reverse the pre-2014 growth in coal consumption. Under the Energy Development Strategy Action Plan (2014–2020), the Chinese government has indicated a total consumption cap of primary energy of around 4.8 billion tonnes standard coal, and a coal consumption cap of 4.2 billion tonnes by 2020 (corresponding to 62% of total primary energy consumption).

Changes to the Chinese *electricity* system have been evident, in turn a result of reform policies evolving from the early 2000s. Here, we can note a peak in the growth of new coal capacity added in 2006 (more than 90 GW installed), with less capacity added annually since then (39 GW in 2014).[39] This period saw an investment boom took place in renewable electricity, supported by China's evolving economic incentive policies.[40]

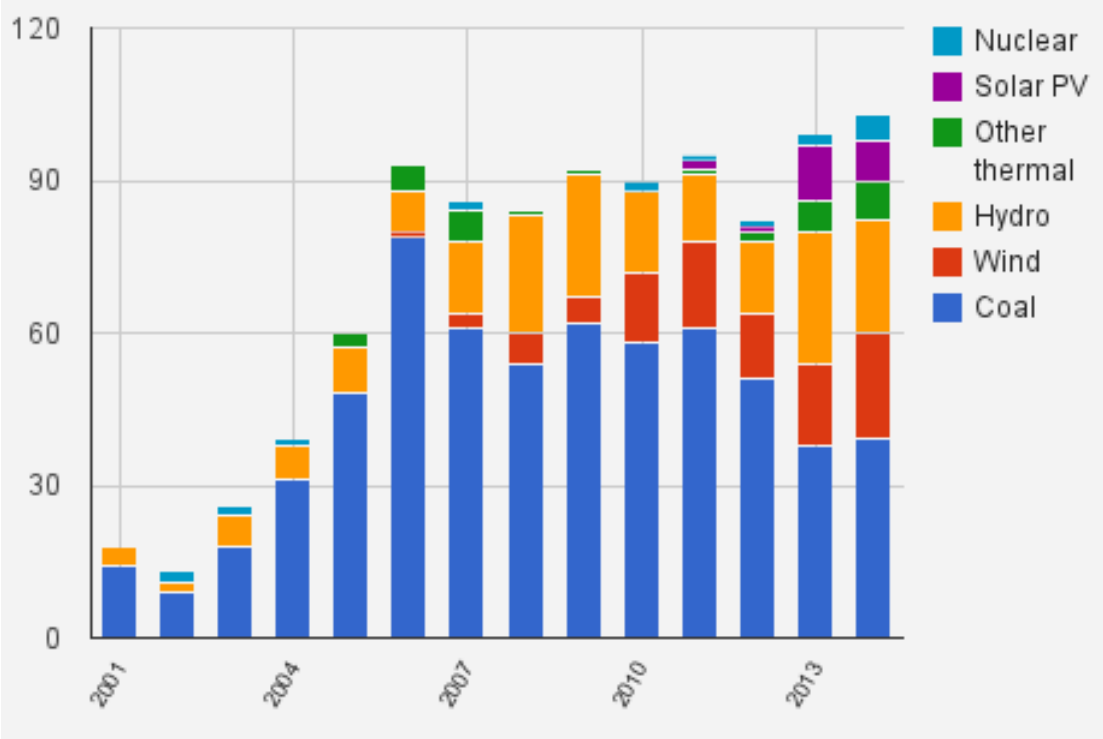

Figure 5. China Power Grid Capacity Additions, 2001–2013, GW (net retirements)

Source: *COALSWARM/Sierra Club, 2015*[41]

At present, China is home to about one quarter of the world's total investment in renewables. China's installed windpower capacity has surpassed one third of the world's total volume, and the capacity added in 2014 was almost half of the world's total volume. In 2005, China had 700 megawatts of installed solar power capacity; the figure had soared to 28 gigawatts by the end of 2014 – a 40-fold increase in less than 10 years. Some observers hold that China might become the world's top solar-power generating country by the end of 2015.[28] The Energy Development Strategy Action Plan (2014–2020) and the 12th FYP for Energy Development (2011–2015) set the target of a 11.4% non-fossil share in the energy structure by 2015 and a 15% share by 2020, to include 200 GW windpower and 100 GW solar-power capacity.

