BERNSTEIN RESEARCH

Asian Coal & Power: Less, Less, Less... The Beginning of the End of Coal

JUNE 2013

Political, social and economic pressures add up to one simple outcome for China's favorite fuel

All industrialized societies eventually decide that, while cheap sneakers are nice, the environmental damage caused by uncontrolled industrial activity is no longer tolerable; China — at least coastal China — is today at that point; coal is the biggest loser from this development

Decelerating power demand growth and structural weakness in other end markets, combined with more hydro, nuclear and renewables and more coal production and rail capacity in China, add up to the once unthinkable: zero net imports in 2015 and falling Chinese demand by 2016

Globally, Chinese demand growth for coal has been the primary driver or the backstop behind every new investment in coal mining over the last decade; the "global coal market" ended with the collapse in price in 2012; regional miners will see almost zero demand in China from 2015

Once Chinese coal demand starts to fall, there is no robust growth market for seaborne thermal coal anywhere; developed market demand is weak due to gas, environmental concerns or industrial activity; that leaves just one large, structural growth market for seaborne coal: India

Portfolio Manager's Summary

For a decade or more, it has been an article of faith among resource and energy investors that China's addiction to ever more coal was an unending source of…well, pollution and carbon emissions obviously…but also extraordinary returns from investing in coal mines just about anywhere in the world.

But betting that the fast-moving laggard (in this case, Chinese industrialization and power demand) will eventually catch up has a natural limit: eventually, it does. China now consumes as much power as Poland on a per capita basis but is half as wealthy (again, on a per capita basis). Coastal provinces consume power at the same levels — on a per capita basis — as western European countries. The model of the energy-intensive North Asian tiger cannot apply for all of China. Jiangsu may become South Korea in terms of energy intensity, but the entire country will not. Global demand is simply not big enough for China to export its energy consumption in the form of finished goods, the way Korea does. Power consumption growth will now continue to moderate. And with it coal demand.

By our estimates, China will cease to import coal in 2015 and will see a decline in coal consumption in absolute terms in 2016 as hydro, nuclear, renewables and gas-fired generation take market share in the power sector; steel, cement and fertilizer demand growth will continue to moderate; and other uses for coal in China (municipal boilers used for winter heating and factory furnaces, for example) will decline. We expect that China will start aggressively decommissioning coal-fired power stations and replacing them with nuclear or renewables by the second half of this decade.

The economics of this energy evolution are not compelling. Coal prices have now fallen permanently. Nuclear and hydro are cheaper than coal-fired power generation in China, but gas, wind and solar are far more expensive. What we are witnessing is not simply driven by economics: China is transitioning through the same environmental and public health crisis that has seen every industrialized nation take steps to constrain its use of coal in the interest of something other than short-term economic growth.

None of this means that China turns into Iceland by the end of the decade, using non-fossil fuel sources for almost 100% of power generation. Nor will China turn into Northern California, with services — not industry — dominating the economy. China will remain the largest consumer of coal globally, by many multiples, for decades. But the change we are observing does mean that the growth story for coal consumption in China is over. And valuations for the Chinese coal stocks — and coal stocks everywhere — will reflect a sector in terminal decline.

The Chinese coal miners are now entering the end of a period that began in 2008 when small-scale, high-cost coal mines were forced out of business first by government edict and then by large-scale, low-cost miners expanding production. This development has resulted in a flat coal price for the last year that is likely to continue through 2015, at least. All the while, the miners will see a squeeze on gross margins as the cost curve both rises and flattens. From 2015, the large-scale miners will take over the entire industry, pushing out imports, and raising, for the first time since 2008, the possibility of Chinese coal net exports.

To state the obvious, terminal decline is bad news for coal miners. It is a mixed blessing for the power sector, which benefits from flat coal prices…but has to build and pay for what comes next — a lot of gas-fired generation and renewables.

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Table of Contents

Exhibit 1 **Financial Overview**

Company	China Shenhua	Yanzhou Coal	China Coal Energy	China Longyuan	Datang Renewable	Huaneng Renewables
Ticker	1088.HK	1171.HK (NYSE: YZC)	1898.HK	916.HK	1798.HK	958.HK
Share Price as of 14-June-2013 (HKD)	23.35	6.78	4.61	7.89	1.86	2.75
52-Week High (HKD)	35.45	14.48	9.04	8.32	2.07	3.02
52-Week Low (HKD)	23.25	6.63	4.57	4.60	0.71	0.87
Rating	Underperform	Underperform	Underperform	Outperform	Market-Perform	Outperform
Target Price (HKD)	20.00	5.00 (ADR: 6.50)	3.00	11.00	1.60	4.00
Market Cap (USD M)	61,674	7,779	11,559	8,227	1,746	2,993
Enterprise Value (USD M)	70,270	14,657	18,617	17,883	8,052	7,532
6M Avg Daily Trad. Volume (USD M)	68.2	37.9	26.4	18.5	3.2	7.0
EPS (RMB)						
2011	2.30	1.76	0.71	0.35	0.10	0.14
2012	2.46	0.73	0.68	0.35	0.02	0.07
2013E	1.99	0.51	0.39	0.48	0.04	0.14
2014E	1.95	0.38	0.19	0.68	0.08	0.20
2015E	1.91	0.14	0.01	0.86	0.12	0.29
EPS Growth						
2011-2012	6.6%	-58.6%	-4.5%	0.3%	-84.7%	-53.0%
2012-2013E	-19.0%	-30.4%	-42.4%	39.7%	145.7%	108.0%
2013E-2014E	-1.8%	-24.4%	-52.2%	39.6%	106.1%	46.3%
2014E-2015E	-2.4%	-63.5%	-94.1%	26.8%	58.0%	43.4%
P/E						
2012	7.5	7.3	5.4	18.0	95.3	32.9
2013E	9.3	10.5	9.3	12.9	38.8	15.8
2014E	9.4	13.9	19.5	9.2	18.8	10.8
2015E	9.7	38.2	331.7	7.3	11.9	7.5
Metrics						
Total Debt/Total Assets (2012)	14.8%	30.9%	26.2%	54.4%	67.7%	61.3%
EBITDA/Net Interest Expense (2012)	41.7x	20.8x	66.5x	3.9x	2.1x	2.5x
Capital Intensity (2012)	20.2%	15.2%	40.5%	69.0%	123.4%	121.0%
FCFE Yield	5.0%	-3.9%	-47.4%	-26.8%	-52.1%	-17.4%
Dividend Yield	5.2%	6.7%	5.8%	1.0%	1.6%	0.7%
Return on Invested Capital (2012)	23.6%	9.1%	12.7%	5.4%	3.5%	4.4%
Return on Equity (2012)	19.1%	8.1%	9.9%	10.0%	1.6%	4.8%
Main Business Segments	Thermal coal, power, railway, port and shipping	Thermal and coking coal (China and Australia), railway, coal chemicals, power and heat	Thermal and coking coal, coke and coal-chemical, coal mining equipment	Power, steam, equipment and coal	Power	Power
Other Income as % of Total Income	0.2%	4.3%	0.9%	7.7%	5.9%	4.5%
2012 Commercial Coal Prod. (M tons)	304.0	61.9	114.4			
– Foreign %	0.7%	27.7%	0.0%			
– Coking Coal %	0.0%	11.3%	0.7%			
Domestic Unit Prod. Cost (2012, RMB/ton)	130.2	309.9	223.0			
Domestic Coal ASP (2012, RMB/ton)	426.2	600.4	477.4			
Coal Mine Locations	Shaanxi, Inner Mongolia and Indonesia; Australia (under development)	Shandong, Inner Mongolia and Shaanxi, Shanxi; Australia	Shanxi, Jiangsu, Shaanxi			
Average Utilization Hours				1,985	1,752	1,774
Average Wind Tariff (RMB/MWh)				497.8	515.6	516.9

Note: The stocks are benchmarked against the MSCI Asia Pacific Ex Japan and S&P 500 indexes, which had closing prices of 440.07 and 1626.73, respectively, on June 14, 2013.

Source: Bloomberg L.P., corporate reports and Bernstein estimates and analysis.

Significant Research Conclusions

In the summer of 2007, everyone knew that Roger Federer was the greatest tennis player of all time, that Tiger Woods was a shoe-in to win the most Majors ever, and that Lance Armstrong was the greatest cyclist of all time. More parochially, everyone knew that Tom Brady was the greatest quarterback ever, that Alex Rodriguez was destined to break the career home run record and expunge the shame of baseball's steroids era, and that Dan Carter was perhaps the greatest All Black ever.

