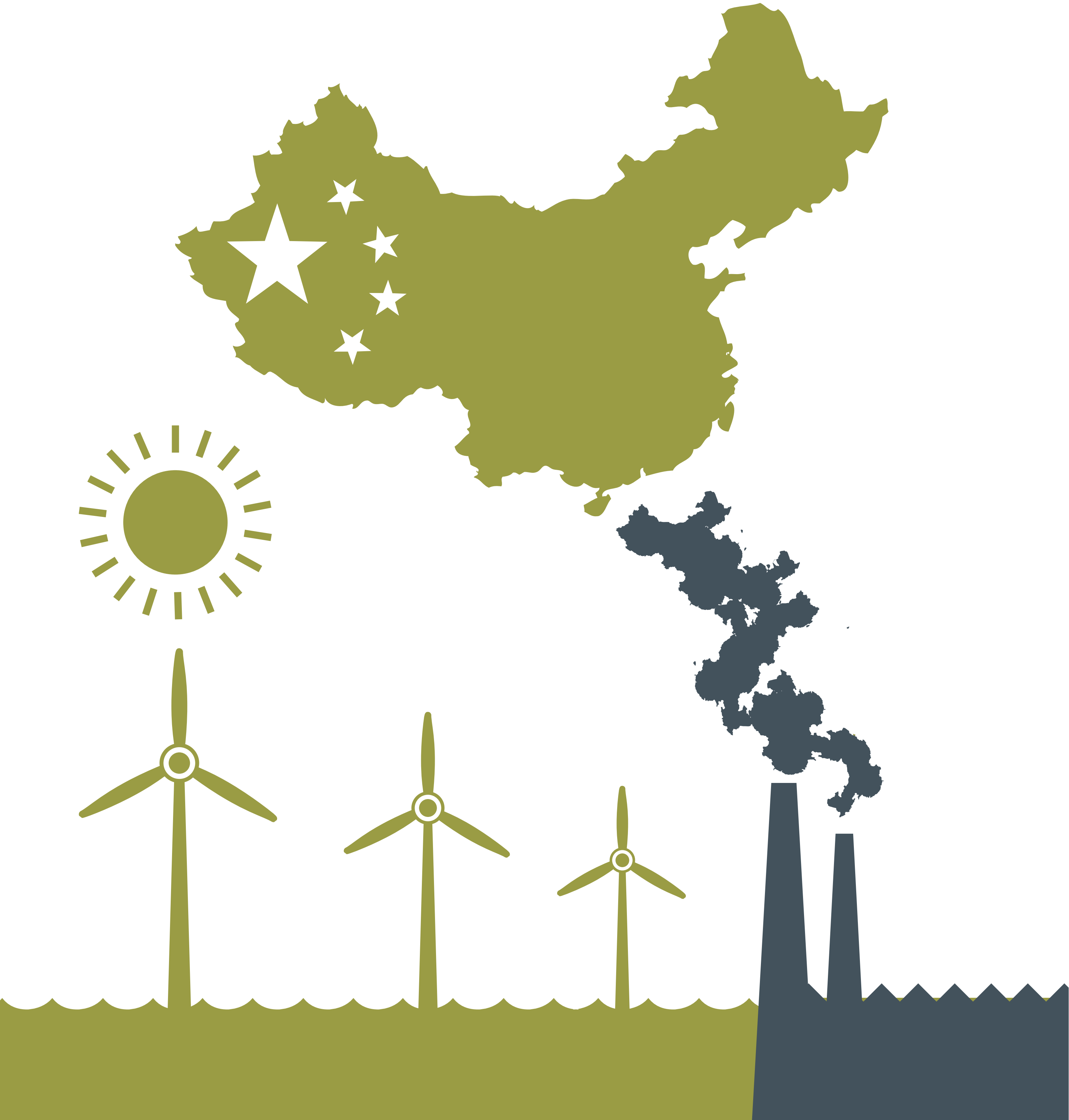
The Great Coal Cap

China's energy policies and the financial implications for thermal coal



About Carbon Tracker

Carbon Tracker comprises a team of financial specialists aiming to make carbon investment risk visible today in the capital markets. Carbon Tracker is applying our thinking on unburnable carbon, stranded assets and wasted capital across geographies and asset classes to inform investor thinking and the regulation of capital markets. We are funded by a number of US and European charitable foundations.

About ASrIA

The Association for Sustainable and Responsible Investment in Asia (ASrIA) is the leading association in Asia dedicated to promoting sustainable finance across the region. ASrIA plays a critical role - as a thought leader, convener and advocate - in facilitating Asia's transformation to a sustainable future and encouraging thoughtful participation by governments, multilateral bodies, corporates, NGOs and financial institutions in addressing the challenges that Asia will face in the years ahead. For over 13 years, ASrIA has provided leadership, helped to build capacity and leveraged expertise to promote the development of sustainable financial markets and systems in Asia.

Background to the research

Following the publication of Carbon Tracker's 2013 global analysis, Wasted Capital and Stranded Assets, we are undertaking research at a regional level, focusing on financial markets with significant exposure to fossil fuel extraction.

Find the full report at: **www.carbontracker.org/chinacoalcap**

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Executive Summary

Since the beginning of the 21st century, China has accounted for over four-fifths of global coal consumption growth, half of which is thermal coal used predominantly to fuel China's coal-fired power generation fleet. The purpose of this report is to demonstrate to key stakeholders that the dynamics of China's thermal coal sector are changing and that a greater understanding of these dynamics is required, particularly in the context of transitioning to greener growth and the role that financial market actors play in this process.

Drivers of peaking thermal coal demand

China's coal demand is changing. Since 2005 a decoupling of China's total coal demand from GDP appears to be occurring. A closer look reveals that year-on-year, China's coal consumption growth is slowing - with 2012 the lowest increase for a decade. This reflects declining absolute coal consumption in 10 of China's 30 provinces.

Lowering power demand growth

Absolute power demand growth in China is showing signs of slowing, resulting in slower demand growth for thermal coal, which currently supplies 79% of China's total power. The key driver is slower GDP growth, which has fallen from a compound average rate of 10% between 2000 - 2010 to 7.7% in 2013. Furthermore, China's economic growth has become less energy-intensive due to a greater reliance on the service sector (which is six times less power intensive than the industrial sector).

Lowering competitiveness of thermal coal

Regulatory responses to some of the major environmental challenges faced in China – most notably relating to air pollution and water scarcity issues - are emerging as key drivers of thermal coal demand peaking. Further environmental regulatory developments are likely, with the policy landscape continuing to shift against contributors to these environmental problems. For example, the continued development of China's emissions trading schemes and the possibility of a carbon tax will serve to increase the perceived risk associated with high carbon power sources.

Increasing competitiveness of non-coal power sources

While the shifting dynamics of China's thermal coal sector are signalling a future downturn, one of the most dynamic elements of the Chinese energy scenario is optimism reflected in the outlook for non-coal power sources. Forecasts from a range of different sources including the IEA and a number of investment banks predict that future installed capacity for nuclear, gas, wind and solar power will even exceed these Chinese Government's forecasts (with hydropower being the only exception).

Asset stranding from 'early-peaking' of thermal coal demand

As highlighted, there are a number of drivers on thermal coal demand which will likely result in a peak in use - however, the timing of this is unknown and widely debated, with forecasts ranging from 2015 to 2030. Peaking at the earlier end of the forecasted range could occur from a combination of factors – including aggressive policy ambitions on behalf of the Chinese Government and significant investment into non-coal power alternatives – and would lead to a far greater level of 'asset stranding'.

Stranded coal-fired power generation assets

In order to illustrate this risk, the IEA's 'Current Policies Scenario' (i.e. 'business as usual') has been compared with the earliest peaking thermal coal demand scenario (based on analysis published by investment banks included in the research). This illustrates the maximum amount of thermal coal power generation capacity that could potentially be stranded in a lower-than-expected demand future, i.e. those assets which, if built on an assumption that thermal coal demand will grow strongly in the future, would be uneconomic if market and regulatory forces serve to peak demand for thermal coal.

This comparison reveals that up to 437GW of China's coal-fired power generation capacity could be at risk of stranding by 2020 due to lower-than-expected demand, equivalent to up to 40% of total installed coal-fired capacity by the end of the decade. While this is a hugely significant proportion, over 70% of the difference in generation capacity between the two scenarios is comprised of expected future capacity that might yet have a pending, and influenceable investment decision – of the 437GW at risk of stranding, 127GW of this coal-fired capacity is already installed (against 2012 levels) and up to 310GW of potential additional capacity is not yet built meaning some capital is still recoverable if these project do not go ahead due to risks of future thermal coal-fired power.

Stranded thermal coal supply assets

The report identifies that the potential gap between business as usual and peaking demand (Figure 1) equates to 1030m tons of annual thermal coal supply (56% of China's demand in 2012) that may not have an end-market in 2020.

In spite of this, China has total proven thermal coal reserves of 46.6bt and 70.1bt of thermal coal resources equating to 23 years and 36 years of thermal coal supply at the current consumption rate (Figure 2). These thermal coal reserves and resources constitute significant future supply that could be at risk from an early-peaking demand future. This poses a potential risk to the value of thermal coal assets of China's coal extraction companies and their investors' holdings.

Vulnerabilities within China's capital markets

Based on the report's analysis, the Shanghai, Shenzhen and Hong Kong stock exchanges are potentially vulnerable to value destruction resulting from structural shifts in China's thermal coal assets, with over 80% of non-state owned assets attributable to companies listed on these exchanges. In particular, Hong Kong Stock Exchange runs the greatest exposure to China's changing thermal coal industry with companies listed on the exchange owning 22.8Bt of thermal coal reserves (Figure 3) – more than three times that of the other two exchanges combined.

The report's analysis focuses on potential implications for direct investors but also identifies exposures passed onto passive investors through Hong Kong's indices. For example, the Hang Seng Enterprises Index, which derives over 18% of its market capitalisation from companies with thermal coal assets, is particularly vulnerable to downside risks.

Identifying wasted capital expenditure (CAPEX)

In 2013 China's coal companies spent approximately Rmb 129 billion (USD$21 billion) to explore for and develop additional thermal coal reserves. Over 80% of this CAPEX was made by the three largest and most investible coal companies with a market capitalisation of over Rmb 45 billion. Such companies also possess the largest thermal coal reserves and – as a consequence – carry the largest exposure to changes in the sector. Based on this report's analysis, investors should question whether this CAPEX spending will mean these larger companies either:

- Exploit cost-advantages to establish a stronger financial foundation and gain market share at the expense of smaller competitors; or
- Accelerate the challenges associated with lower cash flow by investing capital in order to expand coal operations in a declining market (a market which has over 20 years of proven thermal coal supply and brings in to question the most effective use of capital).

Factors to consider when determining potential exposures

The following factors, but not limited to, should be given consideration when investors are undertaking risk assessments:

- Debt levels
- Geographic location
- Revenue sources
- Coal quality
- Political support

Risks to the international coal market

The peaking of China's thermal coal demand would likely result in a sharp decline in China's import demand; this would exacerbate an already over-supplied international market and leave those currently exporting to China needing to find another end-market.

Increasing Chinese thermal coal supply to substitute for imports

Although demand growth is slowing, China is continuing to increase domestic coal supply. In 2011, China's domestic production of coal increased by 800m tons. This upward trend looks set to continue with plans to triple railway track additions between 2013 and 2015 on the previous three year's additions to remove current supply bottlenecks. These efforts to increase domestic supply despite an already over-supplied international market indicate a desire for China to consolidate its domestic sector at the expense of exporters.

Australian and Indonesian exporters at risk

Of notable interest is the reliance of Australia and Indonesia in particular on demand growth, because companies mining in these two countries are the largest exporters of coal to China. There is a need for greater understanding of the potential for a terminal decline in the demand for coal imports to China - if it is treated as merely a cyclical phase, then there is a greater risk of stranded assets in the future.

Recommendations

The report makes a number of recommendations to key stakeholders including investors, policy-makers and companies, the purpose of which are to enhance understanding of stranded asset risk in a low demand future and the potential feed through effects to financial markets.

Investors to: (i) require improved capital expenditure disclosures; (ii) require improved coal quality disclosures; (iii) ensure resilience to lower demand factors; and (iv) implement effective risk monitoring processes.

Policy-makers to: (i) require stress-testing of banks and other financial institutions for exposure to stranded asset risk; (ii) introduce environmental considerations into the scope of macro-prudential activities of financial regulators and the central bank; (iii) set up a framework to assess risks to the future stock of financial assets by improving on and extending application of the green credit and sustainable investment guidelines; and (iv) advance international cooperation on risk management of stranded assets.

Companies to: (i) provide markets with analyses on exposure and resilience to stranded asset risk; (ii) substantiate forward capital spending strategies in the content of demand and price shifts; and (iii) stress-test the benefits of diversifying revenues streams from just pure coal operations.

Concluding remarks

China has made considerable strides in addressing critical domestic environmental challenges and technological developments are making clean technology energy solutions increasingly cost attractive. However, the concepts of stranded assets and wasted capital expenditure have increasing relevance to China's thermal coal sector. For a broad range of stakeholders, there is significant potential value-at-risk associated with a failure to recognise the impact of early peaking demand within the sector. The purpose of this report is to begin to draw attention to the exposure of China's capital markets to this value-at-risk and the investment factors that should be considered to enhance resilience during a period of significant transition in China's power sector.

There is an opportunity for both China and other countries to ease the potential disruption and risks associated with stranding assets by requiring investors and financial institutions with significant assets at risk to develop and agree with the suitable regulator a plan of action for managing the stranding process. Furthermore, fiscal and other incentives can be provided to advance such stranding in an orderly fashion to reduce risks of sudden insolvency and systemic risk. Ultimately, China's imperative and opportunity is to develop its own approach to assessing and effectively managing the financial system consequences of the transition to an ecological civilization.

Foreword

Investing in a Green Economy

This report, *"The Great Coal Cap: China's Energy Policies and the Financial Implications for Thermal Coal"*, confronts the core issues relating to climate change.

As everyone knows (although some continue to deny it), we would need to change our lifestyles if we are to limit climate change to habitable levels. I will not get into the complex debate on the scientific relationship between carbon emissions and global warming here. The simple truth is that if we continue to exponentially increase food and energy consumption, then not only will the earth warm up, we will simply not have enough resources on earth to keep mankind alive. One estimate suggests that if we carry on at the current rate, we need one and a half earths to keep us going. If everyone else consumes like the average American, we would need five earths. This is simply not sustainable.

Making life sustainable for our children and grandchildren would require major changes in our consumption pattern, let alone our investment patterns.

The United Nations Environmental Programme (UNEP) suggests that we live in an *'era of gross capital misallocation'*. In plain language, we are investing wrongly, because we are consuming wrongly. In the words of UNEP's report *"Green Economy: Pathways to Sustainable Development and Poverty Eradication 2011"*:

"Although the causes of these crises vary, at a fundamental level they all share a common feature: the gross misallocation of capital. During the last two decades, much capital was poured into property, fossil fuels and structured financial assets with embedded derivatives, but relatively little in comparison was invested in renewable energy, energy efficiency, public transportation, sustainable agriculture, ecosystem and biodiversity protection, and land and water conservation."

China has often been accused of being a major polluter and CO_2 emitter, but the country's high pollution levels are partly due to it being the "factory of the world", producing mostly for developed markets. The bulk of its energy resources lies in coal, which China has in abundance. Of course, as domestic consumption increases, the pressure on energy usage and carbon emission will also rise.

At the same time, the world can shift significantly into renewable energy. China today is committed to clean energy, spending $34.6 billion in clean energy investments, nearly double that of the United States, as it recognizes that the costs of pollution on its citizens' health and the environment have become visibly unsustainable.

This study by the UK-based NGO Carbon Tracker Initiative, with support from the Association for Sustainable and Responsible Investment in Asia (ASrIA) focuses on changes to thermal coal demand in particular. The report suggests that there is significant potential value-at-risk associated with a failure to recognize the impact of early peaking demand within the sector. This has serious risk implications for investors, energy companies and policy-makers alike – especially as China's power sector transitions to a cleaner future and the world becomes serious about climate change.

Carbon Tracker's argument is that the world is currently powered fundamentally by fossil fuels, which contribute significantly to carbon emissions. If the reliance on fossil fuels were to change dramatically as a result of market or regulatory changes, the impact on valuations will have systemic implications, because in some key markets, these companies account for as much as 20-30 percent of total market capitalization. Furthermore, the subject of social impact investing and green finance, particularly the idea of selling out of fossil fuel investments, have also begun to gain traction among longer-term investors.

I commend Carbon Tracker, ASrIA and RS Group for publishing this important study which will bring to public debate some of the fundamental issues that confront us in the field of climate change, fossil fuels and global capital markets.