Energy system restructuring also includes a range of energy-efficiency policies. Efforts have been made to improve the energy efficiency of major energy-consuming enterprises, through the government's flagship 1,000 Enterprise Energy Saving Action (launched in 2005 under the 11th FYP) and the 10,000 Enterprise Energy Saving Action under the 12th FYP. Part of this effort has targeted coal-based power consumption. The energy efficiency of China's best coal power plants has reached the world's top level, and the average of all its power plants is steadily climbing: coal consumption per kilowatt of its coal power plants is less than 290g. This, in conjunction with changes in economic structure, have

contributed to a lessening of energy intensity – by the end of 2014, energy intensity had dropped 30% from 2005.[28] Concurrent emission reductions in the 11th FYP (2006–2010) exceeded the amount achieved by the European Union under the Kyoto Protocol.

The 12th FYP for Energy Development set the target of a 16% improvement in energy intensity by 2015 against the 2010 level. The Ministry of Industry and Information Technology (MIIT) is the designated government agency in charge of eliminating old and inefficient industrial capacity under the 12th FYP, with responsibility for 19 industries – seven more than the previous FYP. The aim is to achieve reductions of 10 million tonnes of iron, 7.8 million tonnes of steel, and 219 million tonnes of cement, by the end of 2015.

In May 2015, MIIT and MoF jointly released an action plan on clean and efficient use of coal for the industrial sector 2015–2020, aimed at saving more than 160 million tonnes of coal consumption by 2020. China currently has some 620,000 coal-fired industrial boilers, with annual coal consumption exceeding 700 million tonnes. The action plan focuses on four major coal-consuming industrial sectors – coking, industrial furnaces, coal chemical, and industrial boilers. For the coal chemical industry, the recent significant drop in international oil prices is likely to lower the cost of petro-chemical products, adding downward pressure on coal demand. With the emerging viability of oil, as well as environmental considerations, the government is said to be scaling down its coal-to-gas and coal-to-oil projects.

After the rapid growth, driven by overwhelming domestic demand, from the second half of the 10th FYP and throughout the 11th FYP, the downstream demand of the coal industry begun to decline by late 2011. China has started to embrace the 'New Normal' economic imperative: this refers to China's era of relatively slower growth (albeit of higher quality), following three decades of double-digit expansion. The economic contribution from electricity, steel and iron, chemical engineering, and cement is starting to decrease. Under these circumstances, the depression of the coal industry is expected to continue for some time to come.

Even more comprehensive energy sector reforms with implications for the coal industry are currently in the making, however. In April 2015, the central government issued four documents signalling a wide-ranging reform of power supply. China's State Council Document #9 set general guidelines for the reform, emphasizing greater use of market mechanisms, injecting competition and diversification of supply to break up current monopoly structures. The document did not offer details on how these measures would be implemented, leaving that task to supporting releases from other ministries.[42] It did, however, give specific support of demand-side management (DSM) to improve energy efficiency and increase the share of renewable energy and distributed generation, an area pioneered by NRDC in China. The second document, issued by the NEA, specifically mentions DSM as a tool for integrating renewable energy into the grid, allowing utilities to use price signals directing sources of flexible electricity demand (like electric vehicles) to

draw power when renewable energy is available. The third and fourth documents were issued by the NDRC and concern specific pilot projects in the field of power sector reform and DSM.

The proposal would continue reforms that have roots back in the late 1970s, when China began its transition away from a planned economy.[43] Initially, these reforms installed a hybrid pricing system for coal into state-owned electricity generation (a certain quantity sold at planned rates to keep power tariffs low, while the excess could be sold at market prices). The price and quantity of 'planned coal' became subject to contract negotiations between coal producers and power producers at annual conferences hosted by the NDRC. Between the 1990s and the first years of the new century, the NDRC gradually reduced its role, and power producers were forced to buy a growing proportion of non-planned coal at higher costs.[44] When coal prices shot up between 2000 and 2012, power producers were frequently forced to operate at a loss, which dis-incentivized them from investing in the newer infrastructure or alternative technology. From 2012, falling demand and oversupply brought both Chinese and international coal prices down, lessening the gap between market and planned coal prices and leading the State Council to abolish the dual-track pricing system for coal. This boosted collective profits in state-owned power generation companies, even if end-user prices were capped, in turn creating leeway for new investments and further reform experiments.