Six years later, Federer is likely to retire with a losing record against two of his contemporaries. Tiger Woods has been within striking distance during the last round of a Major just once in five years. Tom Brady has a losing record when it counts against the third-best quarterback in the Manning family. Rodriguez has admitted to doping. Lance Armstrong. And finally (this one truly pains me), Dan Carter has a "knock-out" record in Rugby World Cups of one win out of a possible nine.

In short, in every walk of life, six years is a long time. And, at any given time, we know a lot less than we think.

In the summer of 2007, everyone also knew that Chinese demand for commodities in general and energy in particular was limitless. Twenty million people were urbanizing each year and would continue to do so for another two decades. The world — or at least the mining sector as configured at the time — was not large enough to support Chinese demand. Globally, Chinese demand growth for coal was and has remained the primary driver or the backstop behind every new investment in coal mining anywhere. Even as recently as 2011, the dip in demand caused by the global financial crisis had apparently been shrugged off and demand growth was back to the "normal" level: double digits.

Over the course of 2012 and this year, demand growth for coal has decelerated. Views on the short- and medium-term rates of Chinese growth have come down on a variety of fronts…coal, power, steel, aluminum, cement, and the economy in general. The Chinese government is now taking active steps to reduce coal consumption on the east coast.

But — in the same way that there are still plenty of people around who will defend the 2007 consensus assessments of Federer, Woods, Armstrong, Brady, Rodriguez and Carter — the idea that China's deceleration in commodity consumption growth might be permanent and that it might eventually lead to a reduction in coal demand in absolute terms is still a long way from consensus, in our view. Opinions, once formed, change slowly.

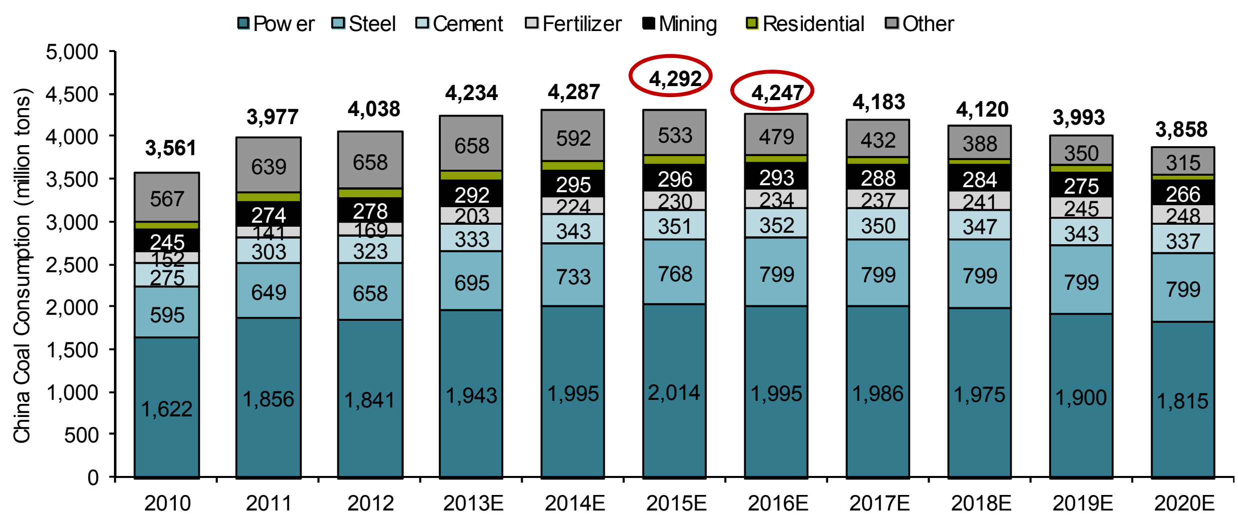
The "short coal" trade has still not turned into a recognition that the last, best structural demand story for coal globally is now over. And with it, "short coal" isn't a trade; it's a permanent state of affairs, in our view. Coal demand in China is about to start falling, and — with India and Indonesia the only remaining structural growth markets for coal — the global thermal coal market will never recover.

To complete the parallel, Roger keeps on losing to a lefty *and* a righty…but we can't quite bring ourselves to acknowledge that the 2007 assessment (admittedly reached with a mountain of evidence) might not be right.

Decreasing Chinese Power Intensity and the Rise of the Services Sector

In China, decelerating power demand growth, combined with more gas-fired, nuclear, hydro, renewables and nuclear generation, and decelerating or falling demand in other coal end markets (steel, cement, fertilizer, industrial usage), give rise to an outcome that is mathematically obvious but still difficult to say or write: 2015 is going to be the peak year for Chinese coal consumption *ever*.

Exhibit 2 **China Coal Consumption by Sector (2010-20E)**

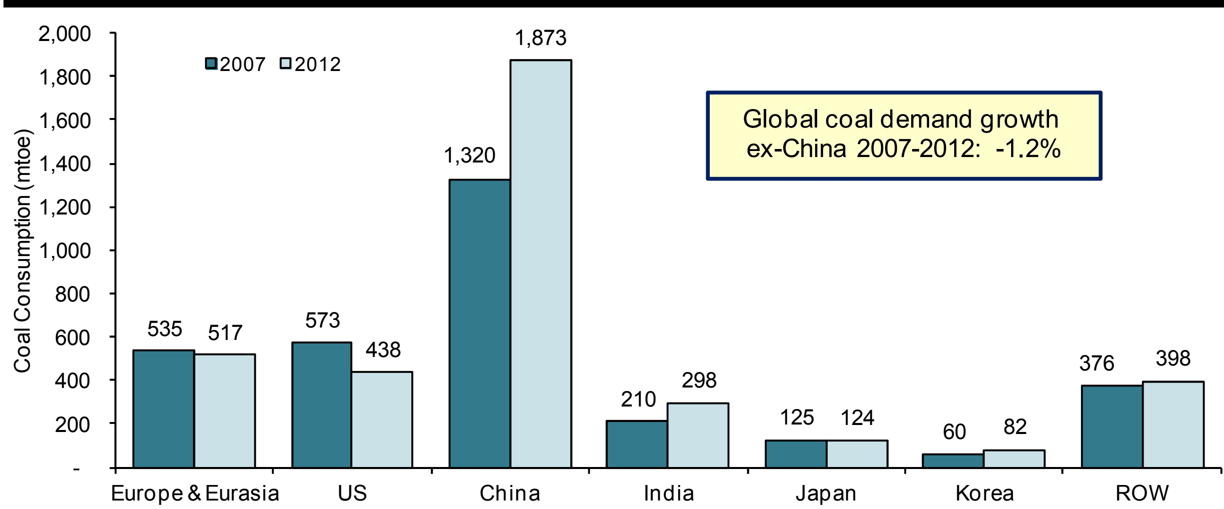


Source: CEIC and Bernstein estimates and analysis.

From 2016, Chinese coal demand will fall in absolute terms, and that trend will never (business cycle fluctuations aside) reverse (see Exhibit 2). There are five primary drivers of falling imports in 2015 and falling coal consumption in absolute terms that we forecast by 2016: (i) continuing investment in coal mining and transportation infrastructure; (ii) decreasing Chinese power intensity; (iii) increasing power generation capacity from nuclear, gas, hydro and renewables; (iv) falling demand growth for steel, cement and fertilizer, and the demise of the "inferior" end markets for coal; and (v) the emergence of the environment as a politically sensitive issue in China and the need to improve air quality...quickly. We discuss each briefly below and in detail later in this *Blackbook*.

More broadly, the implications settle on two key themes. First, publicly traded Chinese coal miners have enjoyed the economic rents associated with being some of the few entities with access to both low-cost coal and transport capacity on China's previously stretched rail network. Without those structural advantages and facing a negative terminal growth and poor capital discipline, the warranted multiples will continue to contract.

Exhibit 3 **Global Coal Consumption (2007 vs. 2012)**



Source: BP Energy Survey 2013 and Bernstein analysis.

Second, China has been almost 100% of global coal consumption growth over the last decade. Global coal demand growth ex-China was -1.2% from 2007 through 2012. As Chinese consumption begins to fall (mirroring the trend in the U.S. and Europe), the global market will enter a period of terminal decline (see Exhibit 3).