Andrew Sheng
Distinguished Fellow, Fung Global Institute Member, Advisory Council,
UNEP Inquiry into Design Innovations for a Green Financial System

Introduction

Carbon Tracker published its 'Wasted Capital and Stranded Assets' report in 2013. This report established the concept that a proportion of global fossil fuel assets are at risk of becoming stranded as a result of regulatory and/or market changes aligned with a carbon-constrained future. It introduced financial data to provide a wider perspective of stranded asset risk, finding that US$674 billion of capital is being spent each year by the world's 200 largest fossil fuel companies on finding and developing more fossil fuel reserves that may not be burnt. As the largest growth market for coal globally since the start of the 21st century, China is a crucial geography in the discussion of stranded assets and wasted capital.

'Stranded assets' are defined by the IEA *'as those investments which have already been made but which, at some time prior to the end of their economic life (as assumed at the investment decision point), are no longer able to earn an economic return*'.[1] The longer investments continue to flow into these assets the greater the associated financial risk if such assets are written-down (reducing the book value of an asset that is overvalued compared to market value) due to stranding.

Momentum is gathering in the mainstream international financial and environmental sectors around the need for fossil fuel companies, their investors and the capital markets on which they list to assess the financial implications of stranded fossil fuel assets. Furthermore, as emphasised by the President of the World Bank, Jim Yong Kim, in Davos, January 2014, 'financial regulators need to lead. Sooner rather than later they must address the systemic risk associated with carbon-intensive activities in their economies'.[2]

Achim Steiner, UNEP Executive Director, echoed these sentiments in Davos by calling on financial regulators to '*track the carbon exposure of your investment and don't be misled by audited accounts which may be in the black when in reality your company or investment, five to 10 years down the line, may be sitting on stranded assets*'.[3]

China is taking significant steps to address critical domestic challenges, in particular related to environmental degradation including air pollution and water scarcity crises. In part, this is being addressed through efforts to increase the efficiency of China's energy sector and increase capacity additions from clean technology energy sources while taking steps that serve to lower the attractiveness of further coal capacity additions – the June 2014 announcement by the chairman of China's Advisory Committee on Climate Change that an absolute cap on carbon dioxide emissions could be set as soon as 2016 typifies the transition being driven by policies in China.[4]

These factors are contributing to a highly changeable coal sector, in particular the power sector which consumes half of all China's coal. Consequently, the concepts of stranded assets and wasted capital have become increasingly relevant as stakeholders attempt to understand the implications of these changes and accurately forecast what is probable in the future.

This report seeks to inform the investment community and other key stakeholders of the drivers and potential risks of coal's changing role in China's power sector, to ease the potential disruption and financial implications of China's transition away from coal and towards a more diverse power base. Those investors who are aware of, and are factoring in, these risks may have certain advantages over peers.

1. Context: Chinese coal demand

1.1 Coal consumption growth is slowing

The future trajectory of China's total coal consumption is a widely debated topic both domestically and internationally.

Through the 1980s and 1990s, China's total coal consumption increased at a steady rate. The turn of the century, however, saw consumption more than double in just 10 years. Since 2000, China has accounted for 82% of total global coal demand growth.[5]

A significant factor in this acceleration has been the unprecedented rate of economic growth. Between 2000 and 2011, China experienced an average annual Gross Domestic Product (GDP) growth rate of 10%. During the same period, the global average was 3%.[6] While it is difficult to attribute causality in this relationship, it is clear that the two were closely related (Figure 1).

Figure 1: China's total coal demand against GDP (Source: World Bank, US EIA)

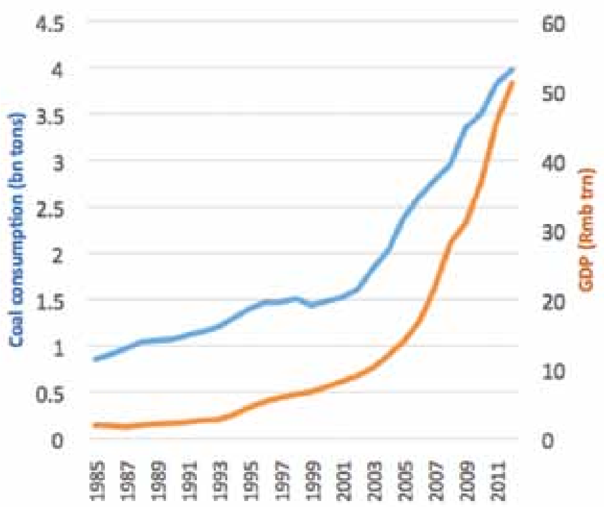
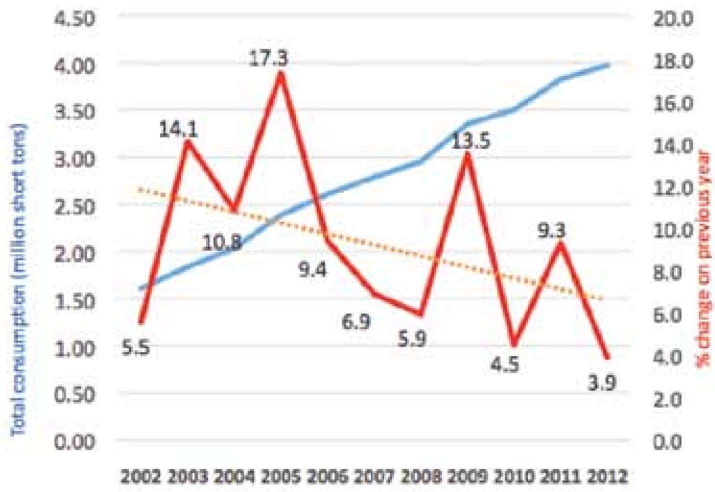


Figure 2: Percentage change in coal consumption in China the past 10 years (Source: US EIA)



However, Figure 1 also points to the fact that, in the last few years, this relationship may be altering. Figure 1 illustrates a clear convergence between coal consumption and GDP. While it is clear that the past 10 years have seen rapid economic growth, a closer look at coal consumption over this period (Figure 2) suggests it is consumption that is failing to keep pace. The latest 2012 coal consumption figures indicate a growth of 3.9%, the lowest recorded in the last decade. Furthermore, applying a trend line displays a clear average deceleration in demand growth across this 10 year period.

Other data sources identify the slowdown in coal demand growth as being more severe. For example, the China Energy Statistical Yearbook 2013 publishes total coal consumption growth in 2012 on 2011 levels at only 1.8%.[7] This represents declining absolute coal consumption in 10 of the 30 Chinese provinces for which data was available, predominantly located in China's Eastern regions (Figure 3)[a].

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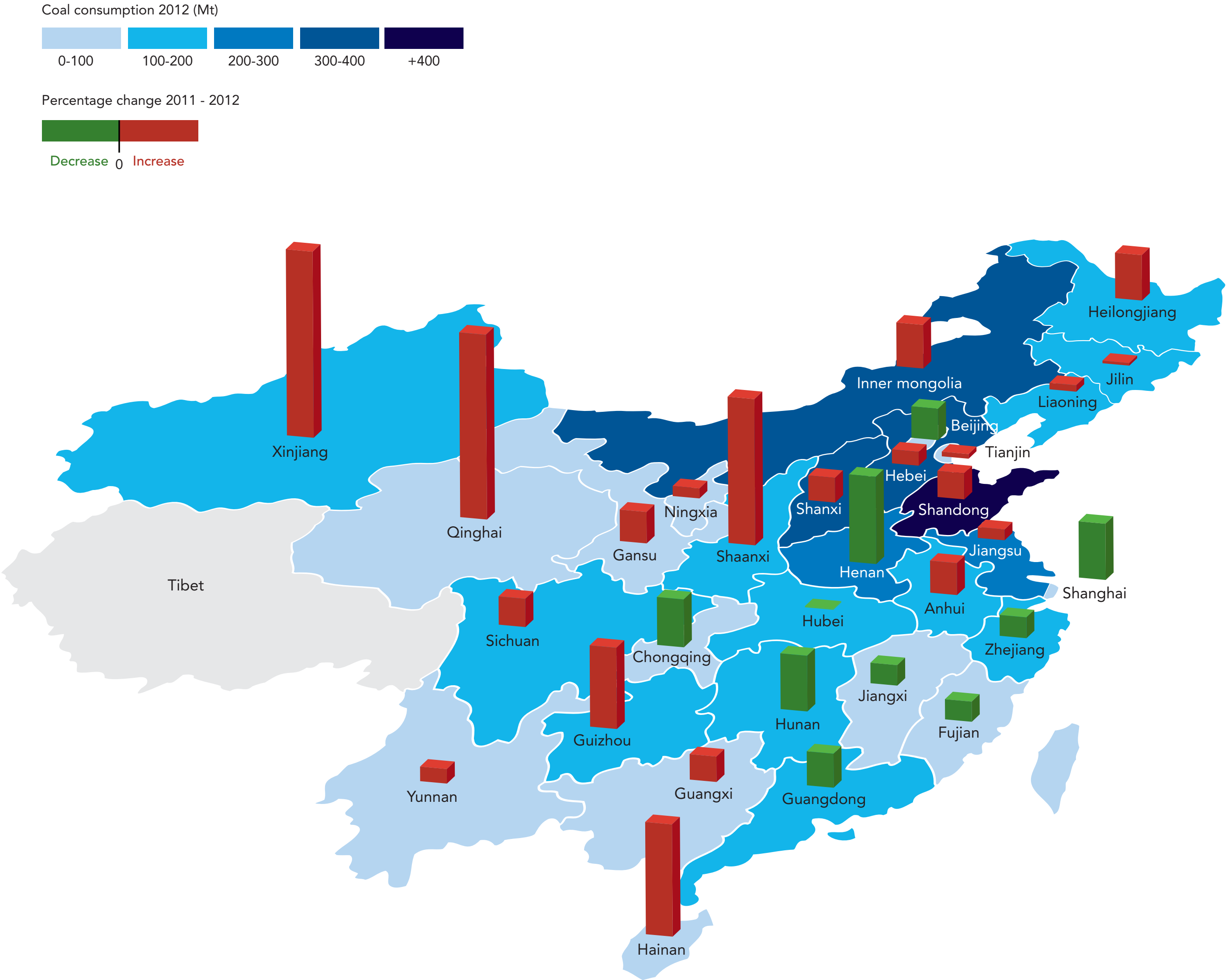
[a] Data was not available for Tibet

Figure 3: China's coal consumption fell in 10 provinces in 2012[8]



1.2 Thermal coal is dominant in China's coal sector

There are two primary distinctions in coal types, brown coal and black/hard coal. Brown coal sits at the lowest rank of coal and comprises a negligible proportion of China's total coal consumption. Black/hard coal can be split into two categories:

- Coking/metallurgical used primarily in steel production due to its high quality
- Steam/thermal coal principally used for power generation

Thermal coal for power generation makes up 50% of China's total coal consumption (Figure 4), whilst China's coal consumption is itself approximately 50% of total global consumption today (Figure 5).

Figure 4: China's coal demand by sector in 2012 (Source: Citi)

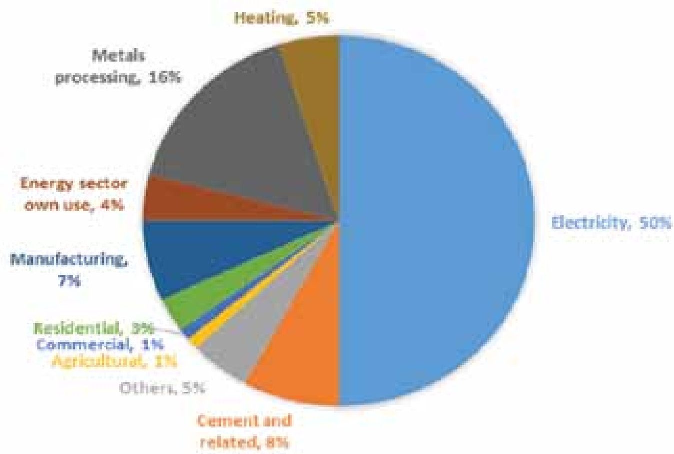
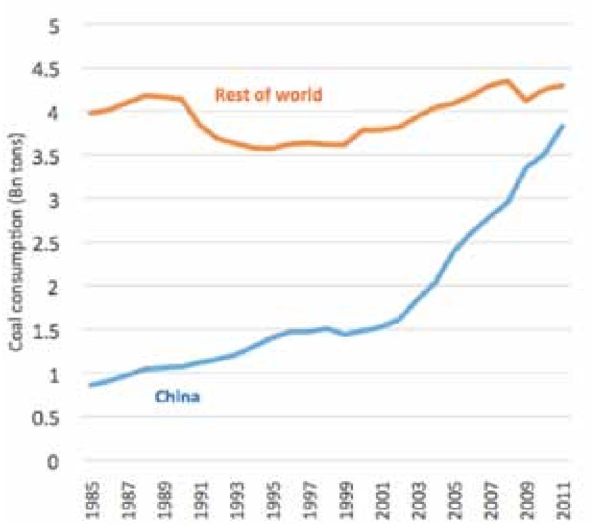


Figure 5: China's coal consumption of world total (Source: US EIA)



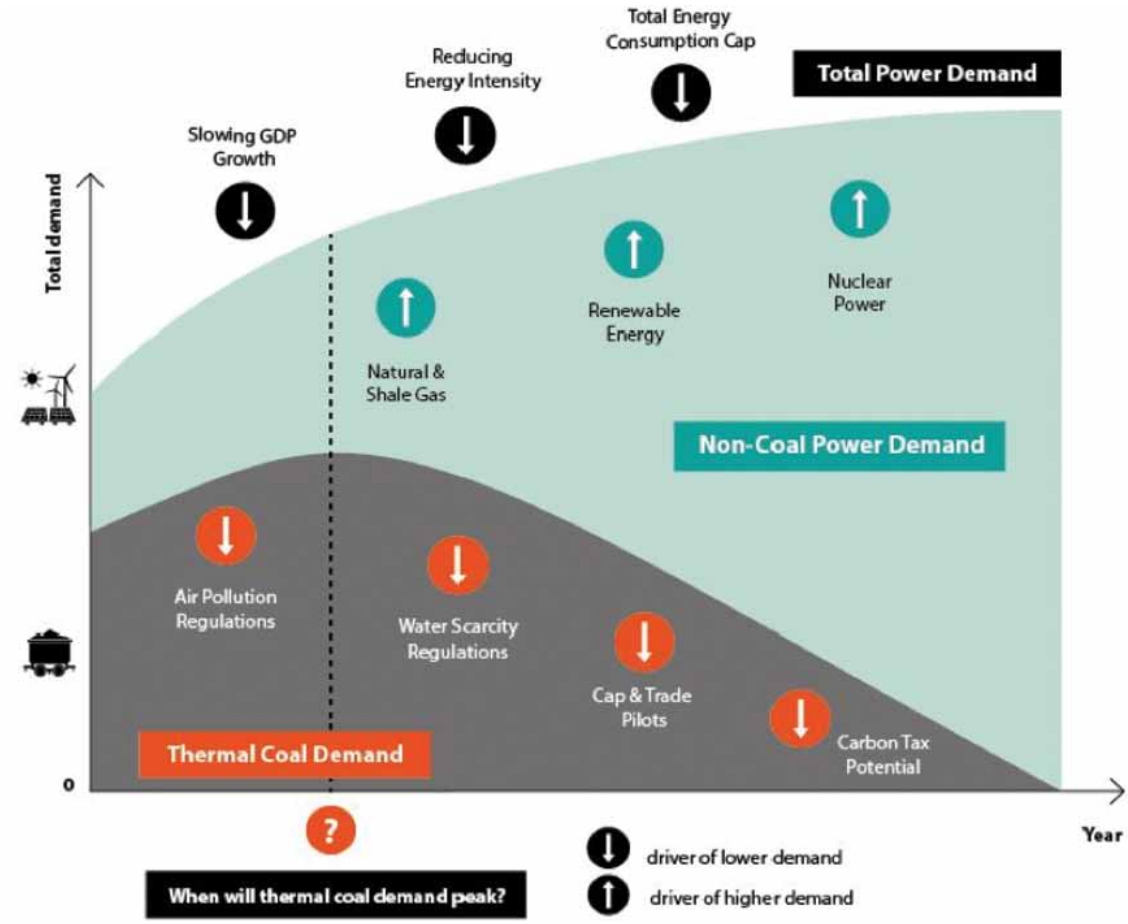
Consequently, based on this analysis, China's thermal coal demand comprises approximately 25% of total global coal demand. The focus of this report will be on thermal coal demand specifically.