3 Energy-restructuring challenges

Notwithstanding the strong national drivers of energy restructuring that contributed to the 2014 decline in coal consumption, China faces many challenges in its efforts to further modernize its energy system.

First of all, the country is rich in coal, but lacks oil and gas. Coal accounts for 94% of China's identified fossil reserves, representing over 13% of total global volumes.[45] This makes coal an important security-of-supply parameter. However, high-quality coking coal and anthracite coal are rare. In known reserves, bituminous coal predominates, over 73%.[46] This poses an extra challenge for China in balancing concerns for security of supply with environmental protection.

Coal deposits can be found almost everywhere in China, except for Shanghai, although most of the country's coal reserves are located in its northern and western regions. The area of Shanxi, Shaanxi, Inner Mongolia, Ningxia, Henan and Gansu together contains close to 69% of the country's total basic reserves. Naturally, China's coal strategy cannot ignore the 'journey to the west'. In southern China, coal resources are concentrated in three provinces – Guizhou, Yunnan, and Sichuan, altogether accounting for close to 8% of total basic reserves.[46]

Table 3. Distribution of basic reserves over one billion tonnes, by region, 2012

Region	Reserves (in billion tonnes of standard coal)	Share	Region	Reserve (in billion tonnes of standard coal)	Share
Shanxi	90.84	39.52%	Yunnan	5.91	2.57%
Inner Mongolia	40.17	17.47%	Sichuan	5.45	2.37%
Xinjiang	15.25	6.63%	Hebei	3.95	1.72%
Shaanxi	10.90	4.74%	Gansu	3.41	1.48%
Henan	9.91	4.31%	Ningxia	3.23	1.41%
Anhui	8.04	3.50%	Liaoning	3.19	1.39%
Shandong	7.97	3.47%	Chongqing	1.99	0.86%
Guizhou	6.94	3.02%	Qinghai	1.60	0.69%
Heilongjiang	6.16	2.68%	Jiangsu	1.08	0.47%

Source: *China Statistical Yearbook 2013;* China Lianhe Credit Information Services

While the geographical distribution has benefited regional industrialisation and growth, this cannot mask the fact that most of the resource-rich northern and western regions are located at great distances from the energy and electricity-consuming economic and urban hubs to the east and south, where most people live. These areas face the highest air pollution problems and pressure for capping new coal power plants. An alternative would be further construction of coal-power in resource-rich regions, with transmission lines to the south and east – but this is not a resource-efficient solution with distances greater than 1,800–2,000 km, nor is it an environmentally sound solution.[18]

Restructuring China's energy system from its extreme coal dependency poses great governance challenges, not least since the coal industry enjoys a prominent strategic position in the national and local economies.

Local governments became important players in China's coal industry after the reforms in the 1970s. A 'revenue-sharing system' for state-owned enterprises was introduced between central and local governments and the central government's monopoly over the coal industry was reduced, providing opportunities for non-state rural enterprises. A 'two-level' central and local administration evolved. Responsibility for granting permission to and administering small-sized coal mines was transferred to the local government, which spurred coal production.[47] Sub-national governments and foreign companies were allowed to invest in electricity generation and infrastructure, boosting rural electrification. In the 1990s, a tax-sharing system replaced the revenue-sharing system. The central government moved towards regulation and macroeconomic management, and administration of more coal mines was decentralized to local authorities, with the exception of the Shenhua Group. One result was the fragmented structure of the Chinese coal industry. A study conducted by the China Coal Research Institute, as part of the China Coal Cap Project, shows that by 2013, there were 12,000 mines in China, less than 1,000 of them with annual capacity of over 1.2 million tonnes.