(i) Continuing Investment in Coal Mining and Transportation Infrastructure and a Resulting Flattening of Costs

We expect that by 2015, the investment in large-scale, highly mechanized coal mines and coal-dedicated rail transport throughout China's coal producing regions will be complete. The frictions to move coal to market will have been removed.

The top 55 Chinese coal miners produced ~2.9 billion tons of coal in 2012, ~8% higher than the top 55 miners produced in 2011 (~2.7 billion tons). This group accounted for ~73% of total coal production in 2012. With further consolidation in the industry, we believe the sector will continue to shift towards larger-scale and lower-cost miners. This will squeeze the high-cost coal miners on the right-hand side of the cost curve out of the market. We believe this group of 55-60 miners will continue to take share in coming years and we expect these miners to be over 90% of the industry by the end of 2015.

(ii) Decreasing Chinese Power Intensity and the Rise of the Service Sector

The various edicts that the Chinese government has issued in recent years about reducing energy intensity and not sacrificing the environment for economic growth are aided by one important fact. The change that the Chinese government is attempting to orchestrate is happening organically regardless of policy.

Over the past decade, China's economic growth has been shifting towards the less energy-intensive services sector. The services sector's share of GDP increased to 44.6% in 2012 from 39% in 2000, while the industrial sector's share of GDP has trended down slightly since the middle of the last decade. The industrial sector in China is roughly 6x more power intensive than the services sector. Therefore, a slight share shift away from the industrial sector serves to reduce power production growth significantly.

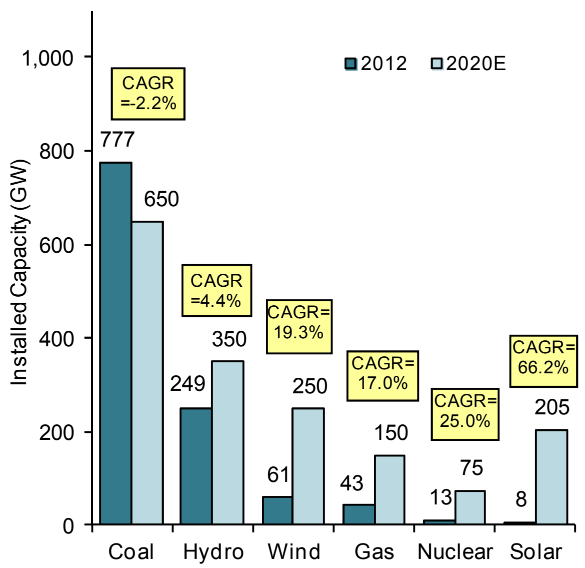
The falling power multiplier is a reflection that China is shifting away from heavy industries to less energy-intensive sectors to drive future economic growth. Power represents roughly half of Chinese coal consumption. However, the trend throughout the key end markets is largely the same. As with every other economy, as the Chinese economy becomes more developed, it is becoming more energy efficient: the same amount of power production growth is creating more GDP growth. This is consistent with the natural evolution of any economy going through the middle innings of economic development.

(iii) Increasing Power Generation Capacity from Nuclear, Gas-Fired Power Generation, Hydro and Renewables

We believe that coal-fired power generation capacity will fall from ~800GW of installed capacity today to 650GW by the end of the decade as inefficient, small, old power stations are decommissioned. Hydro will increase from ~250GW to 350GW. Gas will go from ~40GW to 150GW. Nuclear will increase from ~13GW to 75GW. Solar and wind will be 200GW and 250GW by the end of the decade, respectively (see Exhibit 4 and Exhibit 5).

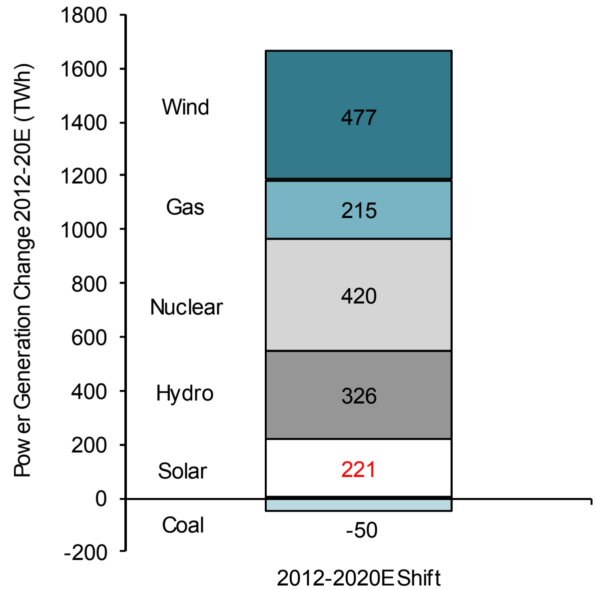
Over this period, power demand will increase by 1,323TWh (up by one-third compared to 2012) and coal-fired generation will decline. With lower power consumption growth and less coal consumption overall — and in an environment of continuing constrained gas supply — renewables will be the source of incremental power supply. Given the long lead times of hydro and nuclear, renewables are the primary means of accelerating the transition away from coal. We think both solar and wind installed capacity could be at least 200GW by decade's end (up from 8.3GW of solar and 61GW of wind today).

Exhibit 4 Installed Capacity by Fuel Source (2012 and 2020E)



Source: CEIC and Bernstein estimates and analysis.

Exhibit 5 Power Generation Shift by Fuel Source (2012-20E)

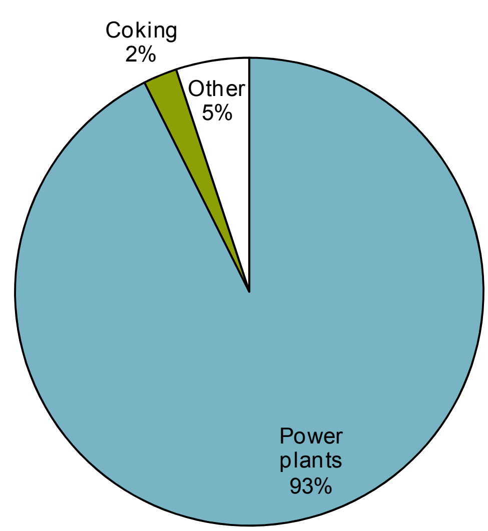


Source: CEIC and Bernstein estimates and analysis.

(iv) Falling Demand Growth for Steel, Cement and Fertilizer, and the Demise of the "Inferior" End Markets for Coal

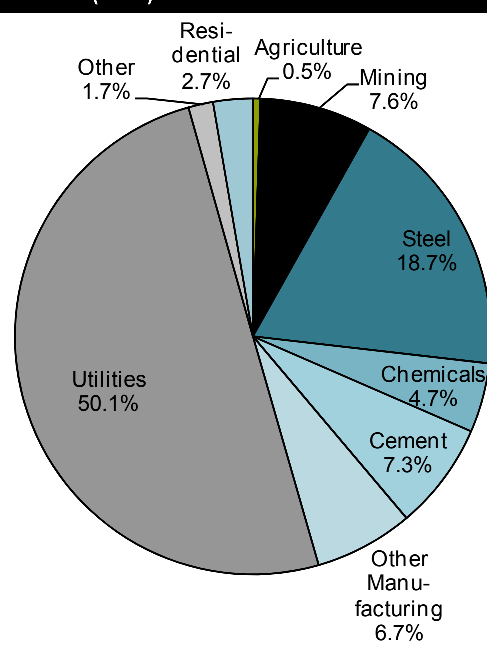
Within the power sector, generation growth from gas, nuclear, hydro, wind and solar will start crowding out coal-fired power generation growth. The steel, cement and fertilizer sectors account for another ~30% of consumption.

Exhibit 6 U.S. Coal Consumption by End Market (2012)



Source: EIA and Bernstein estimates and analysis.

Exhibit 7 Chinese Coal Consumption by End Market (2011)



Source: CEIC and Bernstein estimates and analysis.

The remainder is mining itself, manufacturing, residential use, agriculture and other. Efforts to curb coal consumption outside of the four key end markets have already begun. The ultimate composition of coal usage is clear too: in developed economies, coal is used in power generation and coke production. And that is it.

Chinese coal consumption in factories, municipal entities burning coal for heat and steam, residential usage, the mining sector itself will see coal usage fall from ~800 million tons today to, eventually, zero — the level of coal consumption by these sectors in the U.S. or Europe (see Exhibit 6 and Exhibit 7). Coal demand growth in the steel, cement and fertilizer sectors will moderate.