1.3 How likely is peaking thermal coal demand in China?

The targets set in China's 12th Five Year Plan (FYP), covering 2011 to 2015, and supplementary policies, have outlined future shifts in economic and power sector structures that raise questions over the future growth of thermal coal in China. These government policies can be grouped into three categories that outline the main components of this transition and form the basis of this report's assessment of peaking thermal coal demand in China (Figure 6). Firstly, drivers are combining that are slowing growth of China's power sector. Secondly, China's coal sector is becoming increasingly unattractive to meet this power demand. Thirdly, China's non-coal power sources are becoming increasingly competitive.

Based on consideration of these factors, it is possible non-coal generation will now grow faster than coal-fired generation within a slowing power demand environment. The difference between these growth rates will continue until thermal coal demand peaks and falls in absolute terms (Figure 6).

Figure 6: Drivers peaking China's thermal coal demand



This general trend towards a less coal dependent, more diversified power base, resulting in the eventual peaking of thermal coal consumption is widely accepted. However, there is substantial contention over *the rate* at which this transition will occur. Table 1 presents a summary of forecasts from select organisations providing analysis and comment on possible peaking thermal/total coal demand scenarios:

Table 1: Uncertainty in predicting peak demand

Author/Source[9]	Predicted year of peak coal consumption
Bernstein Research	2015
Deutsche Bank	2016
Citi	Before 2020
IEA World Energy Outlook 2012	2020
China Energy Group, US Lawrence Berkeley National Laboratory	2020
IEA World Energy Outlook 2013	2025-2030
Du Xiangwen, China Academy of Engineering	2030

NB: Not all predictions are specifically regarding thermal coal but total coal consumption instead, but to achieve total coal peaking will require a significant overhaul of thermal coal demand given it comprises 50% of total demand.

As illustrated, there is a broad range of plausible coal demand scenarios presented, suggesting the 'early-peaking' of China's thermal coal demand, i.e. peaking sooner than expected and at the earlier end of the forecasted range, poses a series of risks – for example, to suppliers, consumers, investors and financial institutions.

In order to better understand the likelihood of the early-peaking of China's thermal coal demand, the next section of the report analyses the strength of drivers within each of the three categories highlighted in Figure 6.

2. Drivers reducing power demand growth

Lower GDP growth

Economic growth has been a driver of China's power sector growth, of which 79% was provided by coal in 2011.[10] Between 1990 and 2011, compound average annual growth rate of GDP in China was 10%. However, since 2012 annual growth rates have fallen.

Table 2: GDP growth set to slow

Source[11]	2014	2015
IMF	7.5%	7.3%
Price Waterhouse Coopers	7.5%	7.2%
Goldman Sachs	7.3%	7.6%

In 2012 GDP growth fell to 7.8% and further to 7.7% in 2013 – a 13 year low.[12] While not identical, forecasts of short-term GDP growth shows there is a consensus towards further slowing out to 2015 (Table 2). Many expect this gradual downward trend to continue as China's Xi-Li administration have emphasised the need for improving the quality of growth.[13]

Lower levels of GDP growth will inherently serve to apply downward pressure on power demand growth. However, some coal consumption models (based on those selected from a number of international research companies included in this research) argue that lower GDP growth is not a pre-requisite for early coal demand peaking. For example, the Lawrence Berkeley National Laboratory illustrates in a reference case scenario that coal demand can peak in 2020, simultaneous to GDP growth of 7.7% between 2010 and 2020. The analysis asserts this is achieved as a result of adopting *'all announced policies and goals related to efficiency improvement'*.[14]

Lower energy intensity

In addition, the energy intensity of China's GDP, i.e. energy consumed per unit of GDP, is lowering such that future GDP growth is likely not to be the driver of power demand as previously experienced. Significant progress was made towards energy intensity targets set in the 11th FYP as China delivered a 19.1% energy intensity reduction against a 20% target. During this period, 85GW of coal-fired power plants were shut down as a result.[15] This suggests thermal coal demand will be suppressed by China's ambitions to achieve a further 16% improvement as outlined in its 12th FYP.

Some reports have suggested that the gains made in the 11th FYP exploited, and potentially exhausted, the 'low-hanging fruit' opportunities to achieve efficiency gains, such as the required closures of inefficient coal plants. It is noteworthy that achieving gains in increasingly efficient economies becomes more difficult. However, this also suggests that any additional gains will likely be more structural and sustainable in nature. As such, it could be assumed that those improvements to be achieved in the 12th FYP will be arguably more significant, albeit more modest.

Enlarging service sector

An important driver of future improvements in energy intensity that suggest changes will be structural is the increased economic contribution derived from China's service sector, which is roughly 6 times less power intensive than the industrial sector. As such, a slight shift towards the service sector will have a huge impact on the reduction of power demand growth[16]. Since 2000, China's industrial sector share of GDP has trended down slightly, while the services sector share has risen from 39% to 44.6% between 2000 and 2012.[17] Furthermore, the 12th FYP target is for this to rise to 47% by 2017.

Absolute coal consumption cap

The Chinese Government has set an absolute energy consumption cap of 4 billon tonnes of coal equivalent (TCE) by 2015. Within this target a cap for coal consumption specifically has been set at 2.8 billion TCE, which equates to 3.9 billion tonnes (the difference negates the variable energy content of coal), as part of the plan to reduce coal's contribution to total energy use to 65% by 2017.

This is a highly ambitious target given that coal consumption is already approximately 3.9 billion tonnes, potentially revealing an objective to peak coal demand as early as possible. While this is an expected target that could be exceeded, this provides an indication that China will seek to transition away from coal and towards a less energy, and power, intensive economy.

3. Drivers reducing coal's capacity to meet power demand

This section focuses on those key drivers that threaten competitiveness of thermal coal to meet future power demand.

3.1 Air pollution

'We should be fully aware of the urgency and difficulty of protecting the environment and reducing pollution, as well as the significance and necessity of improving the environment'.[18] **President of the People's Republic of China, Xi Jinping**

The unprecedented air pollution events experienced over the last two years in China, and the subsequent regulatory responses, have promoted pollution related policy and regulatory reform as a key driver of current and future downside pressure on thermal coal demand.

Thermal coal is a major contributor to pollution

Coal burning in power plants is thought to be the source of 15-30% of China's PM10 – particulate matter up to 10 micrometres in size - rising to a maximum of 60% in the winter.[19] Estimates regarding PM2.5, the particulate posing the greatest risk to human health due to its small size, suggest that coal-fired power generation contributes 17% of total PM2.5 in China, making it one of the major contributors alongside vehicular emissions, cement and steel production.[20]

In addition, and arguably cause of the most significant damage relating to use of thermal coal for power generation, is in its supply of secondary sources of PM2.5 which on average comprises over 55% of total PM2.5. Data from 2013 indicate that coal-fired power generation can supply up to 83% of SO_2 emissions and 64% of NOx emissions in each province, which can chemically react to produce PM2.5, creating a large secondary source.[21]

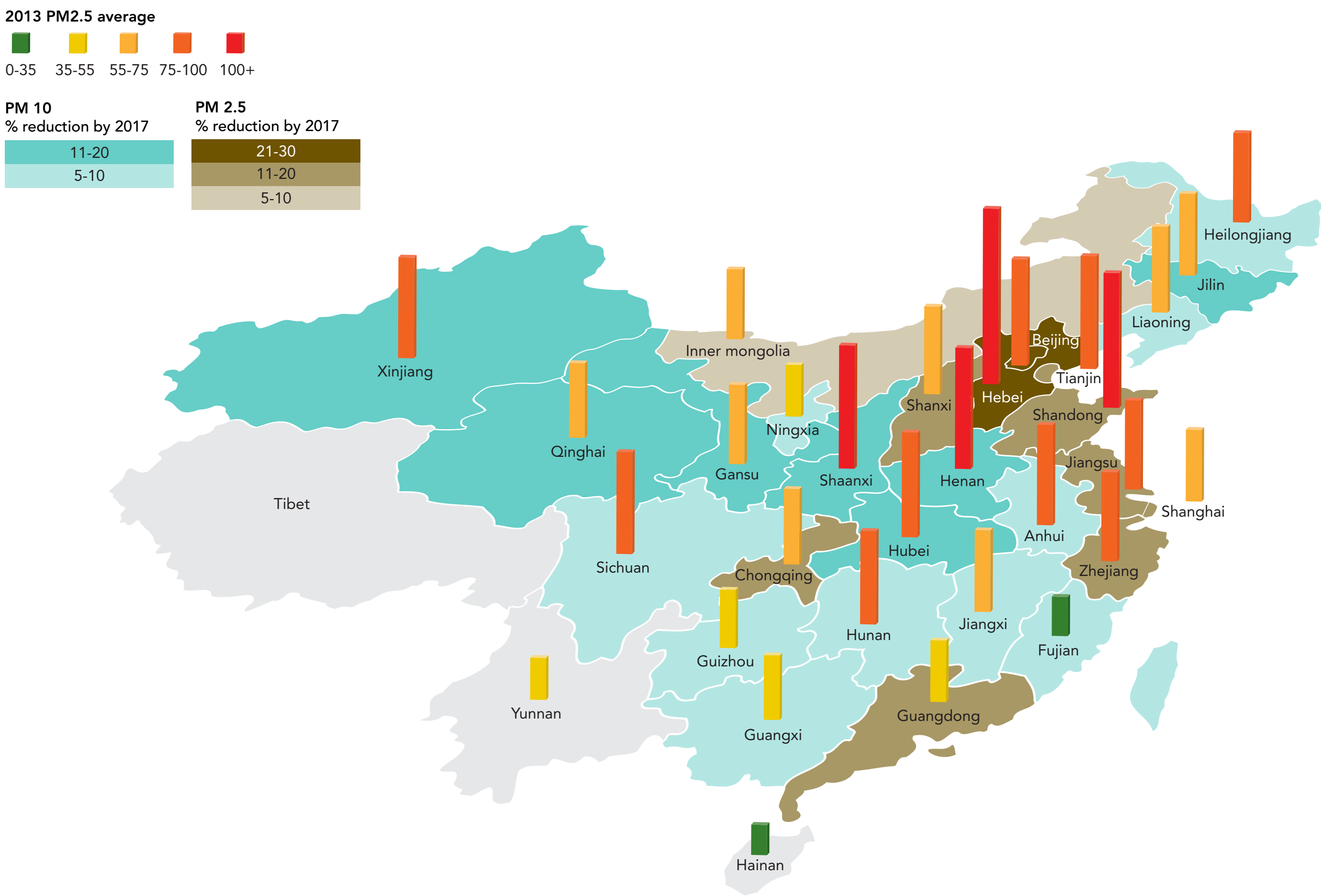
To a certain extent, the use of flue-gas desulphurisation technologies, which have been fitted to 90% of China's coal-fired power plants, denitration technologies and installing baghouse filters[22] can be used to mitigate some of these pollutants. However, a large number of plant operators have thus far failed to employ such efficiency technologies partially due to the resulting increase in cost. Regulatory enforcement has also not been implemented in some cases.

Clean air is a priority in Chinese ambitions

Over the course of 2013, all but two Chinese provinces failed to meet the World Health Organisation's (WHO) least stringent recommendation for PM2.5 levels of 35µg/m^3.[23] Tackling air pollution has become an increasingly urgent priority in China, leading to the development of the Action Plan for Air Pollution Prevention and Control - a provincial level roadmap of pollution control targets that aim to reduce air pollution towards the National Ambient Air Quality Standard of 35µg/m^3.[24]

Comparing PM2.5 and PM10 provincial targets with air quality readings in 2013 illustrates that those most stringent reduction targets are effectively being partnered with those provinces with the most extreme air pollution (Figure 7). By way of illustration, the most ambitious PM2.5 target focus on three key regions – the Beijing-Tianjin-Hebei (Jing-Jin-Ji) area aiming to reduce levels by 25%, the Yangtze River Delta (Shanghai, Jiangsu and Zhejiang provinces) aiming to make a 20% reduction and the Pearl River Delta (Guangdong province) looking to achieve a 15% decline – with the remaining 286 second- and third-tier cities expected to reduce PM10 by at least 10% on 2012 levels.[25]

Figure 7: Air quality targets are beginning to cover China's worst hit provinces



Coal consumption driver: Consumption leakage - Ignoring social and environmental externalities, coal is still a cheap and abundant resource in China. Therefore, it is possible consumption will move – or 'leak' – to those provinces without anti-pollution regulations. This is the risk with piecemeal policy regulation and a strong reason for China to achieve universal PM2.5 coverage soon.

While there are signs that this shift might be happening from East to West in China, this does not detract from the effects of a power market whose growth is slowing structurally. Also, China's has the opportunity to learn from the environmental crises in the East to understand the medium- to long-term effects of allowing coal consumption leakage to the West.

The importance of the multiplier effect

Setting a precedent with such air quality targets, the potential for a multiplier effect may occur as other provinces aim to follow suit. Figure 7 illustrates that over the past year assigning PM2.5 targets has now extended beyond the three key regions set out in the original Action Plan - to Shandong, Shanxi, Guangdong and Chongqing. This represents adding a further 23% of China's total coal consumption to the total demand now constrained by reduction targets in a very short space of time. Total Chinese coal consumption now covered by PM2.5 regulation is at 51% and can be expected to grow further.

It is assumed that additional targets will likely start with those provinces with the worst air quality before extending more widely. Figure 7 reveals that Shaanxi is the standout province in this regard, having the worst air quality among those remaining with only a PM10 target. However, given that all but two provinces failed to meet the national air quality standard in 2013, the scope for widespread PM2.5 targets across China's 31 provinces is significant.

Provinces commit to coal cuts

It is indicative that a number of China's provinces identify coal consumption as an important approach to achieve air quality improvements as many have made coal consumption reduction commitments (Table 3). This is the first time that China, even on a provincial level, has signalled a peak in its coal consumption. It is estimated that meeting these current coal caps will result in a 10% reduction in coal demand across these provinces on 2012 consumption levels.

Table 3: Provincial coal caps [26]

Region	Province	Proposed coal cut/cap by 2017
Jing-Jin-Ji	Beijing	13m
	Tianjin	10m
	Hebei	40m
Pearl River Delta	Guangdong	16m[b]
Other	Shandong	20m
	Chongqing	14m
	Shaanxi	20m
Total		**133m**

By extrapolating the new trajectory of coal consumption in the provinces identified in Table 3 out to 2020, these coal control measures imply a reduction of 655 million tonnes of coal compared to forecast business as usual growth.[27] A meaningful divergence that is likely to widen as more provinces announce coal caps in line with strengthening air quality targets. For example, the Yangtze River Delta area has pledged to achieve 'negative coal consumption growth' by 2017 and speculation has it that reductions may extend from Beijing to the surrounding Bohai Economic Rim, with a target for Liaoning being at least 40m tons[28] and Jilin to limit coal use to less than 2% per year.[29]

In total, 17 provinces have announced intentions to cap or reduce coal consumption in addition to those 12 who have already pledged control measures.

[b] Committed to cap coal at 160m by 2015, which equals a 16m reduction on 2012

Coal support: Conversion technologies - Converting coal-to-gas (CTG) is considered by some to be a viable technology to continue coal consumption but alleviate China's air pollution crisis. Latest reports claim that over 120bcm of CTG projects have been approved with 93.2bcm coming solely from Xinjiang province.

Implementing CTG at this scale could have catastrophic impacts on the environment where they are located, not help them. Research suggests that if all proposed CTG projects are approved, over the course of their 40 year lifetime they will emit 110GtCO_2 - a huge contribution towards dangerous changes to the global climate. The technology is also gravely water intensive requiring 6-12l per m^3 of synthetic natural gas, compared to 0.1-0.2l per m^3 of methane from shale gas. CTG is also very expensive – the latest pilot project cost Rmb 26.04 billion (USD$4.2bn).

Progress on implementation

The implementation of a broad range of regulatory and policy measures related to air pollution have begun, with significant progress being made. For the first time on a city level, fines are being introduced,[30] and air pollution targets being incorporated into law.[31] At the provincial level, progress has been made to digest the PM2.5 targets, what they means for coal consumption and the necessary pathways to achieving them. For example, in Hebei province specific commitments on coal reductions are being made including:

- 8.75mtpa reduction of coal consumption to 2015;
- 40.34mtpa reduction from 2015-2017; to be split across
- Shijiazhuang city reduction of 16.7mtpa by 2017;
- Handan by 16.7mpta; and
- Tangshan by 25.6mtpa.[32]

Furthermore, Shandong, China's largest coal consuming province, has specified that to reduce its PM2.5 by 20% it will retire 21mt of iron capacity and cap steel capacity at 50mt by 2015, while it will cap coke capacity at 40mt by 2017.[33]

More to come

The downward pressure on China's coal demand is likely to continue in the foreseeable future, particularly when considering the rapidly increasing concern related to air pollution. Recently published research by Tsinghua University outlined that the Government's current PM2.5 measures will result in a 20% reduction in the targeted Jing-Jin-Ji region by 2017. Year on year, this means it will take 20 years for the region's PM2.5 levels to reach the national standard, missing the target deadline.[34] To meet the national target of PM2.5 at 35µg/m^3 by 2030 in time will require subsequent, more severe reductions in coal consumption from current levels.