Local governments exerted strong influence over the behaviour of the mines in the market, to boost the local economy and maximize the local tax revenues. Illegal mining with poor safety records evolved as a problem under the protection of local governments or certain officials, with around 70% of the world's mining deaths occurring in China,[48] most often in small-sized private illegal mines. Over 9,000 such mines, three-quarters of the overall number of mines in China, contribute one third of the country's entire coal production, but cause two-thirds of all mining deaths. The death rate per million tonnes of production is three times higher for small private mines than that for large state-owned enterprises (SOEs), and twice as high as the total average level. That being said, 8 of the 14 major accidents in 2014 took place in SOEs, resulting in 140 deaths – 61% of that year's total toll.[49]

Corruption has been another serious problem. Numerous SOEs and major coal-producing provinces have been significantly affected. Recently, two senior executives from China's largest state-owned coal businesses were found guilty, and resigned their representative status at the Beijing People's Congress. They were Cao Jingshan, former deputy general

manager of Datang, and Xue Jilian, former deputy general manager of Shenhua Group and vice president of Shenhua Energy.[50] The phenomenon is in fact widespread. In November 2014, the inspection team of the Chinese Central Party Committee conducted a round of investigations at Shenhua. After that, the country's largest coal company lost several senior management members, including the former CEO of Shenhua Technology and the former vice president of Shenhua Energy.[51] In May 2015, at Shenhua, the inspection team announced party disciplinary punishment of 20 members. The team circulated notices of criticism to 32 members, and removed the qualifications of four evaluation experts for violating the company's internal bidding policies.[52] At the central level, in May 2014, the former deputy director of the coal department of NEA was investigated for corruption. Later that year, over RMB 200 million in cash was found at his home.[53]

In local government, Shanxi province undoubtedly has attracted most media attention. In May 2015, in the coal-producing city of Jincheng, four coal and economic officials were investigated for corruption. These persons were responsible for business areas ranging from coalbed methane (CBM), land and resources, to the local economic and technological development zone. In Gaoping town under Jincheng, known for its abundant coal and iron resources, all three mayors of the past decade were investigated in 2014 for corruption.[54] Jincheng has not only China's best anthracite coal, with roughly one quarter of the country's discovered reserves, but also CBM fields of the highest exploitation value, respectively 70% and one third of Shanxi province's and national total reserves. The Shanxi provincial administration has suffered severe collapse in the anti-corruption campaign, mainly associated with the coal industry.[54]

The central government has taken steps to assume greater control of the industry. Since 2013, the dedicated State Administration of Coal Mine Safety has contributed to shutting down over 3,000 mines (of under 90,000 tonne capacity), and China has now achieved its historically lowest level of major accidents.[55] Undoubtedly, SOEs have a much stronger political mandate for operating responsibly, and are certainly far better placed to do so than small, private mines, in terms of finance, technology, and human resources. Nevertheless, their large production scale and high numbers of workers often become a barrier to ensuring safety.

Since around 2005, the Chinese coal industry has witnessed an intense wave of *Guo Jin Min Tui* ('国进民退'): 'the state advances, the private sector retreats'. The central and local governments have wanted to take control of uncountable small-sized mines, especially in Shanxi province. From late 2008, the Shanxi provincial government started implementing a policy that introduced large state-owned coal enterprises that would take over small private mines. Unsurprisingly, this was strongly resisted by the mine owners, including some non-local investors.

Since the 2008 financial crisis, as the coal price plummeted and downstream demand continued to decline, the coal industry saw new low-cost opportunities for re-structuring. The central and local governments promoted policies in favour of integration of coal resources. The 12th FYP of Coal Industry Development, issued in March 2012, proposed support from the national authorities for cross-region, cross-industry and cross-ownership merger and re-structuring of large-scale enterprises with advantages in capital, technology and management, as well as support for integrated, scaled-up and concentrated operations in coal exploration, power generation and transport. A few larger groups – like the Shenhua Group, the China Coal Energy Group and the Datong Coal Group have since increased their market share.