(v) The Emergence of the Environment as a Politically Sensitive Issue in China and the Need to Improve Air Quality...Quickly

Rich economies reach an inflection point where the population will no longer stand for the environmental damage that its industrial sector is creating. Political pressure follows together with new requirements for environmental remediation and lowered emissions. That means higher costs for industry, and those costs tend to push the polluting activities elsewhere. The focus of economic activity changes: enter the design studios, advertising agencies and artisan cheese makers.

Perhaps the biggest surprise in China in 2012 was that the country appears to have reached that point. The heightened concern over Beijing air quality over the winter capped off a 12-month period of various street-level protests over air, soil and water quality issues. In July, protests forced the suspension of construction on a copper plant in Chifang in Sichuan. In August, in Qidong in Jiangsu, following street protests, officials announced the cancellation of a paper mill waste-water pipeline that would have fed into local fishing grounds, injecting — according to protesters — various carcinogens into the local food supply. In November, Sinopec scrapped a petrochemical plant project in Ningbo in Zhejiang. These announcements came after local protests, some of which were violent.

And then came Beijing's air quality crisis over the winter, and — perhaps more surprisingly — the government announcement that something would be done about it and various statements subsequently that the environment will not be sacrificed for economic growth.

The protest and the government response seem entirely predictable given China's changing demographics and economy plus its atrocious domestic air and water quality. The surprise is that these events are perhaps a decade ahead of schedule. Six months ago, most observers would have guessed that this rising environmentalism was still a decade away. Suddenly, instead it is shaping Chinese energy policy today.

Any economic planner responsible for setting targets for Chinese power supply over the rest of the decade faces a dilemma in roughly eight parts. The key imperative has been simplified in the first half of 2013: keep the lights on, but make sure the skies in Beijing are clear next winter…and every winter going forward.

First, China needs power…and more of it. The economy is slowing but it hasn't stopped. Power demand growth will continue to increase in coming years as a fraction of GDP growth, rather than as a multiple. But power demand is going to continue to go up nonetheless. Further, expectations about reliability of supply are rising as China gets wealthier and a greater share of the economy is dedicated to services. A more sophisticated economy requires higher reserve margins (the percentage of the fleet that is idle but available for dispatch at the moment of peak demand) in order to increase reliability of supply and reduce power cuts throughout the country.

Second, the cheapest and easiest source of power supply in China is coal-fired power stations. China has spent a decade building a modern fleet of coal-fired power stations, and today there is plenty of low-priced coal available throughout China.

Third, despite the attractive economics of coal-fired power generation, the use of coal in east coast cities is being restricted and will be restricted further in coming years. China — like every industrialized economy — is weighing up the impact of ever-increasing pollution on its population and is reducing usage. The fact that the simple, short-term economics militate in favor of more coal does not mean that China will use more coal. As economies get richer, the decision making in this regard gets more complex.

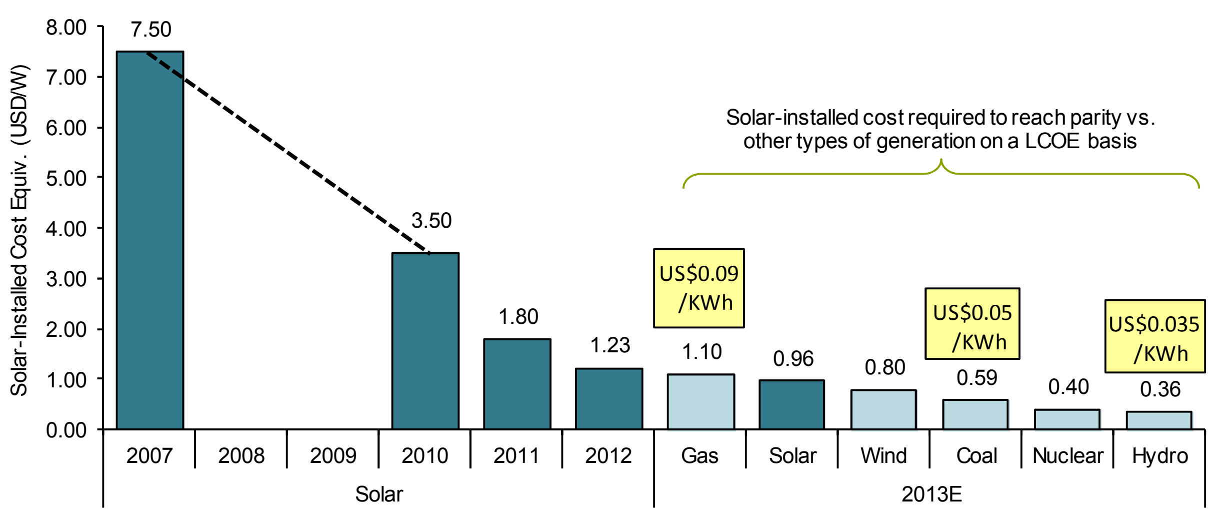
Fourth, China is increasing both domestic gas production and imports. Gas supply to the power sector and gas-fired generation as a share of total generation will increase in coming years. However, gas supply is still constrained and the power sector ranks below residential, commercial, industrial and, potentially, transportation users in terms of priority of supply. If supply to the power sector reaches 70BCM by 2020, it will represent ~5% of total power generation.

Fifth, China continues to expand hydro generation capacity. Total installed capacity at the end of 2012 was ~250GW. However, there are no non-navigable, large, fast-flowing rivers in deep, uninhabited valleys left in China. The easy opportunities were dammed years ago. And large-scale projects like the Three Gorges Dam (given its massive environmental impact and population displacement) are not going to be repeated. That leaves smaller dams. We believe that China will add 100GW of hydro over the rest of the decade. Hydro will remain ~17% of total generation by 2020.

Sixth, nuclear power generation is continuing to ramp up. Installed capacity is currently ~14GW and plans are for China to reach 75GW by the end of the decade. This will mean nuclear capacity will go from less than 3% of total generation to ~10% of total generation. The limiting factor is not technology, ambition, safety concerns or uranium. The constraint to China expanding its nuclear fleet any faster is experienced engineers who can manage these facilities. That is a multi-decade, not a multi-year, development task.

Seventh, wind is currently an under-utilized source of power generation in China. The 61GW of installed capacity operated at a utilization rate of ~19% in 2012. This low utilization rate was a function of an inability or unwillingness from State Grid to dispatch all of the electricity being generated. We believe that the normal level of utilization will (by 2015) be 27%. We believe that State Grid will remain under pressure to connect wind farms and absorb all of the electricity generated.

Exhibit 8 **Solar Installed Cost Required to Reach Parity vs. Other Types of Clean Energy Generation on a LCOE Basis**



Source: Government announcements, media reports, World Nuclear Association, corporate reports and Bernstein estimates and analysis.

Eighth, solar is a rounding error within the Chinese power portfolio today. However, with installed cost now approaching $1/W, solar is economic with gas-fired power generation in China and — on a distributed basis — is economic against on-grid power prices (see Exhibit 8).

Given those constraints and an objective of increasing reliability of supply, improving environmental impacts and controlling cost (probably in that order), we believe that the focus within the power sector will be on (i) completing hydro, gas-fired and nuclear projects on time; (ii) decommissioning old and inefficient coal-fired power stations; and (iii) encouraging renewables to the greatest extent possible. In short, there is simply no room for incremental coal consumption — and the consequential levels of pollution — in any of that.