However, despite extensive efforts to address the air pollution challenge, societal concern is rising. A Greenpeace International survey in June 2013 revealed that more than 70% of residents in Jing-Jin-Ji believe the current timetable to achieve air quality standards by 2030 is unacceptable.[35] In particular, the rising middle class is increasingly vocal about the impact of air pollution, with some of the worst pollution experienced in the three key regions of Jing-Jin-Ji, Yangtze and the Pearl River Delta - where a large proportion of China's middle class reside.

3.2 Water scarcity

While air pollution is currently a critical driving factor in the change in demand for thermal coal, the issue of water scarcity is rapidly gaining ground. Estimates suggest that 45% of China's GDP is derived from water scarce regions.[36] However, achieving economic growth targets in the same manner in the future will likely serve to severely exacerbate water scarcity, meaning a significant reassessment and prioritisation use and consumption of remaining water resources will be required.

'Increasingly grim' – water scarcity

An assessment given in 2011 by Jiao Yong, Vice-Minister for Water Resources, indicated that there was recognition that China's faces an 'increasingly grim' water scarcity situation.[37] The World Bank estimates that China is currently over-exploiting its groundwater to the sum of 22b/m3 per year[38], yet total water consumption could rise by a further 71b/m^3 over the next decade driven in large part by spiralling coal-fired power production, according to a report by the Brookings Institute.[39]

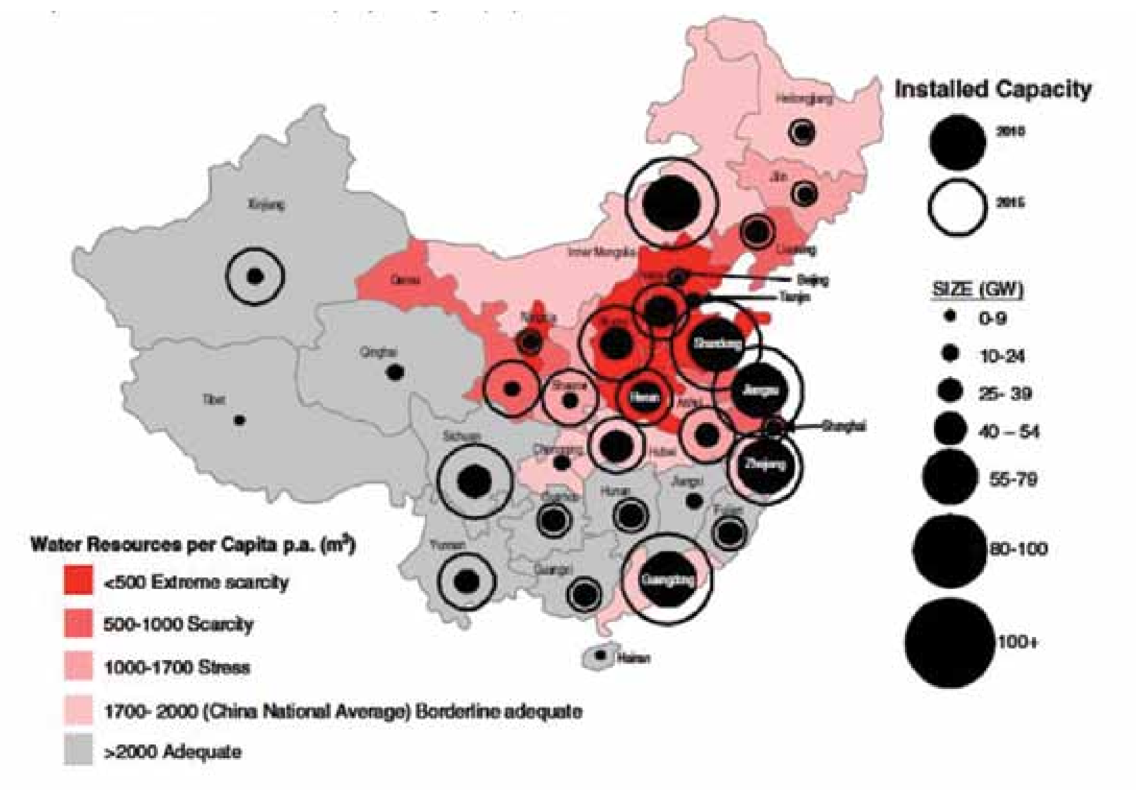
However, the situation is vastly exacerbated by the uneven distribution of China's remaining water resources and the mismatch with its main consumption areas. Broadly speaking, southern regions receive 80% of China's rainfall and snowmelt, while the more industrial, populated and water-intense northern regions receive only 20%.[40] Amid a projected population expansion from 1.3bn to 1.45bn in 2029[41], it is likely that concerns over water security will rapidly increase with a shift of focus onto transparency and accountability on heavy-water consuming industries such as the thermal coal sector.

Water scarcity casts thermal coal demand in doubt

Water is essential for thermal power production, not just in steam-driven turbine generators, but for cooling purposes also. In 2011, the coal sector as a whole accounted for 17% of China's water withdrawals and this is forecasted to increase to 27% by 2020[42]. Coal-fired power generation (which makes up the largest portion of this water use) will be consuming 34b/m3 by the end of the decade on a 'business as usual' pathway.[43]

Figure 8 displays that the majority of China's power generation centres are located in those water scarce provinces primarily in the north-east of the country. Illustrative of the wider problem is that the key coal consuming provinces of Inner Mongolia, Shaanxi, Shanxi, Gansu, Ningxia and Hebei possess only 5% of China's water resources to sustain 30% of its coal consumption.[44] The map also shows that proposed generation assumes the ability to continue production despite the risks posed by a lack of available water.

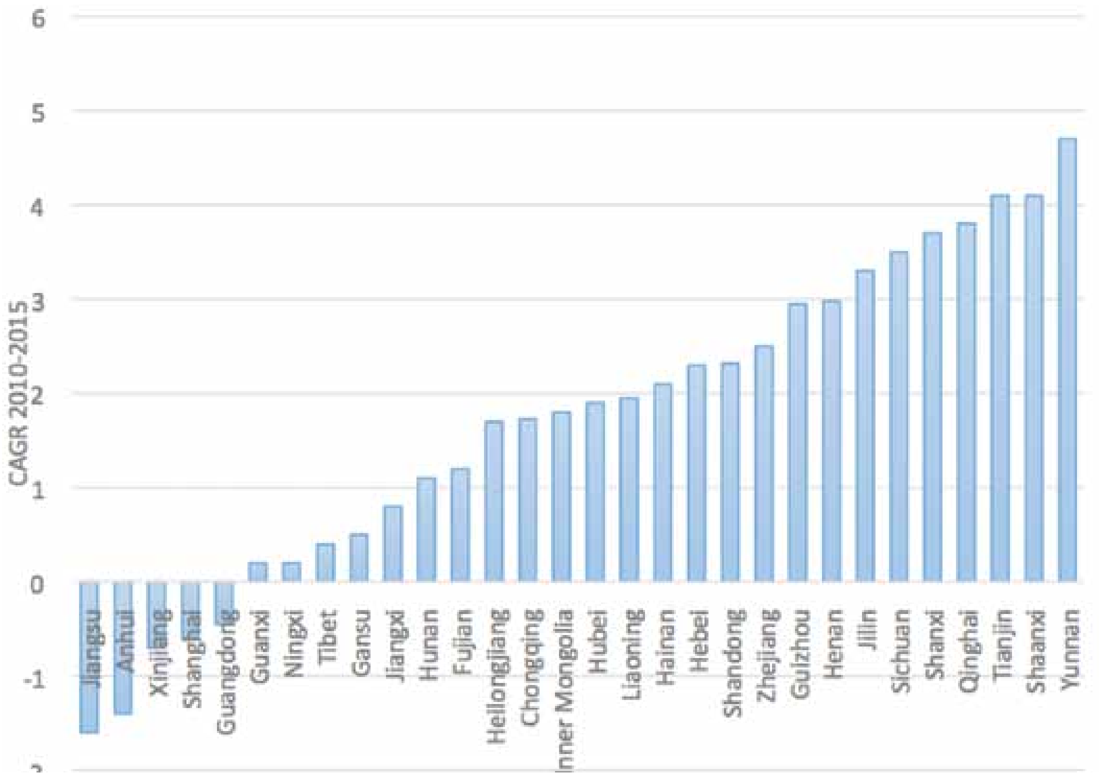
Figure 8: Water scarcity against power generation capacity (Source: HSBC)



Regulation quotas to limit use

Tangible steps to implement tougher limits on water use are expected to affect water-reliant power sources. The 12th FYP aims to achieve a 30% reduction in the water consumption per unit of value-added. The 'Most Stringent Water Management Systems Methods' guidelines[45] - published at the start of 2013 - will be central to achieving this goal. The guidelines outlined the annual water use limit of 700b/m^3 by 2030, which marks approximately a national average compound annual growth rate of 1.1%. This has been apportioned to each province as seen in Figure 9.

Figure 9: Water quotas by province[46]



Effectively capping water consumption will have repercussions for water-reliant industries such as coal-fired power generation, especially in those provinces set negative growth targets.

Coal consumption driver: Efficiency options – The most effective prospect in terms of improving the efficiency of thermal coal burning is improving the washing rate of thermal coal. Washing coal improves its energy content such that less coal needs to be burnt per unit of energy. This reduces net water consumption and in part offsets any cost increases. It is estimated that if all steam coal was washed and 10% of ash removed, overall water consumption would fall by 6-16%. However, the washing rate of thermal coal in China is below 40%.

Increasing water-related costs for thermal coal consumption

A number of factors signal costs for water-reliant industries are likely to increase. In China's northern regions, the water table is dropping by approximately one meter per year.[47] This is resulting in an increase in the costs of extraction for thermal coal consumers requiring water, with an expected impact on profit margins.

Some provinces have required new coal-fired power plants to install closed-cycle and air-cooling loops as methods to conserve water. However, as well as incurring additional installation costs, these techniques can reduce production efficiency by 3-10%, hereby requiring more coal per unit of energy produced and increasing operational costs further.[48]

In 2013, the NDRC announced the Water Resources Fee[49] guidelines, which include a tariff formulation system setting different standards and tariffs for different types of water resources. This has the potential to make operations for water-reliant industries increasingly marginal.

3.3 Emissions trading schemes

China is in the process of piloting emissions trading schemes (ETSs) in 7 provinces and cities - Beijing, Chongqing, Guangdong, Hubei, Shanghai, Shenzhen and Tianjin – a significant development both domestically and internationally. Emissions trading forms a central tenant of China's efforts to achieve a 17% reduction in its carbon intensity of GDP (as outlined in the 12th FYP).

ETSs serve as a mechanism to price carbon emissions above a pre-approved allocation to disincentivise industries from more costly high-carbon options in favour of less carbon intensive, less climate harming alternatives. This positions coal burning as the most costly of conventional fossil fuel types due to its higher carbon intensity than oil and natural gas.

The first to be launched, the Shenzhen ETS was made operational in June 2013, covering 40% of the city's carbon emissions. It is estimated that the Shenzhen ETS will result in a 30% reduction in carbon intensity of GDP by 2015. If successful, this will achieve a reduction beyond the national target set in the 12th FYP. Since then, Guangdong's ETS has arguably outlined the most ambitious scheme, covering 55% of emissions that total over 500MtCO_2e, including the power, iron and steel, cement and petrochemicals.[50]

Discussion on China's use and implementation of carbon markets as a central emissions reduction mechanism continues to evolve. The early developments of the regional ETSs are providing important experience and setting the stage for possible implementation of national carbon market. Recent indications are that this can be expected from 2018,[51] with a national scheme likely to be a strong driver for reducing domestic thermal coal consumption.

3.4 Carbon taxes

In addition to leveraging emissions trading, it is likely that China is also exploring wide scale implementation of a carbon tax structure. While it is yet unclear how a carbon tax would operate in parallel with a national emissions trading scheme, in 2013 China's Minister of Finance, Lou Jiwei, gave strong indications that a carbon tax will be implemented 'in due time'.[52]

An opinion survey of industry experts conducted by the Financial Times estimated that a price per ton of carbon between Rmb 50-100 would serve to increase the costs and narrow the profit margins of coal-fired power generation, resulting in a 10-20% reduction in carbon emissions.[53] On this basis, the introduction of a tax on carbon would provide significant impetus, even in a scenario where penalties were initially small. A carbon tax would radically recalibrate the thermal coal market and radically shift the occurring power transition, both in terms of nature and timing.

3.5 Carbon dioxide emissions cap

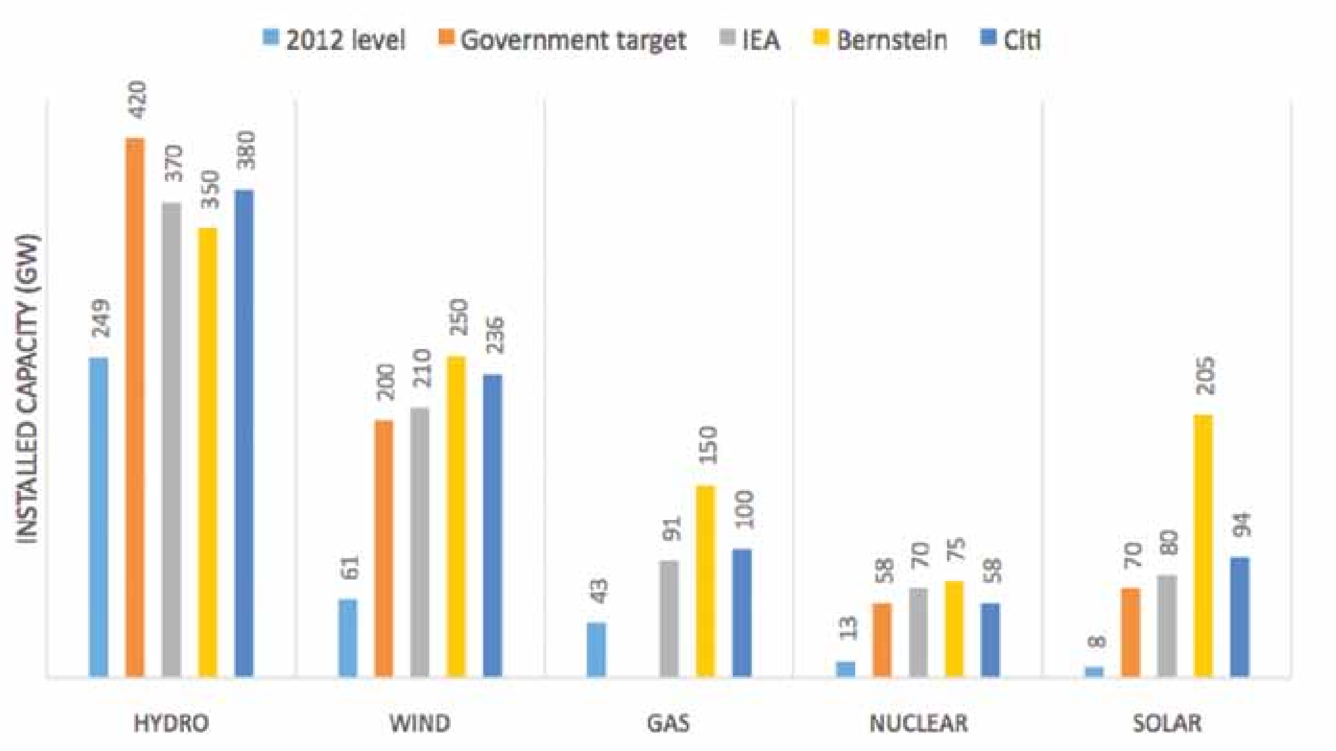
In June 2014, the chairman of China's Advisory Committee on Climate Change announced that an absolute cap on carbon dioxide emissions can be expected in China's next five year plan, which comes into force in 2016.[54] This cap will serve to reduce the capacity of China's coal sector to meet future power demand due to the fact coal is the largest carbon dioxide emitting energy source of the conventional fossil fuel types. This step is another signal that China is willing to take significant actions to move its energy and power sources away from heavy polluting industries.

4. Driver of increased competitiveness from non-coal power sources

In 2012, non-coal power sources grew faster than overall power consumption growth, translating into a decline in growth share for thermal coal. The rate at which these non-coal power sources will continue to grow is an integral factor in considering potential early peaking thermal coal demand.