The continuing decline in demand was accompanied by widespread losses in the coal industry in 2014. The China National Coal Association (CNCA) showed in a recent survey that, in the first two months of 2015, over 80% of China's 90 major coal companies sustained losses of altogether RMB 13.1 billion, whereas their profits in the same period the previous year had been RMB 11.2 billion.[56] Some small and medium-sized businesses of weak financial capacity had to sell off properties to maintain the cash flow: or they simply quit the business. China's large-scale coal businesses, especially those with strong financial capacity and secure financing channels, will experience tremendous opportunities to expand at low cost in the coming years. This is bound to result in greater industrial concentration.

The 'advancing state' is likely to go even further, under the ongoing reform of SOEs. Thus far, there has been the major merger of China Power Investment Corporation and the State Nuclear Power Technology Corporation in the electricity sector, as well as the China South Locomotive & Rolling Stock Corporation and the China North in the transport sector. Something similar may take place also in the energy sector, between Shenhua and China Coal, the country's top two coal companies, in view of today's industrial over-capacity and the future possibility of production limits and integration. In particular, under the government's next-step ambitious international economic initiative, 'One Belt One Road', a merged group will have a bigger say in overseas acquisitions. No national assets would be lost in the merger of these two SOEs. In view of the fragmented industry, a merger of the two would not create a barrier to competition: in 2014, the total output of both Shenhua and China Coal was merely 16% of China's total production of 3.87 billion tonnes that year.[57]

Stronger central control over the coal industry could facilitate the continued energy-system transition. On the other hand, the local political economy of the coal industry is very important in parts of China, notably in certain inland regions where economic activity is relatively low due to lack of ready access to coastal export-oriented manufacturing opportunities. Here, small mines play a significant role in creating employment and generating income. The Chinese centralized fiscal system has resulted in local governments' almost perpetual lack of funding, compelling them to seek additional revenue sources. Supporting local mines – often small-scale, scattered and poorly regulated – can be in

the interest of local governments and some individual officials, at the cost of standing against the will of the central authorities.

Employment in the industry of coal exploration, washing and dressing currently employs over 5.8 million people in China. This number will go down as technology and productivity advance. Estimates show that, even without any coal cap policies, the figure will shrink to 1.6 million by 2050; and if coal cap policies are implemented, another 720,000 jobs will disappear.[58] The current low coal prices are now spurring job losses in the coal industry. A report issued in May 2015 found that half the mines in Inner Mongolia, home to China's second-largest coal reserves, were either not producing at all or were producing at half capacity. Over 100,000 people are estimated to have lost their jobs as a result.[59]

However, as coal consumption continues to fall, there will be growth opportunities in the fields of manufacturing, installation, maintenance and service of energy savings and renewable energy technologies. According to estimates from the Chinese Academy of Social Sciences,[58] wind and solar power have substantially higher employment capacity than does coal power. By 2050, the direct employment opportunities in power generation, power supply, and power-generating equipment manufacturing will increase by some 413,000, indirectly triggering a further 3.5 million jobs in the broader economy. According to the International Renewable Energy Agency (IRENA), China's renewable energy efforts have already created 3.4 million jobs. China leads global employment in solar PV, wind, solar heating and cooling, small and large hydropower, biomass and biogas.[60] A main challenge will be to develop employment skills in renewable energy and energy efficiency-based industries in regions facing hardship in the coal industry.

Various governmental policy stakeholders have crucial roles to play in efforts at transitioning and rebalancing towards a greener energy system. The government has some critical decisions to take, in order to ensure cross-departmental policy coherence. On the one hand, it is seeking to reduce the reliance on coal significantly and to increase the share of renewable energy, in view of the need to embark on a low-carbon growth pathway and also take advantage of the socio-economic co-benefits. On the other hand, the transition must be engineered with great care, so that major coal-producing provinces and businesses can deal smoothly with the challenges concerning employment, regional development and many other issues.

Current power-price liberalization efforts, an important goal of the Chinese Communist Party (included in the Third Plenum communiqué in 2013), is also a challenging endeavour for the government. Full price liberalization could entail higher costs across the economy. For this reason, the greatest challenge to power liberalization is likely to come not from the power producers, but from consumers, especially industry (responsible for 87.25% of total power consumption in 2013). This can prove risky for the Chinese government. It would provoke powerful opposition and expose power prices to volatility in coal prices and in electricity demand, removing an element of control that the Chinese government has been long accustomed to holding. The long-term payoff

will be a power sector that responds flexibly to changing market conditions, allocates capital effectively and invests in cleaner fuel sources.