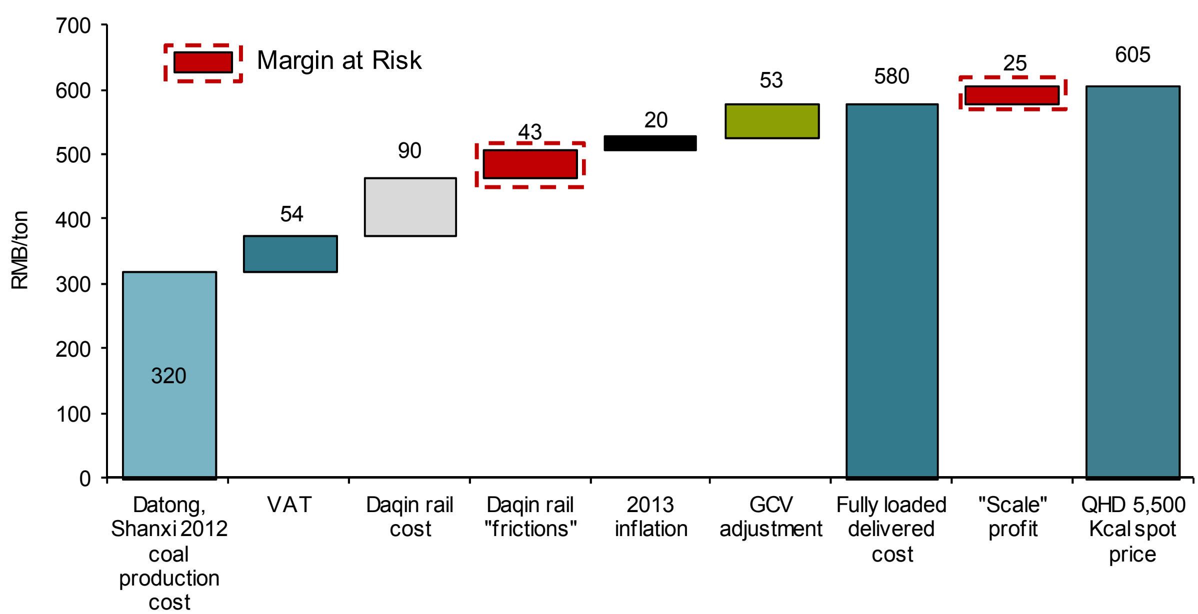
Implications for Coal and Power Stocks

The implications of all this for the Chinese coal miners are terrible. The three Chinese coal miners that we cover — Shenhua, Yanzhou and China Coal Energy — have to a greater or lesser extent enjoyed, since mid-2007, the benefits or an idiosyncratic commodity story: yes, China needed coal like it needed other commodities. But China *has* coal; it just could not get that coal to market.

The Chinese coal miners enjoyed the economic rents that arose from being some of the few entities with access to low-cost mines *and* rail access to get coal to market. That advantage is now fading. We are outlining a future with a negative terminal industry growth rate, flat prices, intensifying competition and ever greater capital and operating expense to mine coal.

We believe that for an increasing share of the large Chinese coal miners, the economics of incremental production to sell into a RMB605/ton coastal coal market are only marginally attractive (see Exhibit 9).

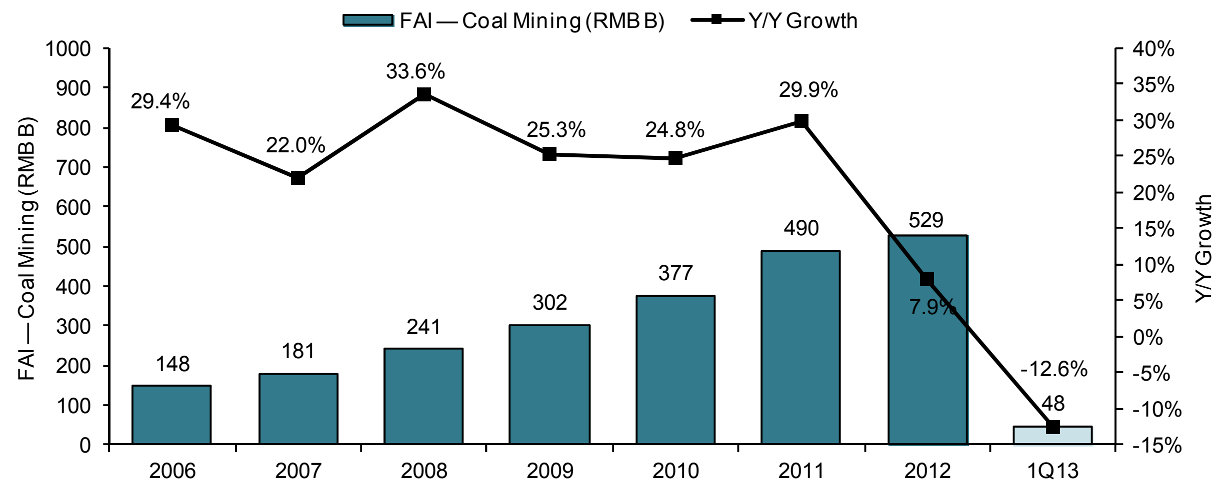
Exhibit 9 **Qinhuangdao Coal Price Composition (June 2013)**



Source: Bloomberg L.P., SX Coal and Bernstein estimates and analysis.

In short, we have reached a flat part of the cost curve where coal price volatility is likely to be low over the long term and coal mining profitability is likely to remain stressed. This stressed group is no longer simply high-cost, small-scale miners with poor access to transport but includes the publicly traded Chinese coal miners too. Coal prices will remain flat, volume growth will be weak and costs will continue to go up. Investment in new coal mining production capacity is now falling (see Exhibit 10). However, the lag between investment and commissioning means that we will see hundreds of millions of tons of new Chinese coal production capacity come on-stream in the next two years.

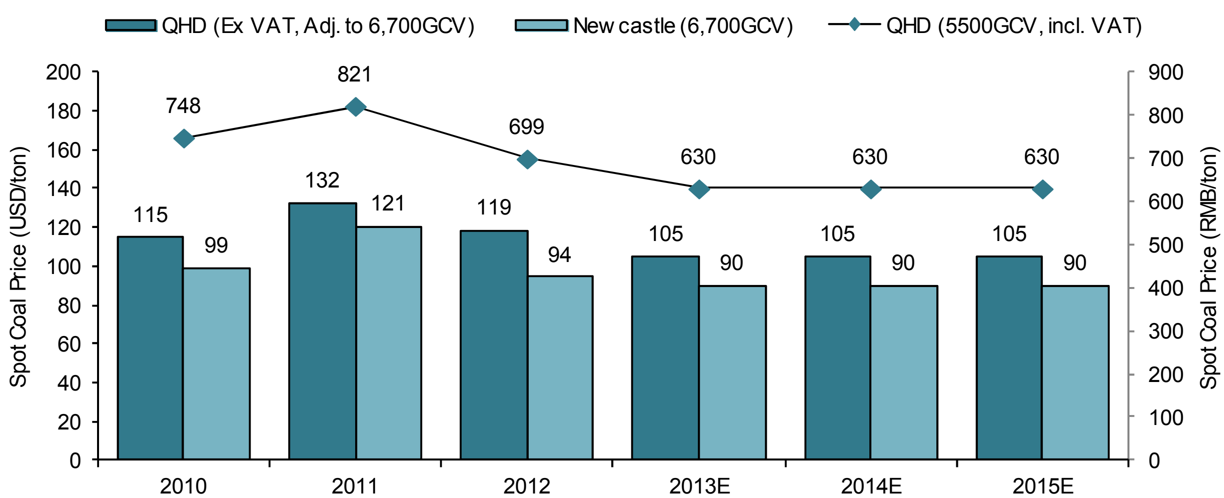
Exhibit 10 **FAI in China Coal Mining Sector (2006-1Q:13)**



Source: NBS, CEIC and Bernstein analysis.

As costs rise across the industry, so will the cost curve. But the cost curve will also flatten as new capacity from scaled miners comes on-stream. We believe that coal prices will remain roughly flat through 2015 at least (see Exhibit 11).