Figure 10 displays the different installed capacity forecasts from a selection of secondary sources - the IEA, Bernstein Research (predicting thermal coal peaking in 2016)[55] and Citi (predicting 2020 will be the turning point[56]). While these different forecasted scenarios provide only a point in-time perspective of China's future power mix, the analyses provide interpretations of key drivers and offer useful reference points of differing, but feasible power futures. Barring the contribution of hydropower, all scenarios predict installed capacity by 2020 will exceed targets for wind, nuclear and solar displaying a clear belief in the Chinese Government's drive to diversify the country's power base. With the arrival of a Renewable Portfolio Standards potentially imminent, the renewable energy sector looks set to receive greater political support in the future.

Figure 10: Comparing installed capacity forecasts for non-coal power sources to 2020[57]



Strong backing for gas

The ability for gas-fired power generation to substitute for coal can be seen as one solution to the air pollution crisis and, as such, suggests a strong future for the power source. As an example, Beijing has already outlined that by the end of 2014 it will have replaced coal-fired power plants with natural gas plants equivalent to 40% of its targeted 23mt coal cut.[58]

Conventional natural gas

Both domestic gas consumption and imports of liquid natural gas (LNG) are increasing in China. In 2011 China achieved natural gas consumption of 130bcm and has set a target of 230bcm by 2015 in the 12th FYP; approximately 8% of the power mix.[59] The NDRC estimates that if this 2015 target is met that the additional 120bcm will mitigate 5.8m tons of SO2 emissions, equivalent to 28% of national emissions, therefore positioning gas in a strong position to help mitigate air pollution.[60]

China has technically recoverable natural gas reserves of approximately 32tcm – vast in comparison to current supply levels. China is attempting to exploit more of these reserves by, for example, alleviating current transportation constraints with the addition of more than 150bcm of pipeline capacity to those three regions[61] targeted most heavily by air pollution restrictions – Jing-Jin-Ji, the Yangtze and Pearl River delta regions. While domestic supply bottlenecks are being removed, China is also increasing its imports of LNG, most notably with the recent $400bn agreement with Russia for the supply of approximately 38bcm of natural gas annually for the next 30 years.[62]

Shale gas and coal-bed methane

A huge component determining the extent to which gas can substitute for coal in China is the level to which China is able to exploit its shale gas reserves, which the US EIA has adjudged to be the largest of any nation.[63] The near-term prospects for shale gas remain highly debated and uncertain given the early stages of exploration and development, geological complexity and market drivers. However, shale gas has been given strong political backing, development of the fuel was identified as a priority in the 12th FYP.

By way of illustration, Petrochina successfully applied fracturing technologies in two pilot shale projects at the end of 2013 in the Sichuan and Yunnan basins.[64] Furthermore, China has been active in seeking foreign expertise with Shell and Hess having signed Sino-foreign joint ventures with Chinese state-owned companies. Furthermore, the second of China's shale gas auctions was opened up to non-state owned and Sino-foreign ventures, representing a sign of the political will behind ramping up supply.

Post-2020, once price reforms take hold providing the financial incentives to develop domestic resources against imports, up to 88bcm of shale gas is expected to be supplied through to 2035 according to the IEA in 2013. However, it is anticipated that any acceleration of geological, market and technological preparedness in the meantime, will see forecasts exceeded, making higher estimates for gas capacity additions highly feasible.

Nuclear power

There is a general consensus that China will stick closely to its target of 58GW of nuclear power by 2020. Nuclear power projects are long-term developments and so in comparison to other power sources are less volatile and more predictable. Given that 1GW of nuclear power generation displaces 4mt of coal[65], the scaling up from 13GW in 2011 to 58GW in 2020 will see 180t cut from total coal consumption. In terms of a reduced power demand market this is significant.

Table 4: Provinces to increase renewable energy

Province	% increase in renewable energy capacity
Beijing	15%
Hebei	15%
Shandong	10%
Shanxi	10%
Tianjin	15%

Renewable energy power sources

China has outlined a sizeable up-scaling of renewable energy capacity in its 12th FYP in response to which a number of those provinces with coal reduction targets have also stipulated renewable energy goals (Table 4).

The US EIA gives an indication of the potential impact this will have on thermal coal demand by estimating that if all renewable targets are met and come at the cost of coal-fired power, it would reduce coal's proportion of the energy mix to 63% (from 79%) by 2020.[66]

Solar

Solar currently makes up a negligible amount of China's power generation mix – approximately 0.7% of installed capacity and a tenth of that in terms of generation. Outside forecasts exceed the Government's targets for future growth, however, with Bernstein being most bullish by forecasting a rise from 8GW of installed capacity to 205GW by 2020.[67]

In light of 2013 figures for installed solar capacity, this may not be quite the outlier it seems. According to Bloomberg New Energy Finance, China more than doubled its total solar power capacity over the course of last year alone, by adding 12GW.[68] This is more than any country has ever installed in one year. A further 14GW to be added during 2014 is targeted, making the original 12th FYP target of 35GW look conservative, a development that was acknowledged in the May 2014 announcement of an updated target of 70GW of solar by 2017.[69]

2013's surge in capacity additions was largely due to the Rmb 1/kWh feed-in-tariff for large photovoltaic projects only being applicable to those units connected to the grid by the end of 2013. A feed-in tariff remains in place, scheduled to last 20 years. Nevertheless, it is the proximity of solar to grid parity – the point when electricity supply sits at the same cost to ratepayers as traditional technologies[70] - to coal-fired power generation that largely underpins earlier peaking demand forecasts. As the technology and market for solar advances, costs will only continue to decline leading some solar industry participants to predict that a levelling in cost of solar PV to coal-fired power generation will occur by 2016.[71]

Wind

For the first time ever, 2012 saw wind power generation capacity additions of 26TWh increase more than thermal coal-fired power generation, which only grew by 12TWh, a mere 0.3%.[72] The Fourth Wind Survey by the China Meteorological Administration estimate total wind power potential to be 2TW to 3.4TW, of which 500GW is potentially exploitable offshore wind.[73] Broadly speaking, this suggests that meeting the 200GW of installed capacity target by 2020 – 30GW offshore – is certainly within reach.

In 2012, the utilisation rate for installed capacity was only 19% because many wind farms were not connected to the grid.[74] As a result wind power capacity additions were 5GW lower in 2012 than 2011. The State Grid is attempting to alleviate this inefficiency with the addition of 30,000km of high-voltage transmission capacity.[75] Overall, the potential for wind power to make a meaningful contribution to China's air pollution problem is significant given the highest wind speeds found in the north-east in particular – conveniently also the region where power demand and coal-fired generation are highest.

Hydropower

Hydropower capacity targets articulated in the 12th FYP exceeds predictions from the selected secondary sources featured in Figure 10 on what is considered feasible. Currently, hydropower is the only renewable power source at scale in China. As such, there is general scepticism about the extent to which this sector can expand. A number of commentators, such as Bernstein Research and Citi, assert that the majority of non-navigable, large, fast-flowing rivers largely been brought online with only smaller, less powerful rivers remaining as exploitable opportunities. However, in 2012, China added additional 16GW of hydropower – a record increase in capacity providing evidence that the power source may still be set to expand in line with targets.[76]

5. Implications for China's coal sector and its investors

As a country, China has an abundance of coal. However, in the recent past a number of domestic producers have suffered from numerous supply bottlenecks that spurred a transition towards imported coal. There have been significant efforts to remove these bottlenecks in order to deliver increases in domestic production such that - combined with increased imports - the Chinese market has become oversupplied.

Slowing domestic thermal coal demand growth has exacerbated the coal sector's overcapacity, resulting in losses to coal producers, consumers and their investors. Large sums of proven and potential coal reserves and coal-fired power capacity, combined with weaker forward demand, signal that the this transition – and the associated fallout – is not yet complete.

This provides an opportunity for investors to be well positioned to benefit from the changing dynamics of China's power sector by identifying the winners and losers in the market in order to align more closely with the transition to a more diversified power sector.

China's coal companies' are losing value

Both China's coal suppliers and consumers may experience losses through the changing power market as the Chinese Government puts in place proactive policies to overcome environmental problems, in addition to consolidating its coal sector. On a provincial level, governments are gradually shutting down coal-mines with capacities under 90,000 tonnes per year as well as those that do not comply with safety requirements. Estimates suggest this effort will close 1,725 mines with a capacity of 117.48 million tonnes.[77]

Operators of coal-fired power generators are being affected in a similar manner. For example, in Hebei, the second highest consumer of coal, it was announced all power generation assets less than 100MW will be retired and to begin retiring those under 200MW that are not co-generation facilities,[78] incurring write-downs in the region of Rmb15 billion (USD$2.4bn).[79] In Beijing the target has been set to retire 1,200 high polluting companies by 2017, which will start with those smaller, less efficient operators.[80]

These signals towards a consolidated coal sector are arguably beginning to be reflected in the financial performance of coal producers and the respective share prices. For example, China Shenhua Energy Co., China's largest coal producer (and often used as a proxy for the 'health' of energy shares), reported an 11.5% drop in net income for the first nine months of 2013[81], largely due to increasing costs not being matched by demand and price increases. This resulted in Rmb 1104 billion (USD$178 billion) being lost in its market value since share prices peaked in 2007.[82] Similarly, China Coal Energy Co.'s net income fell 65% in 2012 on the previous year and the share price has fallen 82% since 2008.[83] These trends have been increasingly observed across the sector as a whole.

5.1 Asset stranding from 'early-peaking' of thermal coal demand

Future stranding of coal-fired power generation assets

'Stranded assets' are defined by the IEA as *'investments which have already been made but which, at some time prior to the end of their economic life, are no longer able to earn an economic return'*[84]. The intervention that causes stranding can arise due to a number of factors including regulatory changes or economic changes such as in price or cost.

Managing the transition in China's thermal coal demand from strong growth to a peak and subsequent fall will inherently result in a degree of asset stranding because the assets installed to meet this high demand will have lifetimes that extend beyond the period for which they are needed and economic. For example, coal mines have lifetimes up to and over 20 years and coal-fired power plants have lifetimes up to and over 40 years – in the instance that demand transitions from strong growth to peaking demand in as little as 15 years, as is possibly happening in China's coal sector, the mismatch in timeframes will lead to stranded coal assets. The more rapid and stark this transition the greater the extent that unmanaged asset stranding may be.

In the previous section, Table 1 highlighted that forecasts for China's peaking thermal coal demand range from 2015 to 2030. Peaking at the earlier end of the forecasted range could occur from a combination of factors including aggressive policy ambitions on behalf of the Chinese Government and significant investment into non-coal power alternatives. The 'early-peaking' scenario would lead to a far greater level of 'asset stranding' because the difference between the expected trajectory of demand on which investments would be based and the realised pathway of lower demand and pricing would be greatest.

In order to illustrate this risk, the IEA's 'Current Policies Scenario'[85] (i.e. 'business as usual') has been compared with the earliest peaking thermal coal demand scenario (based on analysis published by investment banks included in the research). This illustrates the maximum amount of thermal coal power generation capacity that could potentially be stranded in a lower-than-expected demand future, i.e. those assets which, if built on an assumption that thermal coal demand will grow strongly in the future, would be uneconomic if market and regulatory forces serve to peak demand for thermal coal.

Figure 11: Coal-fired power capacity at risk of stranding with near-term peaking coal demand[86]

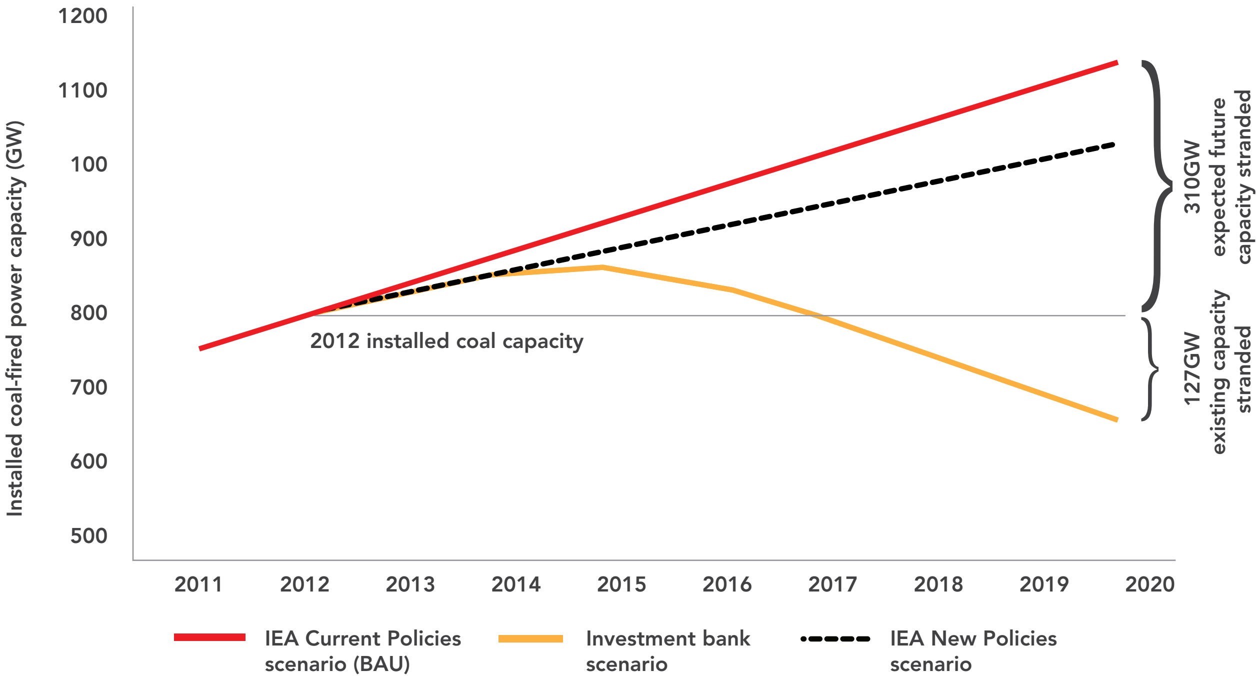


Figure 11 reveals that up to 437GW of China's coal-fired power generation capacity could be at risk of stranding by 2020 due to lower-than-expected demand, equivalent to up to 40% of total installed coal-fired capacity by the end of the decade. The IEA's 'New Policies Scenario' shows that the 'cautious implementation' of already announced policies does not significantly reduce the scale of potential coal-fired power generation asset stranding. As it currently stands, the operators of the generation assets which are 'stranded' will incur financial losses should the write-down of these assets occur, i.e. to reduce the book value such that they are not carrying more than their recoverable amount.

However, of particular importance is that over 70% of the difference in generation capacity between the two scenarios in Figure 11 is comprised of expected future capacity that might yet have a pending - and therefore open to influence - investment decision. By way of illustration, of the 437GW at risk of stranding, 127GW of this coal-fired capacity is already installed (against 2012 levels) and would potentially be stranded, but up to 310GW of potential additional capacity is not yet built meaning significant capital is still recoverable.

The changing dynamics of China's thermal coal sector pose a significant financial risk to power generation companies such that the various stakeholders involved – including the companies, their investors and policy-makers - should re-consider current investment decisions against lower demand futures that could rapidly strand coal-fired capacity and result in wasted capital.

Stranded thermal coal supply

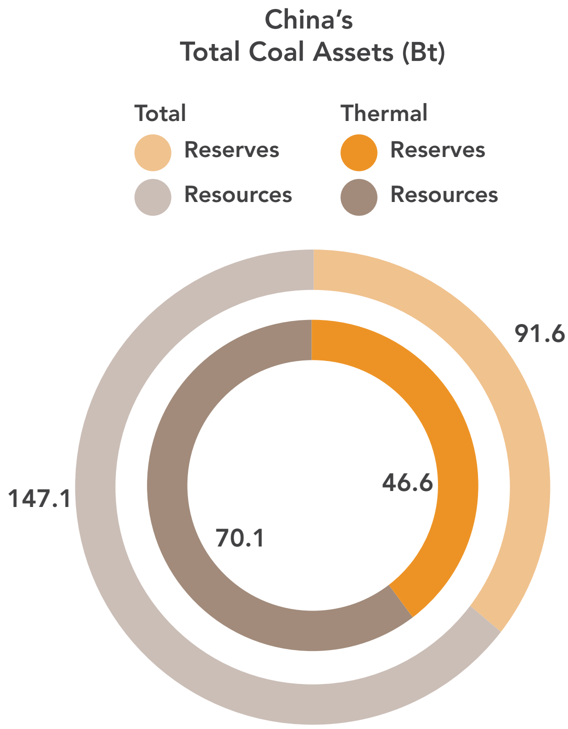
The potential gap between business as usual and peaking demand (Figure 11) is equal to 1030m tons of annual thermal coal supply (56% of China's demand in 2012) that may not have an end-market in 2020.[87] This signals that an end to the oversupply of China's coal does not appear imminent.