Summing up, coal is China's major energy source and material for chemical engineering. The coal industry has proven its significance to socio-economic development, evident in its contribution to economic growth, energy supply and security, employment and regional development. Popular demands for environmental protection and economic restructuring to sustain growth rates are important drivers of the current energy system transition. This transition is a complex matter, entailing more than the simple elimination of coal in the near term. In addition to ensuring a cost-effective and stable energy supply to the nation's rapidly urbanizing society, it will be essential for Chinese politicians to take local poverty, alternative jobs, and other politico-economic factors into consideration when drafting a package of policies. Reform will have to include appropriate policies for supporting transfer of the coal industry, customizing taxation and other fees, and developing clean and efficiency technology for coal exploration and use.

4 Corporate indicators of change: Shenhua Coal

This section examines signs of the transition 'on the ground' in China, as represented by the major coal company Shenhua. Understanding behaviour at the industry level is crucial, if the transition is to succeed. Industries are important causes of the environmental problems spurring the transition, but they are also essential as regards developing the solutions. Shenhua is a central SOE, a group that also includes China Coal, as well as more recent entries, five major power companies in particular: the China Huaneng Group, Datang, China Huadian Corporation, China Guodian Corporation and China Power Investment. China's coal-industrial landscape also includes local SOEs, integrated under pressure from provincial governments, such as Shandong Energy and Henan Coal Chemical, and private companies, many emerging in Inner Mongolia in recent years, like the Yitai Corporation, Yidong Investment, Mengtai Coal Power and Huineng Coal Power.

Table 4. China's top 10 coal-producing companies, 2010–2012, output in million tonnes

Rank 2010	Rank 2011	Rank 2012	Name of company	Ownership	2012 Output
1	1	1	Shenhua	SOE	456.65
2	2	2	China Coal	SOE	175.52
4	3	3	Shanxi Datong Coal	Local SOE	132.67
NA	5	4	Shandong Energy	Local SOE	122.92
7	6	5	Hebei Jizhong Energy	Local SOE	115.64
5	7	6	Shaanxi Coal & Chemical	Local SOE	113.68
3	4	7	Shanxi Coking Coal	Local SOE	105.40
10	NA	8	Hebei Kailuan	Local SOE	83.54
8	9	9	Shanxi Lu'an	Local SOE	80.08
NA	10	10	Shandong Gunkuang Mining	Local SOE	76.17

Sources: *CNCA, NBS, and China Lianhe Credit Rating*

In recent mergers, a few leading mega-companies have gained increasing capacity and influence. Shenhua has maintained an unchallenged lead, with annual output over 400 million tonnes. In the second tier of companies we find a mixture of central and local SOEs with production

exceeding 100 million tonnes but less than 200 million tonnes. No private company is yet ranked among the top ten coal businesses in China by production capacity.

Shenhua, founded in 1995 and one of the 53 large-scale SOEs directly administered by the central authorities, is the world's largest coal supplier. It ranked no. 178 in the 2013 Fortune Global 500, and owns 80% of China's mega-mines of over 10 million tonnes capacity. Shenhua is integrated with electricity, railways, ports, shipping, coal-to-oil, coal chemical and other diversified businesses. Its rate of corporate economic contribution has for many years topped the country's coal industry, with high annual profits among all the central SOEs.

However, Shenhua has not escaped the depression and low coal prices that have affected the entire national industry lately. Its total output of commercial coal in 2014 was 307 million tonnes, a 3.6% drop compared to 2013, with coal sales of 451 million tonnes – a 12.4% drop. Its management members in the major coal-producing Ningxia province have decreased their salaries since May 2015, with cuts as high as 40% in some cases. Following that, Shenhua headquarters announced that the total salaries paid to its entire staff would be cut by 10% in 2015.