Exhibit 11 **Bernstein Coal Price Forecasts: Qinhuangdao and Newcastle**



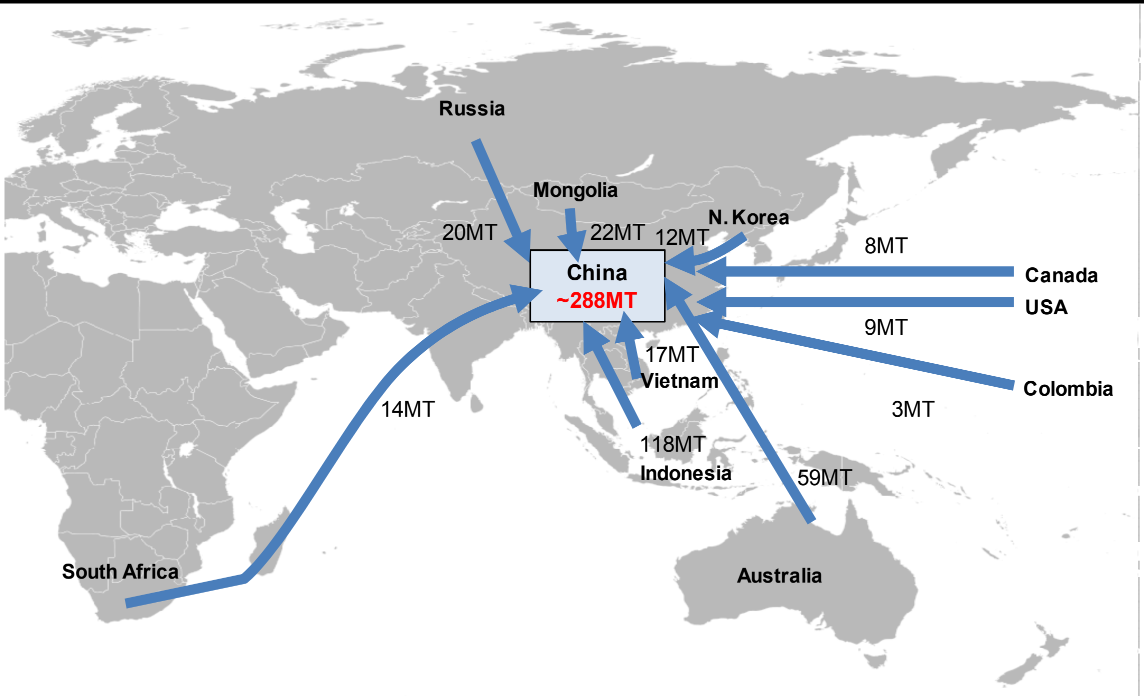
Note: Figures for 2010-15E are yearly average prices.

Source: Bloomberg L.P., SX Coal and Bernstein estimates and analysis.

The seaborne market's expansion in the last five years has been largely driven by Australian and Indonesian miners competing against small-scale Chinese coal miners (with high costs and poor access to transport) in serving power stations in coastal China. In short, it hasn't been a fair fight.

And it won't be going forward. China has been the prize of the coal mining sector globally for the last five years. However, now that domestic demand has fallen, large-scale miners with access to much improved transportation will push out the seaborne market…or the government will do it for them by banning ever-higher grades of imported coal. China is going to start giving back almost 300 million tons of coal to the seaborne market annually (almost 30%). The next best option for this market is not good: India (see Exhibit 12).

Exhibit 12 **Major Seaborne Coal Exporters Supplying China (2012)**



Source: Wikimedia commons, SX Coal, Public Press, EIA, BREE, RBCT and Bernstein estimates and analysis.

For the power sector, counter-intuitively, prospects do not seem that much better. The primary benefit of the falling coal price — cheap coal — is now priced in. From an earnings perspective, the second quarter of 2013 will be the last time that the power companies have easy comparisons against year-ago coal prices. From July, the power companies face a world of flat coal price, flat power pricing…and flat demand growth. At the same time, the power companies now have the primary responsibility to build the gas-fired power stations and renewable power generation capacity that will crowd out coal-fired generation going forward. The capital cycle for the power sector is, as we outline in this *Blackbook*, beginning again.

Valuation Methodology

Chinese Coal Miners: We value China Shenhua at HK$20.00 per share on a P/E basis by applying a forward multiple of ~8x to our 2014 EPS estimate of RMB1.95. Further, assuming that the company maintains a ~40% dividend payout ratio, a $20 share price implies a 5% dividend yield, which we believe investors will require given the continuing deteriorating profile of the industry. We value China Coal Energy at HK$3.00 per share by taking the average of (i) a forward P/E multiple of ~8x to our 2014 EPS estimate of RMB0.19 and (ii) a P/B multiple at the average of the lower quintile of global coal mining peers. We value Yanzhou at HK$5.00 per share on a P/E basis by taking the average of (i) a forward P/E multiple of ~8x to our 2014 EPS estimate of RMB0.38 and (ii) a P/B multiple at the average of the lower quintile of global coal mining peers. Our valuation for Yanzhou (ticker YZC; the NYSE-listed ADR) multiplies Hong Kong valuation by 10.0 (the number of H-shares each ADR represents) and divides by the HK$ exchange rate. We believe China Coal Energy and Yanzhou can find some support at these levels. On a DCF basis, we believe that China Coal Energy and Yanzhou stocks are worth zero. However, we do not believe that will be reflected in valuation over the next 12 months.

Chinese Renewable Operators: We value China Longyuan at HKD11.00 by applying an average P/E ratio of ~13x to our 2014 EPS estimate of RMB

0.67/share. The valuation reflects an equity raise in 2013 that the company announced on May 2012. We value Datang Renewable at HKD1.60 by applying an average P/E ratio of ~16x to our 2014 EPS estimate of RMB 0.08/share. Valuation is stretched due to concerns around the company's debt levels and the potential for an equity raise in 2013. We value Huaneng Renewables at HKD4.00 by applying an average P/E ratio of ~16x to our 2014 EPS estimate of RMB 0.20/share.

Risks

There are numerous risks to our investment thesis on Shenhua, China Coal Energy and Yanzhou. Some of these risks are below.

First, contrary to our expectations, electricity demand growth may continue to grow at its historically high rate, increasing demand for thermal coal. Second, contrary to our expectations, steel growth may accelerate, increasing demand for coking coal. Third, coal production and rail transportation capacity may not increase at the rate that we are forecasting over the long term. As a result, coal pricing may not decline in the manner we are anticipating. Further, in the event that rail transportation capacity expansion fails to materialize, movement of coal resources across internally owned logistics and shipping assets may benefit diversified coal and generation companies like Shenhua. Fourth, the companies may decide to alter their investment strategies or enter into new business segments, changing capital expenditures or dividend payout rates and dividend growth rates. Fifth, China may relax its coal export quotas and India may become a more significant importer of coal than we are forecasting, providing a source of additional growth for the coal companies that are not currently included within our estimates. Sixth, the global economy may accelerate, leading to higher-than-anticipated demand for Chinese manufactured goods, increasing demand for Chinese coal and pushing up the price of seaborne coal. Seventh, the Chinese government may choose to stimulate the economy, resulting in an increase in demand for steel, power, cement and — ultimately — thermal and coking coal.

The key risks to the wind power companies' business model are: a reduction in the wind installed capacity target in China or a change to the mandatory tariff, grid connection and dispatch policy. In addition, a reduction in the amount of debt financing available for renewable energy projects in China would negatively impact growth rates both in terms of installed capacity and earnings. An increase in wind turbine prices is a risk given that more than 50% of construction costs relate to turbines. Finally, a reduction in transmission infrastructure construction in China would negatively affect the sector.

An increase in interest rates would negatively affect the companies as they are all highly levered. As with most utilities, given the stable nature of the revenues, high levels of debt are warranted. As a natural consequence of falling manufacturing costs, a stable regulatory environment and improved infrastructure, we anticipate an increasing sophistication among the renewable energy generators over sources of debt funding (more corporate bonds, less bank borrowing) and lower cost of debt over time. Accelerating inflation over the medium term and continuing monetary tightening are risks to our positive stance on the sector.

Investment Conclusion

Our expectation of flat coal prices and easing supply constraints in China in coming years is premised on a structural slowdown in Chinese power consumption growth at the same time as improvements in coal production capacity and transport capacity ease the path to market. We expect this to be an ongoing process that started at the end of 2011 and is likely to continue broadly through 2015.

We rate Shenhua (1088.HK), China Coal Energy (1898.HK), and Yanzhou Coal (1171.HK) **underperform** with target prices of HK$20.00, HK$3.00 and HK$5.00, respectively. We rate China Longyuan (916.HK) and Huaneng Renewables (958.HK) **outperform** with target prices of HK$11.00 and HK$4.00, respectively. We rate Datang Renewable (1798.HK) **market-perform** with a target price of HK$1.60.

Less, Less, Less: The Beginning of the End of Coal — Why, How and When Chinese Coal Consumption Falls

Chinese Consumption Falls in Absolute Terms from 2016

For a decade or more, it has been an article of faith among resource and energy investors that China's addiction to ever more coal was an unending source of…well, pollution and carbon emissions, obviously…but also extraordinary returns from investing in coal mines just about anywhere in the world. But betting that the fast-moving laggard (in this case, Chinese industrialization and power demand) will eventually catch up has a natural limit: eventually, it does.

In this chapter, we set out our view that (i) China faces lower power consumption growth and less coal consumption overall by 2016, and that (ii) in an environment of continuing constrained gas supply, renewables and nuclear are the source of incremental power supply. We think both wind and solar installed capacity could be over 200GW by the end of this decade (up from 61GW of wind and 8.3GW of solar in 2013). In this chapter, we also outline what we think the Chinese power portfolio looks like by 2020.