In this context, it is important to consider that China holds vast sums of coal reserves and resources that are, to different degrees of certainty, waiting to be consumed (Table 5).

A noteworthy portion of these reserves and resources are controlled by 'SASAC' - the State-owned Supervision and Administration Commission (SASAC) of the State Council. However, within the remaining assets are those owned by state-owned companies, resulting in the overall reserves and resources apportioned to the state being larger than SASAC assets alone. The remainder of this is owned by private and publically listed companies.

Table 5: Reserves and resources in China[88]

	All Coal	Thermal Coal
	Total (Bt)	**Total (Bt)**
Reserves	91.6	46.6
Resources	147.1	70.1
Non-SASAC reserves	72.5	36.1
Non-SASAC resources	114.9	52.1



The notable statistic from Table 5 is the huge scale of China's total coal reserves and resources. Current coal reserves equal 91.6bt, all of which are expected to be burnt and return value, will supply the domestic market for over 23 years assuming China's coal consumption peaks and remains constant at 3.9 billion tons as the Government has targeted.

This does not account for the likely decline in consumption after peaking and the contribution from those coal resources that are likely to be proven. If all 147.1bt of coal resources are proven and brought to market, based on the same assumptions as above, this is equivalent to 38 years of coal supply in China – industry classifications mean those assets termed 'resources' include coal 'reserves'.

As previously stated (Table 3), approximately half of China's coal is thermal – consistent with the current proportion of China's total coal use. On this basis, China's current thermal coal reserves will supply current demand levels for 23 years also, whilst China's thermal coal resources will supply power demand for 36 years.

These thermal coal reserves and resources constitute significant future supply that could be at risk from an early-peaking demand future. This poses a potential risk to the value of China's coal extraction companies' thermal coal assets and their investors' holdings.

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[c]Coal companies distinguish between coal assets according to their probability of being exploited. See Appendix for details of China's coal classification system. To give an indication however, typically 'reserves' are defined to have at least a 90% certainty of being exploited. Coal 'resources' are defined as having at least a 50% probability of being exploited.

Coal asset value-at-risk

A range of scenarios have been developed that explore the impact of lower coal prices to the value of coal assets in line with a future peaking of global coal demand post-2020, i.e. illustrative of the changes being predicted for China's coal sector. HSBC revealed that such a future could affect the valuations of coal assets by as much as 44% as it becomes uneconomical to extract the assets from the ground and bring them to market.[89] For Glencore Xstrata, a large international diversified company with 33% of EBITDA sourced from coal, this translated into a 7-15% downside risk on market value – a hugely material impact for investors in China's coal sector. For pure coal companies, there is even less resilience to drops in asset value where there are few or no alternative revenues sources.

Investors should expect the policy regulations currently having a material impact on China's coal, as outlined in this report, to not only persist but to deepen, particularly as China's environmental challenges continue. In such a future, investors have an opportunity to reassess the extent of assets potentially at risk across China's coal sector.

5.2 China's capital markets potential exposure

Hong Kong Stock Exchange most exposed

China's investors are predominantly exposed to the risks of lower-than-expected thermal coal demand for power through those companies listed on its stock exchanges.

A number of China's largest state-owned groups are also parent companies of energy and/or pure coal companies listed on China's stock exchanges. In order to better understand how much of China's total thermal coal is owned by listed companies, Table 6 attributes the reserves and resources of those state-owned groups to the listed entities in which a controlling stake is owned, i.e. over 51% of stock.

This represents the maximum amount of thermal coal assets under control of the listed entity which, alongside those non-state controlled listed coal companies, gives the total listed thermal coal reserves and resources on the Shanghai, Shenzhen and Hong Kong Stock Exchanges.

Table 6: Thermal coal reserves and resources listed on China's stock exchanges

	Parent Company	Listed company/ subsidiary (ownership %)	Ticker	Max thermal reserves (Bt)	Max thermal resources (Bt)	Market Cap (CNYbn)
Shanghai stock exchange		Datong Coal Mine Group Co Ltd	601001 CG EQUITY	4.2	8.9	10.5
		Yangquan Coal Industry (Group) Co Ltd	600348 CG EQUITY	0.1	0.3	15.0
		Yanzhou Coal Mining Co Ltd	600188 CG EQUITY	2.0	3.1	33.2
	Shanxi Coal Import and Export Co Ltd	Shanxi Coal International Energy Group (57%)	600546 CG EQUITY	0.1	0.1	8.2
		Zhengzhou Coal Industry & Electric Power Co Ltd	600121 CG EQUITY	0.2	0.3	4.4
			Totals	**5.6**	**12.7**	**71.3**
Shenzhen Stock Exchange	Shanxi Coking Coal Group Co Ltd	Shanxi Xishan Coal & Electricity (54%)	000983 CS EQUITY	0.6	0.8	17.9
		Jizhong Energy Resources Co Ltd	000937 CS EQUITY	0.2	0.3	14.4
			Total	**0.8**	**1.1**	**32.3**
Hong Kong Stock Exchange	Shenhua Group Co Ltd	China Shenhua Energy Co (73%)	1088 HK EQUITY	12.0	17.3	297.3
		Datang International Power Generation Co Ltd	991 HK EQUITY	6.6	6.6	54.4
	China National Coal Group Corp	China Coal Energy Company Limited (56.6%)	1898 HK EQUITY	4.2	4.7	67.4
			Total	**22.8**	**28.6**	**419.1**

Key observations:

- China's stock exchanges have high exposure to China's thermal coal with over 80% of China's total non-SASAC thermal reserves attributed to coal companies listed on the Shanghai, Shenzhen and Hong Kong stock exchanges. This reduces to 61% when looking at China's listed non-SASAC thermal coal resources as a percentage of total resources.
- The Hong Kong Stock Exchange is far more highly exposed to fluctuations in the value of China's thermal coal sector than the Shanghai and Shenzhen exchanges, on account of having over three times the listed thermal coal reserves and twice the listed thermal coal resources than the other two exchanges put together.

Hong Kong exposed to foreign coal

In addition to thermal coal located in China, the Hong Kong Stock Exchange also lists coal companies with thermal coal assets located outside of China (Table 7). This further exposes the exchange to assets within what may emerge to be a structurally declining market.

Table 7: Thermal coal assets listed in China, located outside of China

	Listed company	Ticker	Thermal reserves (Bt)	Thermal resources (Bt)
Hong Kong stock exchange	United Company Rusal Plc	486 HK EQUITY	1.3	2.3
	CNOOC	975 HK EQUITY	0.0	2.7
	CLP Holdings Limited of Hong Kong	883 HK EQUITY	0.5	0.5
		Totals	**1.8**	**5.5**

Thermal coal assets of the listed companies identified in Table 7 are located in Kazakhstan and Australia. On this basis, the value of these assets are more susceptible to changes in policy and regulation, political decision-making and market conditions of these given countries. In a situation whereby there is a loss in asset value, the emergence of this risk could have feed through effects to the Hong Kong Stock Exchange.

The Hang Seng Enterprises Index is heavily reliant on prosperity of China's coal sector

Through participation in market indices the financial performance of China's coal companies is passed on to investors not only invested directly in the companies themselves, but also to those passive investors tracking these indices. With this in mind, investors are encouraged to understand and evaluate the exposure of each index to China's coal assets.

A number of the listed companies with thermal coal reserves and resources are listed on the main indices of the Shanghai, Shenzhen and Hong Kong Stock Exchanges. Analysis of the CSI300 (an index of 300 A-share stocks listed in Shanghai or Shenzhen); the Hang Seng Index (of the largest 50 listed companies on the Hong Kong Stock Exchange); and, the Hang Seng China Enterprises Index demonstrates that these indices have, on average, seen declines in the region of 30% over the past 3 years.

Table 8 illustrates that those tracking the Hang Seng China Enterprises Index are far more exposed to the future commercial prosperity of China's thermal coal sector than the other two indices. The market capitalisation of listed coal companies with thermal coal assets on the Hang Seng China Enterprises Index comprises 18% of the total index market cap, as opposed to 2% for both the Hang Seng Index and the CSI300 Index.

Table 8: Index exposure to thermal coal reserves and resources

Index	Total thermal reserves (Bt)	Total thermal resources (Bt)	Total market cap of coal companies (CNY Bn)[d]	Market cap of coal companies as % of total index market cap
Shanghai Shenzhen CSI 300 Index	7.2	13.5	96.54	2.0%
Hang Seng Index	12.0	17.3	292.8	2.0%
Hang Seng China Enterprises Index	16.2	22.0	344.6	18.2%

[d]Companies market capitalisation aims to represent coal dependent value by reducing total market cap by an amount proportional to revenues derived from non-coal activities

5.3 Investors to evaluate coal companies' capital expenditure

Table 4 illustrates that the coal companies with thermal coal assets listed on the Hong Kong Stock Exchange are considerably larger than China's other coal companies listed on the Shanghai and Shenzhen Stock Exchanges in terms of market capitalisation. They also own the vast proportion of China's listed thermal coal. By way of illustration, China Shenhua Energy Co., China's largest coal producer, has a dominant role in China's thermal coal production controlling over half the thermal reserves on the Hong Kong Stock Exchange, while Datang International Power Generation Co. and China Coal Energy Company Ltd. also control significant thermal coal assets.

These companies are, therefore, most exposed to the changing dynamics of China's thermal coal sector. They are also likely to be deemed most investible due to their size, and perceived security in terms of market capitalisation. On the basis of the analysis in this report, investors are encouraged to evaluate closely the business models and decision-making of these companies in particular, in terms of accounting for changing market conditions. Of particular interest from the investor perspective is the projected capital expenditures towards developing and expanding coal production.

Questioning coal capital expenditure

The capital necessary to bring to market the approximate 23 years of demand that can be supplied by current proven thermal coal reserves is to a degree already sunk into these assets. However, for a great deal of China's coal resources, this decision will still be being influenced by market and regulatory conditions.

Table 9 reveals that the CAPEX in 2013 of China's listed companies with significant thermal coal assets was an estimated Rmb 129 billion (USD$21 billion).

Table 9: Capital invested by China's coal companies in 2013

	Parent Company	Listed company/subsidiary (ownership %)	Ticker	Capital expenditure 2013 (CNY bn)[e]
Shanghai Stock Exchange		Datong Coal Mine Group Co Ltd	601001 CG EQUITY	1.9
		Yangquan Coal Industry (Group) Co Ltd	600348 CG EQUITY	1.3
		Yanzhou Coal Mining Co Ltd	600188 CG EQUITY	10.2
	Shanxi Coal Import and Export Co Ltd	Shanxi Coal International Energy Group (57%)	600546 CG EQUITY	4.4
		Zhengzhou Coal Industry & Electric Power Co Ltd	600121 CG EQUITY	0.7
			Totals	**18.5**
Shenzhen Stock Exchange	Shanxi Coking Coal Group Co Ltd	Shanxi Xishan Coal & Electricity (54%)	000983 CS EQUITY	1.7
		Jizhong Energy Resources Co Ltd	000937 CS EQUITY	3.4
			Total	**5.1**
Hong Kong Stock Exchange	Shenhua Group Co Ltd	China Shenhua Energy Co (73%)	1088 HK EQUITY	51.7
		Datang International Power Generation Co Ltd	991 HK EQUITY	32.6
	China National Coal Group Corp	China Coal Energy Company Limited (56.6%)	1898 HK EQUITY	21.1
			Total	**105.3**

[e]CAPEX totals have been apportioned in line with the percentage of total company revenue derived from coal where this total is under 90%. Above 90% the total CAPEX figure has been used.

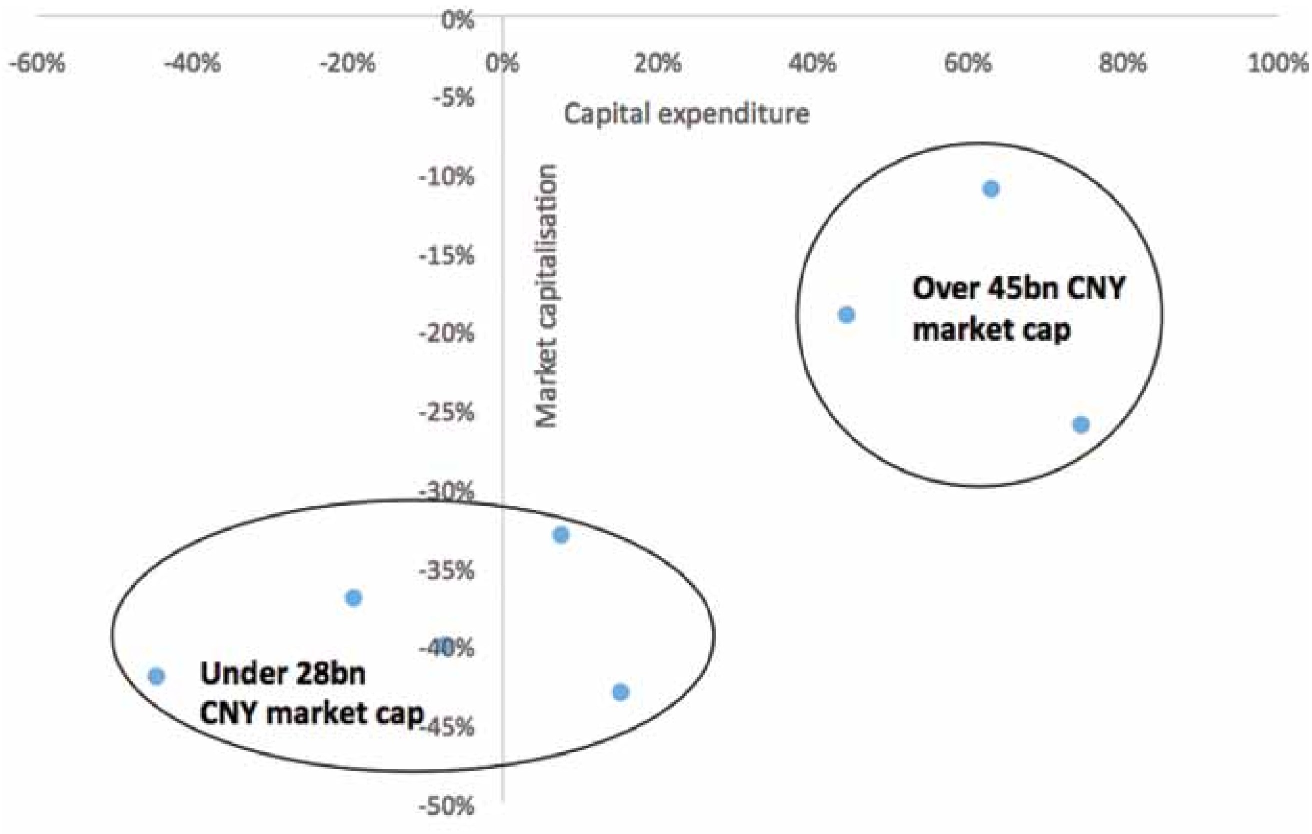
Key observations:

- China Shenhua Energy Co invested almost twice as much capital in 2013 as any other company with thermal coal assets, dominated the above analysis.
- Companies listed on the Hong Kong Stock Exchange reflect over 80% of total capital expenditure spent by Chinese coal companies.

A high risk approach?

The above analysis illustrates the divergence in the scale of capital spending between the largest three coal companies listed in Hong Kong and the remainder of China's listed coal companies. Furthermore, as Figure 12 illustrates, in spite of falling value over the past 3 years, these three companies (with market capitalisations in excess of Rmb 45bn) have continued to expand capital expenditure, while smaller companies have followed the reverse trend of reducing capital expenditure.

Figure 12: Percentage change in market capitalisation and capital expenditure for listed companies over the last 3 years



A potentially aggressive strategy for expansion – there are two possible outcomes to be considered for these three larger companies; i) an increase in market share, exploiting better positioning and resilience to lower demand environments that will potentially force smaller competitors out of the market (as Figure 12 shows, their market capitalisation is decreasing less quickly than that of smaller competitors); or ii) China's coal sector decline is more structural than currently perceived, meaning greater capital expenditure results in greater capital at risk and potentially accelerates the challenges associated with lower cash flow.

5.4 Risk factors to coal companies

The following section provides an overview of factors that could determine exposure of China's coal companies to a low demand future.

Debt levels

China's coal prices fell 25% in 2012 to Rmb530/ton (USD$85.5/ton) from Rmb855/ton (USD$137.9) in November 2011.[90] The fall in price levels resulted in a fall below production break-even point, forcing output to lower and result in lost revenues for a number of producers. These prices have not rebounded and it is likely that peaking coal demand will prolong lower prices. Consequently, it is assumed that it is increasingly important for China's coal companies to manage capital more productively as debt servicing becomes more challenging.