In recent years, Shenhua has enjoyed a high standing in the market, thanks largely to its mature non-coal business portfolios. These include electricity generation, coal chemical, and transport – all helping to offset the crushing impact of falling coal prices. In response to the crisis and government policies, the company has taken further steps towards diversifying and decarbonizing its portfolio:

- adjusting coal mine output and product structure, and reducing annual production by 45 million tonnes in 2014;
- greening power generation, reported as the fifth largest windpower operator in China (5.5. billion kW wind and solar capacity), with ten plus all future coal-power generating units with near-zero SO_2, NOx and particle emissions, in addition to having China's first carbon capture and storage (CCS) demonstration project of 100,000 tonnes annual capacity operating in Inner Mongolia;
- structural optimization, through expanding cleaner energy programmes such as shale gas, wind power, and electric car batteries;
- in the production, storage, transportation and combustion of coal, Shenhua has adopted a close-loop transport system to reduce dust, and has improved the treatment of mine water, industrial wastewater, sewage and other wastewater, to reduce the COD.
- shifting the focus of the drivers of profit, from coal mining to clean energy.

Shenhua has also extended this strategy abroad. For instance, in 2014 the company initiated a windfarm project in Tasmania, Australia, the agreement on which was signed in the presence of the leaders of both countries. Initial project capacity is 30 megawatts, with a total investment

of AUD 60 million. Feasibility studies and environmental assessments are currently being undertaken.

The company's report for the first half of 2014 reported that the non-coal portfolio share of the business had grown to 55% of total business, with profits for these activities increasing by 10.8% from the same period the previous year. According to the 2014 budget, capital expenditure invested in coal portfolio accounted for only 12.2% of the total, whereas investments in electricity generation and transportation portfolios were 38.1% and 42.9%, respectively. As regards electricity generation, between late 2014 and early 2015 Shenhua won several contracts, located in Quanzhou of Fujian Province, Jiujiang of Jiangxi Province, Beihai of Guangxi Province, Weinan of Shaanxi Province, and Anqing of Anhui Province. Electricity generation is expected to become a major portfolio in the company's overall business structure.

Company sources report that Shenhua pays close attention to the issue of climate change. It seeks to develop relevant solutions by focusing on clean energy and low-carbon technologies, recycling industries, CO_2 emissions reduction and other aspects, with proactive exploration for a low-carbon transformation of the traditional energy industry. Coal-mine gas power-generating technology is under development.

Shenhua mentions the following aspects of its broader CSR programme:

- safe production: death rate is 0.002 to 0.004 per million tonnes – one tenth of that of the US coal industry;
- resource conservation, energy saving, emissions reduction and environmental protection: highest emissions standard, and over 85% recovery rate in coal mining – 10% above the national requirement;
- contribution to the regional economy: working with local governments and societies in its core mining areas in north Shaanxi and Erdos of Inner Mongolia;
- active participation in philanthropy, including environment and biodiversity-related public interest activities;
- technological innovation;
- human resource development.

According to the company, investments to energy-savings and environmental protection was up from RM2 billion in 2012 to RMB 7 billion in 2013,[61] with a drop to 4.5 billion 2014 – the latter probably reflecting the company's general economic downturn in 2014.

In analysing Shenhua's corporate environmental strategies, it is essential to recognize the unique characteristics of SOEs in China, and especially Shenhua's position as a major and significant SOE. Since 2008, the state-owned Assets Supervision and Administration Commission (SASAC) has requested central SOEs to develop their CSR, including the environmental dimension. It lies within the responsibilities of Shenhua, as

a state-owned economic body, to ensure and even champion collaboration with government policies, and to take the public interest into full account.

Concerning *regulatory drivers*, many of the industrial policies mentioned above require major coal businesses like Shenhua to comply, participate and contribute. From the FYP major enterprise energy-saving policies, to the emissions-trading scheme and the more recent air-related energy-intensity requirements, the pressure for compliance is unprecedented. In contrast to small businesses that are difficult to regulate, there is a specific supervisory body, the SASAC, dedicated to monitoring, managing and externally driving the completion of each target. Market forces may provide powerful economic reasons, but the regulatory driver pulls the trigger, enabling immediate response.

Under such regulatory pressure, and with the declining coal industry, a *risk-avoidance strategy* entails diversifying the business portfolio, gradually shifting from fossil fuel and building strength in integrated energy-technology solutions. With low-carbon industry emerging as a definite trend of the future, frontier business groups are embracing the *new imperative of economic competitiveness*, and investing in low-carbon energy technologies and environmentally friendly solutions.