Our expectation of flat coal prices and easing supply constraints in China in coming years is premised on a structural slowdown in Chinese power consumption growth at the same time as improvements in coal production capacity and transport capacity ease the path to market. We expect this to be an ongoing process that started at the end of 2011 and is likely to continue broadly through 2015. Over that entire time, we expect coal prices to trend downward, while still being susceptible to seasonal bumps. Coal prices are today ~30% lower than the 2011 peak in November 2011.

In this chapter, we also set out our view that South Korea and the U.S. are poor proxies for "mature" per capita Chinese power consumption. The two main counter-arguments we hear to our view that the current weak power consumption growth in China is structural and therefore long term are: China consumes 3,700KWh per capita while South Korea and the U.S. consume ~9,500KWh and ~12,500KWh, respectively. Therefore — goes the argument — there is plenty of headroom left for China. We do not agree.

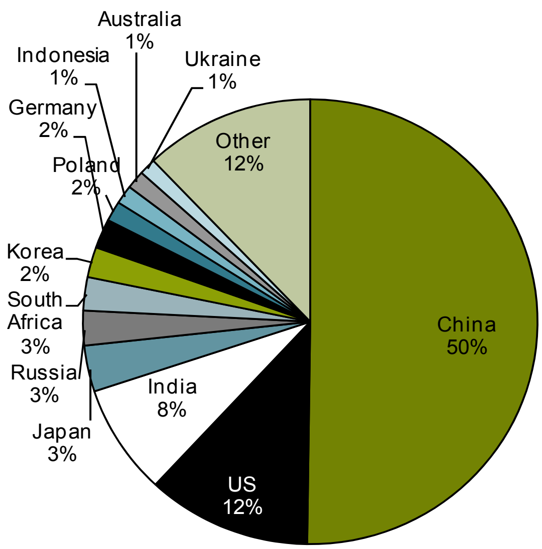
South Korea is 48 million people making one-third of the world's ships and roughly half of the flat screens. Half of South Korea's GDP is from exports. Roughly 40% of the country's imports are minerals, coal, gas and oil; 60% of exports are machinery and electronics. China is simply too large to replicate that kind of export-dominated, energy-intensive model over the long term…or, more accurately, the rest of the world is too small.

The U.S. is also a poor proxy for "mature" per capita Chinese power consumption because of the sheer scale of residential power consumption. The U.S. consumes 12,500KWh per capita; 40% of that power consumption is residential and is a function of wealth (TVs, computers, set top boxes), home size (air conditioning, lighting, heating), or both. China will not mirror that kind of power consumption by 2020.

The Stakes for Global Coal Once Chinese Demand Starts to Decline

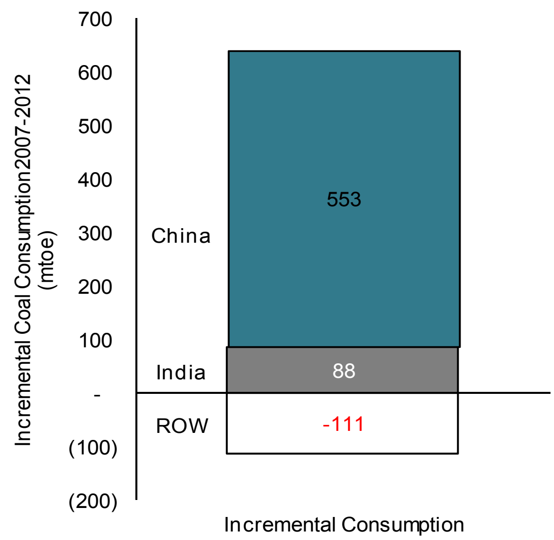
It is not possible to overstate the importance of China to the seaborne coal market or the global coal market altogether (see Exhibit 13). Coal consumption in the rest of the world (outside of China and India) has been in decline over the last decade (see Exhibit 14 and Exhibit 15). Cheap gas in the U.S., combined with tightening emissions standards everywhere and falling (or more efficient) industrial activity, has resulted in falling power demand and/or falling coal demand in most developed economies.

Exhibit 13 World Coal Consumption (2012)



Source: BP Energy Survey 2013 and Bernstein analysis.

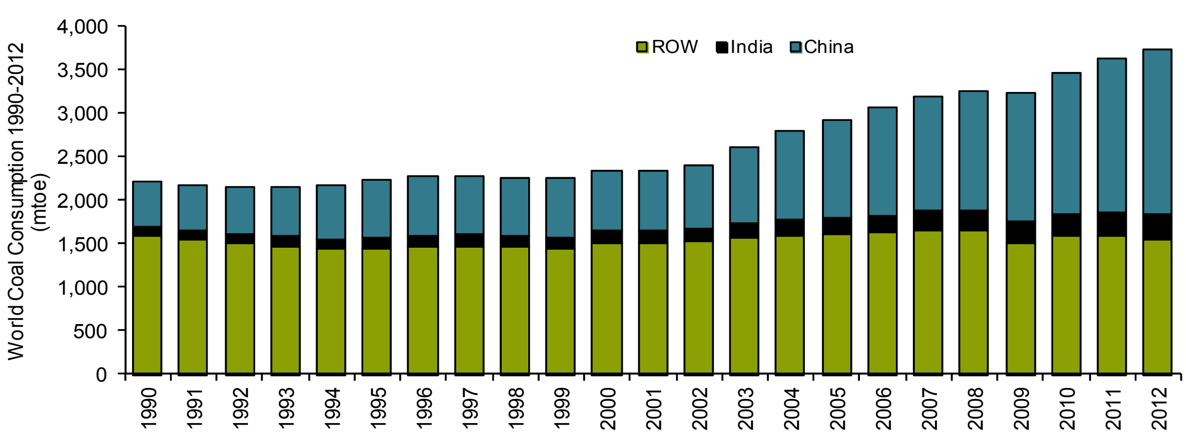
Exhibit 14 Incremental Coal Consumption (2007-12)



Source: BP Energy Survey 2013 and Bernstein analysis.

Globally, Chinese demand growth for coal has been the primary driver or the backstop behind every new investment in coal mining over the last decade. The "global coal market" ended with the collapse in price in 2012.

Exhibit 15 World Coal Consumption (1990-2012)



Source: BP Energy Survey 2013 and Bernstein analysis.

Regional miners will see almost zero demand from China in 2015, a drop of almost 300 million tons. There is simply nowhere else for that coal to go. India is a miserable next best option for the seaborne market. And the trend of declining consumption in the rest of the world is unlikely to reverse.

How and Why Chinese Coal Consumption Starts Falling

The Chinese government is, in our view, today motivated to improve air quality and the country's environment in general.

All industrialized economies reach the point where the collective decision is made that — while cheap sneakers are nice — it is better to have someone else pollute their air, their water and their soil in order to produce the high tops. China — at least coastal China — has reached that point. The coal sector is, in coming years, the biggest loser from this development. And the hits have already started landing.

In May, Beijing's municipal environmental agency announced that the city will reduce coal consumption from 23 million tons annually currently to 15 million tons in 2015 and 10 million tons in 2020. Four new gas-fired heating and power stations will be commissioned in 2014 to supply the energy lost with declining coal use.

In April, Chart Industries CEO Samuel Thomas noted on the company's first-quarter conference call that they were told by Petrochina that "they don't expect to see new coal-fired power plants built in any of the coastal cities, they don't expect to see significant new coal gasification projects allowed anywhere that will affect the air quality of the coastal cities."

In short, the long term doesn't look very good for the coal industry. And neither does the short term. The recent much-publicized National Development and Reform Commission (NDRC) proposal to ban imports of coal with low gross calorific value also included a less-publicized proposal to ban the use of low-quality coal in China from all sources, domestic or imported. This policy proposal wasn't an action to protect domestic coal miners, but to reduce coal consumption permanently. In short, the Chinese government is now legislating against the coal mining sector.