For example – in 2013, a now-defunct Shanxi coal-mining company defaulted on its Rmb 3 billion (USD$500m) trust loan. The trust loan default was the first of its kind in China and had previously promised investors a yield of 10%.[91]

The occurrence of such a significant loan default negatively impacted on the ability of many coal companies' to raise further capital on lower cost structures. Integral to this development has been an order from the Chinese Banking Regulatory Commission (CBRC) to regional offices to improve and enhance regulatory scrutiny of credit risks associated with the coal-mining industry.[92] By way of further illustration, in Hebei province, the second largest coal producer in China, banks rejected loan applications to polluting industries worth Rmb 13.2 billion (USD$2 billion) in 2013.[93]

Table 10 over the page depicts that the debt to market capitalisation ratio – a broad indicator of a company's ability to service debt and raise capital - of those listed companies with thermal coal reserves has, almost universally, deteriorated over the past 3 years. China's largest coal companies – Shenhua Energy and China Coal Energy– have fared better against the sector, with the latter in particular being the only company to improve its debt rating against market value.

From an investor perspective, awareness of this risk is important and provides an opportunity for closer monitoring of i) those companies whose ratio is increasing most rapidly – for example, Shanxi Coal International Energy Co.; and ii) those companies whose ratio is the largest relative to those within the sector – for example, Datang International Power Generation Co.

Table 10: Coal becoming an increasingly indebted sector

Listed company/ subsidiary	Debt to market cap (April 2011)	Debt to market cap (April 2014)	Change (+/-)
Datong Coal Mine Group Co Ltd	0.04	0.32	+0.28
Yangquan Coal Industry (Group) Co Ltd	0.07	0.25	+0.18
Yanzhou Coal Mining Co Ltd	0.15	1.88	+1.73
Shanxi Coal International Energy Group (57%)	0.47	2.57	+2.10
Zhengzhou Coal Industry & Electric Power Co Ltd	0.22	0.9	+0.68
Shanxi Xishan Coal & Electricity (54%)	0.12	0.95	+0.83
Jizhong Energy Resources Co Ltd	0.13	0.94	+0.81
China Shenhua Energy Co (73%)	0.11	0.28	+0.17
Datang International Power Generation Co Ltd	2.42	4.42	+2.00
China Coal Energy Company Limited (56.6%)	1.15	0.94	-0.21

Coal quality

Efforts to rationalise China's coal sector have commenced, largely driven by actions to correct current overcapacity issues and respond to certain environmental problems. In this evolving scenario, an important option remains the closure of mines supplying less competitive, low quality coal.

Low quality coal can primarily be defined based on the following criteria; i) sulphur content which has a direct impact on the polluting capacity of burning coal; ii) ash content which reduces the calorific content of coal or can be washed out, consuming water and incurring additional costs in the process; iii) moisture content which reduces the calorific content of the coal or can be removed at additional cost; and iv) the calorific value/ heating value which determines the amount of coal needed to be burnt per unit of energy.

The China's National Energy Administration estimates that in 2014, 1,725 small mines producing 117.48mt of low-quality coal will be phased out[94]. However, this contribution alone will not correct over-supply in China's coal sector. Consequently, additional small and inefficient mines responsible for producing low quality coal can be expected to close. Understanding how differentiated coal quality produced by certain coal-mines relates to broader market transitions provides investment opportunities.

Figure 13: Coal quality comparison of China's biggest thermal coal assets

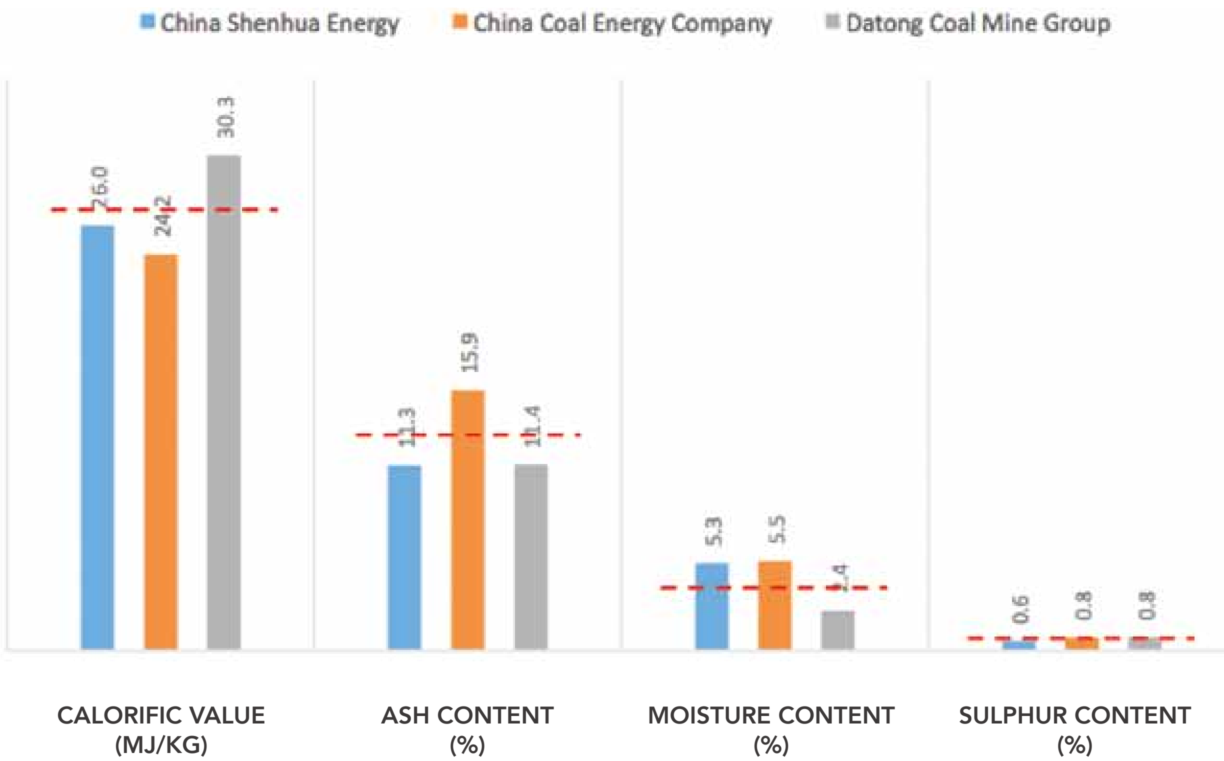


Figure 13 focuses on the quality of thermal coal of China's largest thermal coal companies (data was not available for Datang International Power Generation Co.) and compares this to the sectoral average for each quality indicator across China's total thermal coal (as represented by the red dotted line).

Leveraging analysis of coal quality allows investors to understand how certain assets positioned against the sectoral standard and can be used as a gauge of resilience to lower-than-expected demand and possible regulatory risks.

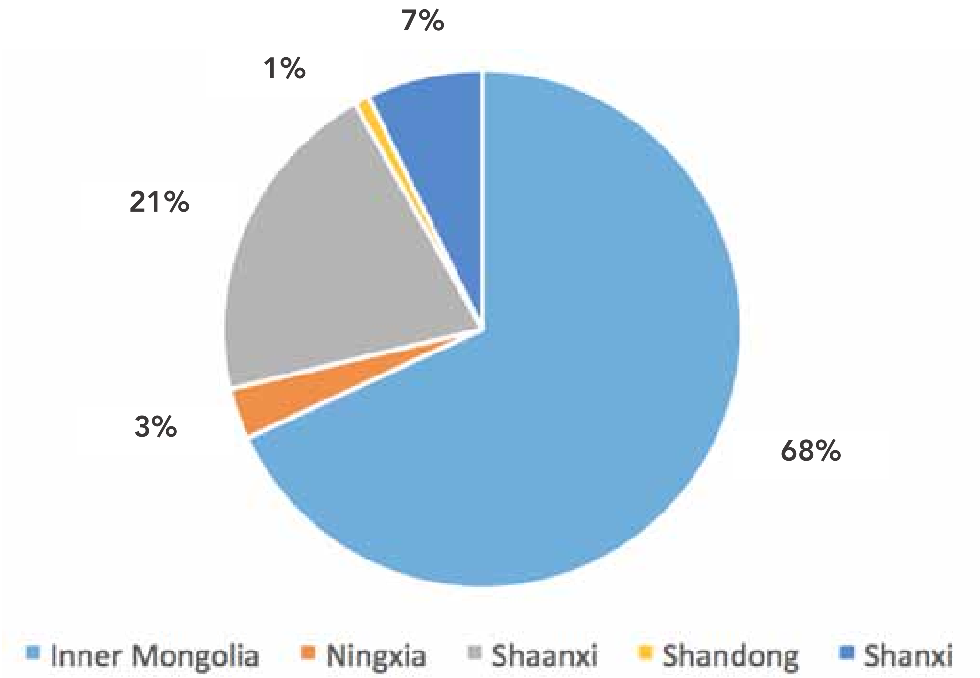
Geographic location

The geographic location of a company' coal assets can have a material impact on its market competitiveness, determined on the basis of; i) distance from demand centres; and ii) differences in extraction feasibility due to regional geological variation.

As outlined in the report, China's coal consumption centres are predominantly located in the north-east of the country. In terms of extraction feasibility, the southern parts of China are considered to be more geologically complex, with a higher probability of complications and subsequent higher supply costs. Areas in the west of the country, including Xinjiang, are home to vast sums of coal. However, such areas are less explored and present larger unknown risks. Furthermore, these areas are positioned furthest from coal demand centres. This is likely to result in higher costs associated with transportation of coal or transmission of power.

On the basis of geographic location, the larger and more sophisticated coal companies tend to own China's most favourable mines. For example, China Shenhua Energy's mines are located in five provinces that perimeter China's coal consumption centres (Figure 14).

Figure 14: The location of China Shenhua's thermal coal is in close proximity to its market



Political backing

Coal companies that are fully state-owned, or in which the state has a controlling stake, could be considered to be in a stronger position in an oversupplied market to be rationalised. It is likely that China's leading mining groups will be maintained and grown so that such companies can compete with other mining powerhouses in international markets. As such, measures to protect these entities in the future are to be expected. In some instances, state-owned groups benefit from subsidies, lower-cost loans and easements for infrastructure development to help garner a competitive advantage in the marketplace.

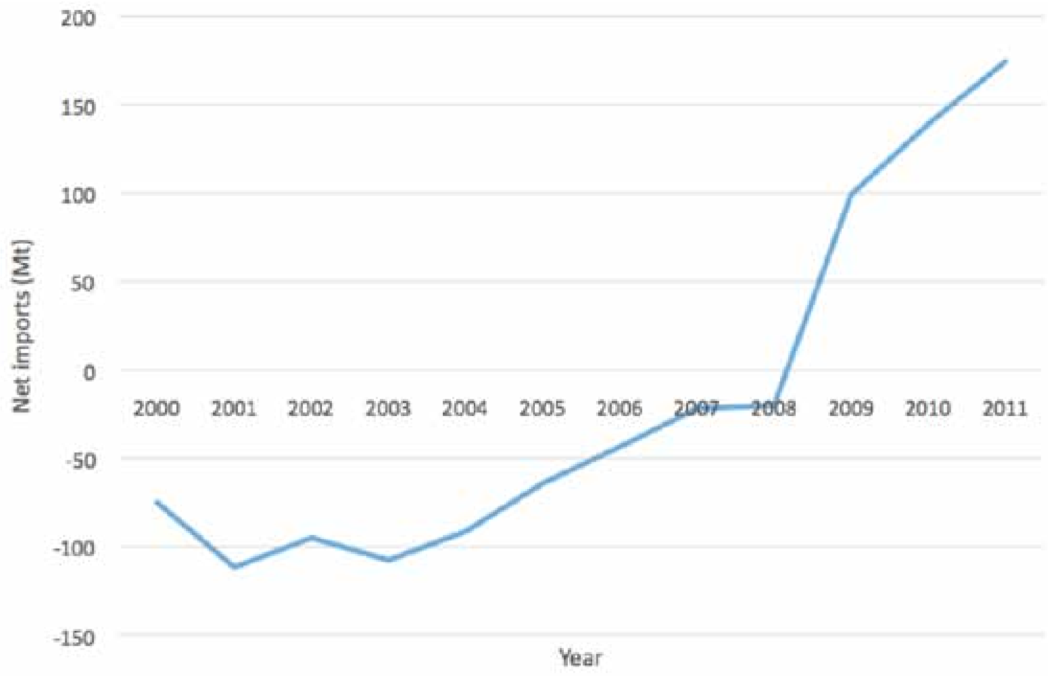
No diversified revenue sources

Those suppliers whose revenues rely wholly on thermal coal are more vulnerable to a slowing thermal coal sector than those with more diversified revenue sources. Slowing thermal coal demand should incentivise coal companies to transition into broader-based energy companies with operations and revenue streams reflecting China's changing energy sector.

6. Implications for international investors

Over the past 10 years China has become the biggest influencer on the demand and price of traded thermal coal. Figure 15 displays the rapidity with which China has shifted from being a net-exporter of coal to the largest net-importer globally - thermal coal accounts for approximately 80% of this total imported coal demand - as Chinese power generators enjoyed cheap international coal amid domestic supply issues.

Figure 15: China's net imports of coal[95]



There are indications that China will mitigate, as much as possible, the damage caused by slowing domestic thermal coal demand growth by consolidating its own coal sector. This is likely to result in a sharp deceleration in China's seaborne thermal coal demand. Exporters of thermal coal to China – working on the assumption that the Chinese market will soak up additional supply – will likely be the hardest hit.

6.1 International oversupply likely to deepen

There are two major trends occurring that suggest China's seaborne thermal coal demand is declining and the oversupply of international thermal coal markets is deepening; i) supply from domestic producers is increasing; and ii) China's absolute demand for thermal coal is approaching a peak.

Increased domestic supply

Since 2011, China's domestic production has grown by 800 million tons[96] – a significant amount in a slowing demand growth environment and a contributor to domestic over-supply. However, rather than reduce domestic supply, efforts are underway to improve transportation infrastructure in order to bring more of China's vast coal reserves and resources to market and reduce sector losses.

Developments in China's transport infrastructure have made progress moving away from truck deliveries exposed to expensive diesel and road tolls, to improved rail infrastructure. Estimates indicate rail added between 2010 and 2013 at 3938km - between 2013 and 2015, a further 9592km is expected.[97] This will make a significant contribution to reducing transportation costs such that previously unreachable demand centres are now an economically viable destination for additional supply. This goes some way to suggest a sizeable portion of the thermal coal market currently supplied by international exporters will be taken over by domestic supply.

Due to the geographical size of China, to a certain degree, there has been a bifurcated market with the coastal demand centres served more by international imports than central, land locked provinces - seaborne imports currently meet 7% of total demand and 20% of coastal region's demand.[98]

However, over 50% of China's proven coal reserves are in Inner Mongolia and Shanxi and over 65% of its resources are in these two provinces. This high level of regional concentration of supply means that once China establishes affordable transportation routes from these coal hubs they should be able to supply demand centres more from domestic producers, hereby mitigating domestic losses from reduced demand as much as possible.

Chinese seaborne demand to lower

International thermal coal markets are suffering from *'chronic oversupply…that will endure for a decade'* argues Wood Mackenzie, which also assumes global seaborne thermal coal demand – which accounts for approximately 93% of all traded thermal coal – will more than double between 2013 and 2035.[99] This provides indications as to to the potential scale of over-supply, and therefore coal assets at risk of being stranded, should traded coal demand growth not continue as previously experienced.

This viewpoint is supported by a large number of market commentators because China's coal supply is increasing alongside slowing total coal demand growth. For example, in May 2014, in a report published by Goldman Sachs, it was argued that China's seaborne thermal coal demand was 'past its peak'[100] after previously asserting that China's coal imports had gone from being a *'boost to a drag on demand'*.[101] The IEA corroborates this general trend in their latest World Energy Outlook report, whereby analysis estimates that China's net imports will peak before 2020 (under the 'New Policies Scenario') and reduce thereafter.[102] At the same time China's exports are reported to be growing month on month.[103] The combination of these factors suggest a convergence towards zero for China's import requirements in the future, leaving coal supply previously destined for China to find a new end-market or heighten the level of oversupply already present in international coal markets.

6.2 Who is reliant on China's imports?

Global coal exporters who are over-reliant on China's future coal demand are more exposed to value destruction from these trends and investors should be aware of the potential changing nature of the market, particularly in light of exposure to those exporters who could be left with stranded coal assets.