5 Main Conclusions

This report has presented an overview of trends in the Chinese energy system and recent policies and policy drivers that signal a potential discontinuation of the 'golden age' of continued growth for coal in China. It has briefly discussed the counterforces and challenges facing China in shifting its energy system from coal to low-carbon energy solutions.

Some 90% of China's carbon emissions come from the consumption of fossil fuels, 68% of which are attributed to coal combustion. In 2014, however, coal consumption in China saw its first decline since the start of the century, a year when growth continued in the use of alternative renewable energy sources and China continued to use its energy more efficiently.

With stronger environmental activism from the growing urban middle class, constructing a balanced and sustainable development model has become increasingly important. It was empowered public opinion that triggered the government's high-profile 'battle against smog', as well as unlocking the potential for more deeply involved civil society on related issues, ranging from toxic air pollution, acid rain, public health and solid waste to water pollution.

All trends point to the necessity of a less-polluting energy system, to be achieved largely by reducing reliance on coal as well as on other heavy fossil fuels. China has already started to respond to this need, having implemented policies aimed at restructuring the economy, optimizing the energy structure, reducing coal consumption, and triggering business championship.

The Chinese leadership has recently promoted the concept of 'eco-civilization', in the pursuit of a prosperous, thriving and sustainable society. This overarching guiding principle is being incorporated into the country's economic, political, cultural, and social development. Building an ecological civilization entails changing not only the industrial structure and production mode, but also human consumption behaviour and lifestyles. This is the first time that the Chinese government has raised environmental issues to such an unprecedentedly high level of significance.

Most recently, a fifth component, 'greening', has been added to the government's overarching modernization principles. Recognizing the need to transform itself into a robust knowledge-competitive economy, and also taking the leadership role of addressing global climate change issue as a responsible great power, China is firmly set to embark on the path to a low-carbon future.

This will not be an easy transition to navigate. While stepping up its efforts against polluting coal, the government must take into consideration the coal industry's tremendous significance for the national economy and the hundreds of thousands of families who depend on its labour-intensive extraction. Perhaps some of the losses may be offset by China's growing renewable energy industry, but it will take more than an

economic narrative to succeed in this, because policymakers will have to balance the interests of various deeply-involved stakeholders – not least, the major coal-dependent provinces and the heavyweight central SOEs. The political economy and social aspects of the transition may give rise to incoherent and sometimes conflicting industrial policies.

Despite the macro-trends, it is up to each individual company to choose whether to lead and stay ahead of the game by drawing together technology, capital and human resources to become a champion of green competitiveness. This report has indicated how the world's largest coal company, Shenhua, is adapting and shaping itself for new socio-economic expectations, diversifying its business portfolios and enriching its corporate environmental strategy. Shenhua is responding to China's new economic imperative and the global low-carbon agenda both by complying with the necessary regulations and by seizing emerging alternative opportunities in non-coal portfolios. This has played a critical role in offsetting the crushing impact of declining coal prices. The company is investing heavily in decarbonizing its operations and innovating emission-reducing solutions, while also implementing more elaborated corporate environmental strategies. Shenhua's documented experience and the potential drivers can offer important lessons for other coal companies as well as for the broader community of observers.

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The Fridtjof Nansen Institute (FNI) is an independent foundation engaged in research on international environmental, energy and resource management politics and law. Within this framework the institute's research is mainly grouped around seven focal points:

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- European energy and environment
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The main disciplines are political science and international law, but FNI researchers also hold degrees in economics, geography, history and social anthropology, and have special language and regional expertise on Russia and China.

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of sulphur dioxide and nitrogen oxide of respectively 46,000 tonnes and 174,000 tonnes. The company invested RMB 497 million in reclamation, and newly added green area exceeded 18,500 square kilometres. The remaining RMB 1 billion+ was used for energy-saving projects, focusing on renovation of the boilers, co-generation, frequency transformation, waste heat and pressure utilization, marked by a total saving of 320,000 tons of standard coal.

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