Figure 16: Chinese coal imports in 2012[104]

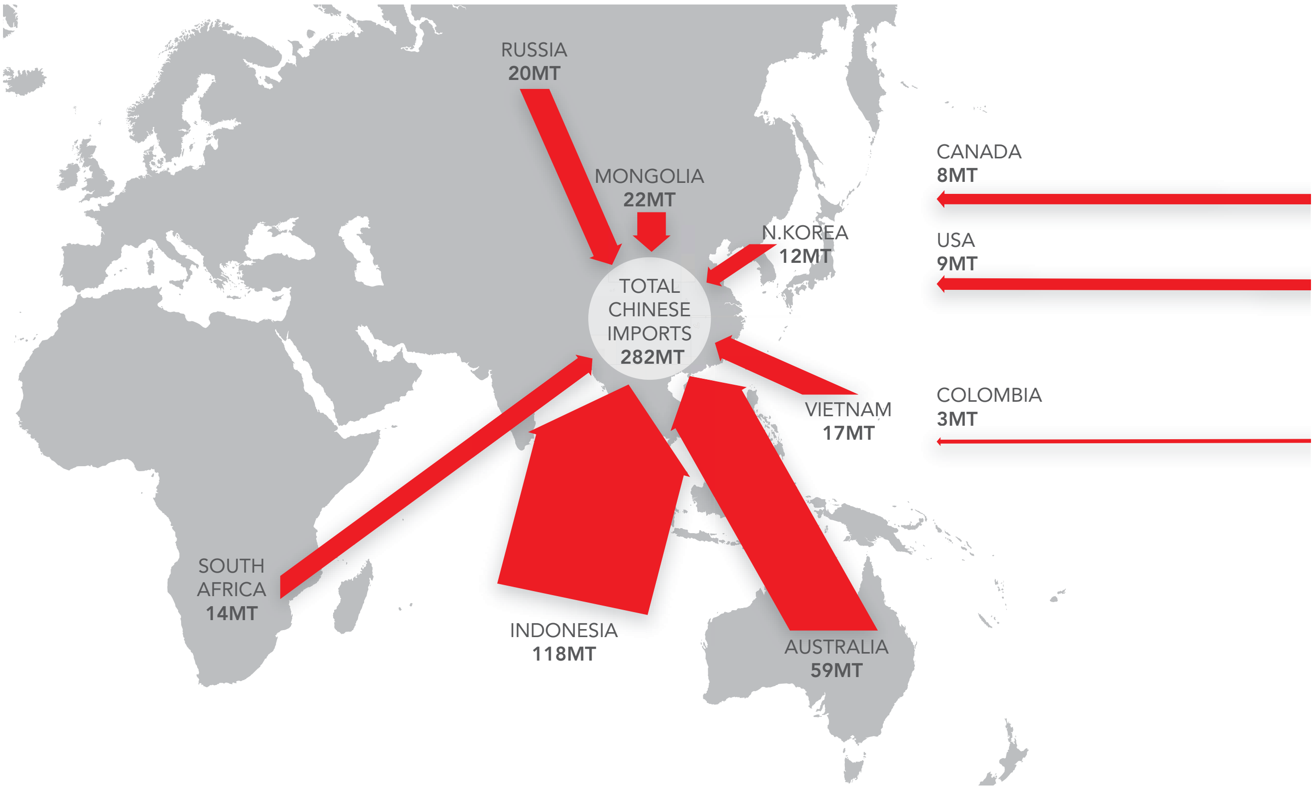


Figure 16 shows total coal exports to China in 2012. Approximately 220Mt of China's total imports of 282Mt was thermal coal.[105] Australian and Indonesian coal companies are the two largest exporters to China. Although Indonesia is by far the larger exporter, it is argued that Australia may be most exposed to lower demand levels because of its greater *reliance* on China as an export market, as illustrated by the following:

Australia has greater value-at-risk

In 2012, total thermal coal exports from Australia were valued at AU$171 billion[106]. It is estimated that 46Mt of Australia's thermal coal was exported to China, equating to 29% of Australia's total thermal exports. As such, the total value of thermal coal exports to China was AU$49.59 billion. This is equivalent to 20% of Australia's total merchandise exports.

Indonesia's total coal exports make up only 13% of its total merchandise exports[107], meaning thermal coal contributed roughly 10.4% to total merchandise if the industry average is applied. Overall, it can be concluded that Australia is more financially reliant on China's demand for thermal coal and therefore more exposed to the risks of future demand falls.

Indonesia to increase domestic consumption

Indonesia's consumption of its domestic coal stocks more than tripled in the past decade suggesting less of its current supply is available for export and indicating their reliance on Chinese seaborne coal demand is likely to fall.[108] Furthermore, in 2010, Indonesia imposed a market obligation on large coal producers requiring 24% of all supply to be sold domestically.[109]

Australia's risk analysis is questionable

The Australian Bureau of Resources and Energy Economics (BREE) is a significant voice in Australia's commodities sectors. However, it appears the notion of peaking coal demand and the drivers behind this transition does not factor into its analysis and recommendations. The BREE stipulates that *'emerging economies have limited, if any, policies in place to limit carbon emissions, and are expected to expand their coal consumption to fuel economic expansion,'* within which *'China is likely to remain a large coal consumer'*.[110]

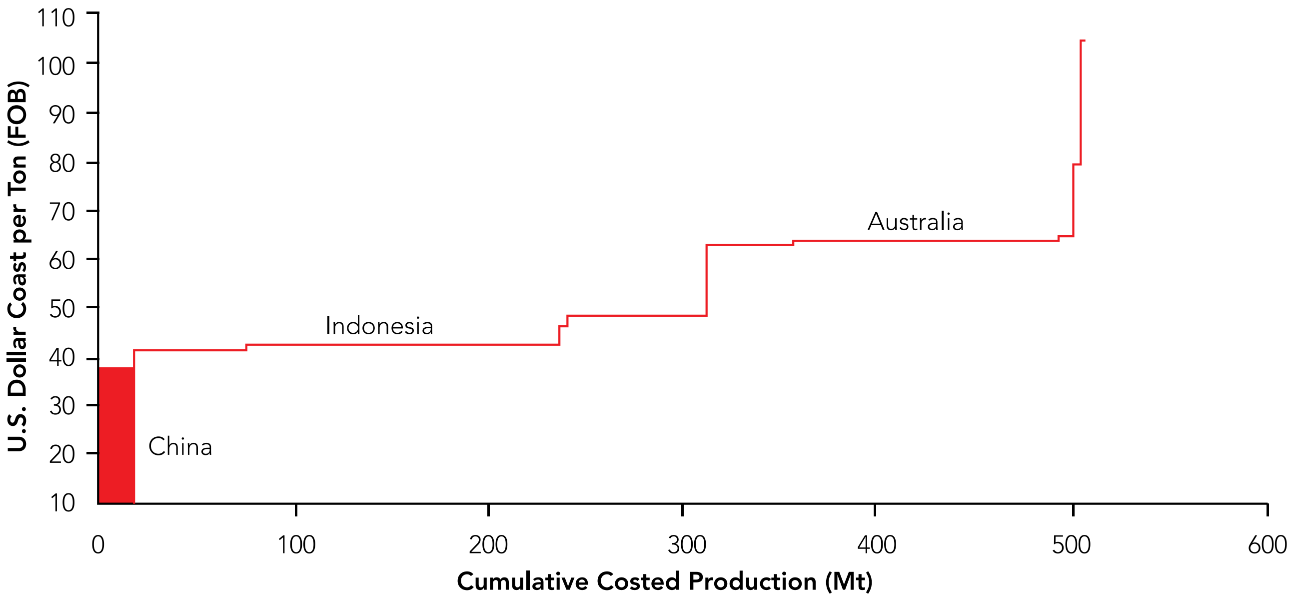
Although one Australian coal company recently called the present predicament for coal exports *'the most challenging coal market environment since the global financial crisis,'*[111] it appears BREE's forecasts are being adopted by the mainstream industry. For example, a number of new coal export terminals are being built along Australia's coastline. If all are constructed, this would increase Australia's total coal export capacity six-fold to 944Mt by the end of the decade.[112]

With clear uncertainty surrounding China's future seaborne coal demand, and few viable alternative export destinations existing outside of China, this brings into question whether export expansion of this scale could result in wasted capital expenditure into potentially strandable assets.

Indonesian supply costs undercuts Australia's

Figure 17 illustrates that on a completely unhindered market basis, Indonesian coal is supplied more cheaply to per ton than that of Australia. This means that Indonesian coal will be more competitive when demand falls and competition heightens between suppliers in an increasingly oversupplied market. This is likely to render some Australian coal without an end-market and stranded.

Figure 17: Exporter cost curve per ton, 2010[113]



Coal quality restrictions may strand Indonesian coal assets

The above analysis indicates that a number of factors favour Indonesian exports over those from Australia. However, one important driver that does not relates to the coal quality of which Indonesian coal is the worst of all exporters to China. Policy signals coming from China intimate that as part of efforts to reduce air pollution, increase coal-fired power generation efficiency and protect domestic coal producers, a restriction on the coal quality of imports is imminent. For example, in 2013, the Chinese National Energy Agency (NEA) released draft regulations that would restrict imports below 4,540kcal/kg on a net-as-received basis and with sulphur content above 1% and ash content above 25%.[114]

Domestic coal suppliers, however, are treated more favourably, with more lenient criteria only restricting supply of coal with heating value less than 3584kcal/kg, sulphur content above 3% and ash content above 40%. These restrictions were suspended in July 2013. However, in the context of worsening air pollution conditions, it is increasingly likely that these regulations will re-surface.

In this instance, the lower heating value of Indonesia's coal means it will be most adversely disadvantaged by such restrictions (Table 11) – lower coal quality increases the amount of coal needed to produce the same amount of electricity, meaning greater levels of emissions and local air pollution. Indonesian coal's lower calorific content means that while it is priced 30-50% lower than Australian coal,[115] the extra low grade coal required to produce the required amount of energy compared to a higher grade equivalent serves to negates somewhat these supply cost benefits.

Table 11: Quality of thermal coal from China's importers[116]

Country	Seaborne thermal coal 2012 (Mt)	Heating value (average KCAL/KG*)	Sulphur content (%*)	Ash content (%*)
Russia	15.6	6,177	0.34	11.7
Canada	6.24	5152	N/A	N/A
USA	7.02	5545	0.65	7.55
Colombia	2.34	6129	0.68	7.12
Australia	46.02	6008	0.57	14.6
Vietnam	13.26	7124	0.61	14.3
Indonesia	92.04	5029	0.72	6.9
South Africa	10.92	6141	0.8	13.8

* Where a range of values is given, the median value is presented

Furthermore, across thermal coal exporters to China, Indonesian coal has the second highest level of sulphur content. In comparison, Australia's coal is of a higher quality and therefore would theoretically be more resilient to a quality restriction on imports.

In summary, there are factors that suggest both weaknesses and strengths for China's two major exporters, Australia and Indonesia – and these can be balanced against one another. Regardless of these dynamics, both exporters are likely to be directly impacted by the peaking of China's thermal coal demand. Losses will be suffered as China consolidates its domestic sector, such that investors in either market should question the exposure of their investments to a lower-than-expected thermal coal demand future in China.

7. Recommendations and concluding remarks

This report has illustrated that China's policies in addressing certain domestic challenges, most notably air pollution and water scarcity, in addition to increasingly competitive clean technology energy solutions, may potentially reduce demand and create overcapacity in China's thermal coal market. The directional effect of these developments could be to reduce the value of China's coal assets and lead to the stranding of some of China's coal reserves and resources, and the power generation assets used to burn them. The directional impact of these developments could:

- Depress the value of some associated financial assets;
- Negatively impact shareholder value and the balance sheets of fossil fuel intensive banks and other financial intermediaries; and
- Disrupt and potentially create a systemic risk to financial markets.

Theoretically, regulatory and market advancement will inevitably lead to stranded assets to some extent. In China, the longer declining demand for coal is treated as a cyclical phase, the greater the scale of potential stranded assets. Therefore, the challenge that is now faced is to recognise and more effectively manage this process to avoid such an outcome.

Overall, there is an opportunity to better understand the nature and scale of impacts from stranded asset risk from a global perspective. China's imperative and opportunity is to prepare itself for such feed through effects of domestic and international energy policies, technology developments and market responses on the current and future stock of coal assets, financial assets and associated institutions. Recommendations are made to key stakeholder groups to help advance this preparation.

Investors

- Require improved disclosures from coal companies with regards to future capital expenditure strategies, with specific reference to expected developments in China's thermal coal sector.
- Require improved disclosures from coal companies with regards to the quality of thermal coal reserves and resources, and resilience again lower market demand dynamics.
- For new investment analysis, ensure risk factors that determine resilience to lower demand are clearly and accurately factored into investment decision-making.
- Implement effective risk monitoring processes to ensure timely and accurate analysis of changing investment risks associated with market upheavals.

Policymakers

- Prepare for such feed through effects to minimise asset stranding and protect the current stock of financial assets by:
  - o Requiring stress-testing of banks and other financial institutions for potential on balance sheet exposure to stranded asset risk and subsequent risks to market stability; and
  - o Introducing environmental considerations into the scope of macro-prudential activities of financial regulators and the central bank, underpinned by a robust approach to financial market impact analyses of major environmental policies and developments to determine likely impact on financial institutions.
- Set up a framework to assess risks to the future stock of financial assets by:
  - o Improving on and extending the application of its existing green credit and sustainable investment guidelines; and
  - o Stress-testing all new investments against transparent criteria regarding policy responses to a changing power sector.
- International cooperation is critical to enhance broader risk management of stranded assets by ensuring relevant issues are on the agenda at key meetings of the G20, Financial Stability Board, the Bank of International Settlements and the World Bank.

Companies

- In line with recently emerging global developments, provide markets with information and analysis on potential exposures and resilience to the risk of stranded assets (such moves have been initiated by some of largest oil and gas companies such as Exxon Mobil, Shell and Total).
- Adopt more conservative capital spending strategies that reflect demand shifts and broader market upheavals.
- Stress-test the benefits of diversifying revenues sources from pure coal to a broader range of prospering technologies that more closely reflect China's power transition.

There is an opportunity for both China and other countries to ease the potential disruption and risks associated with stranding assets by requiring investors and financial institutions with significant assets at risk to develop and agree with the suitable regulator a plan of action for managing the stranding process. Furthermore, fiscal and other incentives can be provided to advance such stranding in an orderly fashion to reduce risks of sudden insolvency and systemic risk. Ultimately, China's imperative and opportunity is to develop its own approach to assessing and effectively managing the financial system consequences of the transition to an ecological civilization.

Appendix: Methodology

Reserves and resources data

Coal reserves and resources data was provided by Raw Materials Group (RMG). More information is available at **www.rmg.se**. RMG collect data from companies and amalgamate it in their databases. The system for categorising mineral resources and ore reserves in China changed recently. The new system uses a three-dimensional matrix based on degrees of confidence in Economic, Feasibility and Geological evaluations which determines whether an asset is allocated either 'resource' or 'reserves' status. Further information on this system and how it matches up to the JORC classification system can be found here **http://www.srk.com/en/newsletter/jorc-and-chinese-resource-classification-system-srk-view.**

The reserves and resources data is based on the most recent reported information on reserves as disclosed at May 2012. As with any snapshot analysis, ownership of reserves will continue to change and reserves will be extracted and added to a company's portfolio of assets, subject to the annual reporting cycle, and the economic context. RMG was selected as having the most complete dataset available.

Data accuracy

We believe the dataset to be of sufficient quality to give a reasonable representation of the exposure of listed entities. We welcome comments on how to improve the analysis and suggestions of useful outputs for future research.

Coal allocation to companies

The fact that many Chinese state-owned groups often had one or more listed energy/coal daughter companies presented a unique challenge how to apportion coal assets. In this study we have apportioned all coal reserves and resources to the listed daughter company adjudged to be the primary energy/coal operator for the state-owned group as investors would have exposure to the full risk of the company.

While these coal assets may in fact be spread across the group's companies if they control more than one energy/coal company, this method uses the logic that the larger the energy/coal company, the more coal assets it will be producing. This enables us to give an indication of the maximum exposure of one entity to the group's total coal assets.

Financial data

The market capitalisation and capital expenditure data for this study was provided by a Bloomberg terminal. Using the best available data, financial data has been apportioned in line with a company's coal operations. Where a company's market capitalisation has been presented, this figure has been apportioned in line with the percentage of the company's total revenues that have been sourced from its coal operations. Where a company's capital expenditure has been published, this has been apportioned in line with the percentage of this total going towards future coal operations. In both instances, where this percentage was above 90% it has been rounded up to 100% and the total figure has been published.

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