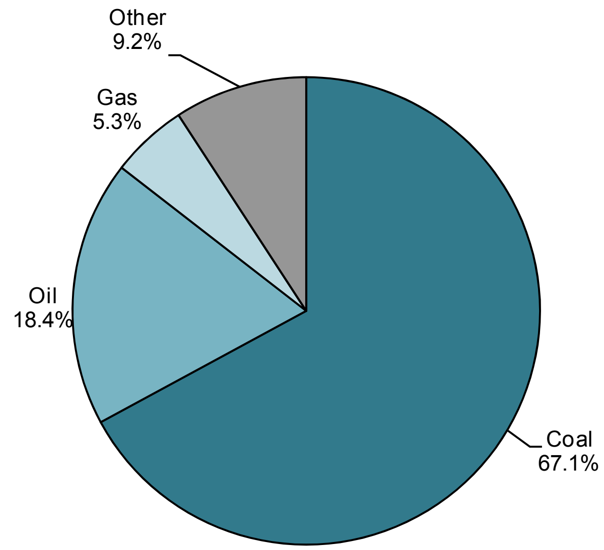
For any industry, when the government in your largest end market starts banning the sale of your product, the long-term implication is poor. Bans on imports may be good news for domestic coal miners on the day the news hits in terms of supply and demand (less coal) but the Chinese government's clear intention is ultimately terrible news for the sector — less coal.

Industrial societies reach a point where they determine that the long-term economic cost (in terms of health outcomes and the environment) of burning coal in inefficient facilities in large cities outweighs the short-term economic benefits. China has reached that moment. Following Beijing's lead, coal consumption in large east coast cities is going to decline in coming years due to falling energy demand growth, substitution from gas and renewables, and the transition of economic activity to the interior of the country.

In short, the air quality crisis in Beijing over the winter is not being wasted. It came at an opportune moment. First, public opinion was focused on this issue throughout 2012. Second, the new government could adopt aggressive policies to alleviate the problem without facing criticism for directly causing pollution in the first place ("*not on my watch*"). Third, the economy has reached a point where power consumption growth and energy consumption growth overall are structurally slowing while the working age population is now falling. The trend is on the Chinese government's side. The problem can be acknowledged because there are viable solutions to fix it. In all that, coal is the biggest loser. Coal is still the largest source of energy in the Chinese economy (see Exhibit 16). The uses of coal in China include end markets that no developed, modern economy would tolerate (see Exhibit 17).

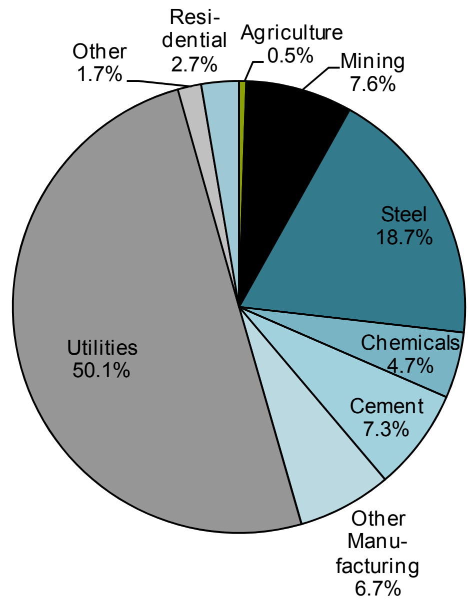
Coal use in factories and for water heating and steam in large east coast cities is going to be phased out over the rest of the decade (at least in instances where there is no remediation of pollutants).

Exhibit 16 Chinese Energy Consumption by Source (2012)



Source: CEIC and Bernstein estimates and analysis.

Exhibit 17 Chinese Coal Consumption by End Market (2011)



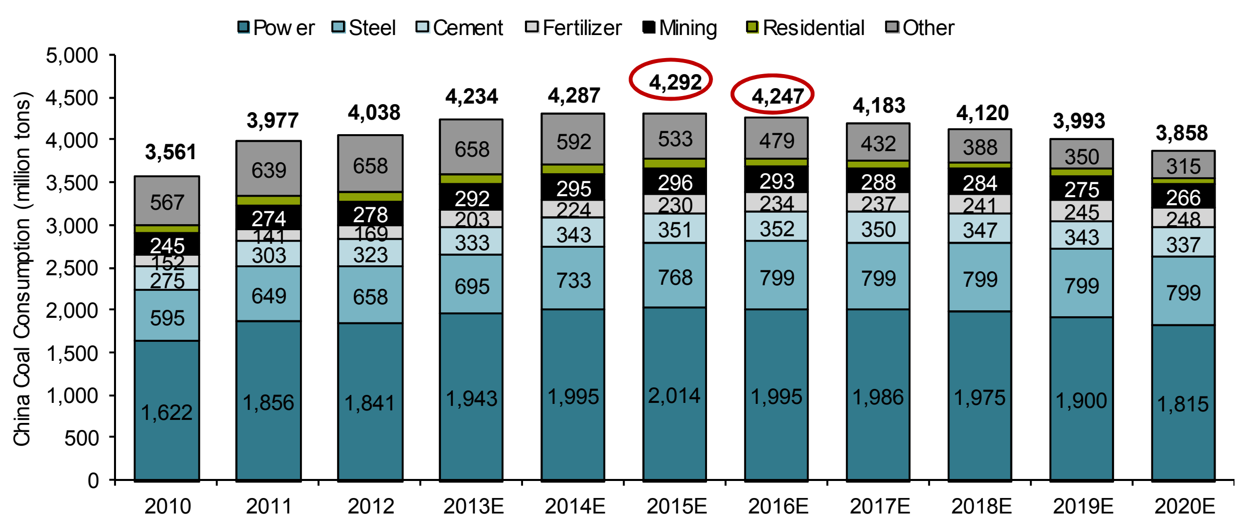
Source: CEIC and Bernstein estimates and analysis.

Coal demand growth in steel, cement and fertilizer sectors will moderate. Coal demand in the manufacturing, mining, residential sectors and in other industries will fall between now and 2020. And, as a consequence, coal consumption in the power sector will fall too.

In short, we expect that Chinese coal net imports will be close to zero by 2015 and that coal consumption in China will start to fall in absolute terms in 2016 (see Exhibit 18).

The open questions are: (i) whether China will begin exporting coal again (potentially above the previous quota of 50 million tons) and (ii) whether it will be gas-fired generation, nuclear or renewables that will take the most share from coal in terms of peak power supply in coming years.

Exhibit 18 China Coal Consumption by Sector (2010-20E)



Source: CEIC and Bernstein estimates and analysis.

The Chinese government is clearly motivated to improve air quality and China's environment in general. Renewables are a significant part of the initiative to reduce coal demand. We believe that gas availability to the Chinese power sector will be limited to 60-70BCM (sufficient for only 4-5% of demand by 2020). Hydro opportunities are limited. The ramp-up on nuclear is constrained not by safety, technology or uranium but by access to qualified and experienced engineers to run the stations at the end of the quintupling of nuclear capacity by the end of this decade. Solar and wind therefore become the primary near-term sources of power generation and coal substitution that the government can boost.

Distributed solar is the ideal technology for a modern economy facing low reserve margins, high-peak power demand, environmental concerns around the use of coal and economic concerns about the price of LNG. As Pollyannaish as it sounds, we expect coal consumption in China to fall by mid-decade and adoption of renewables to continue to accelerate. Economics aside, the impact on both the environment and greenhouse gas emissions globally is unambiguous if we are right.

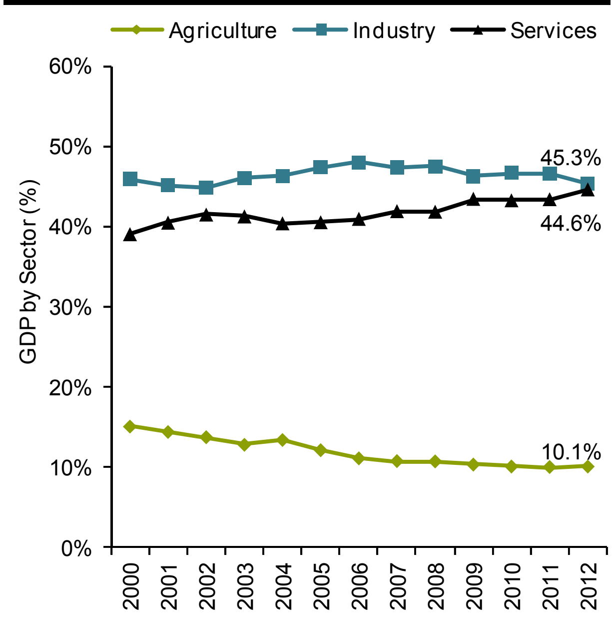
Slowing Power Consumption Growth in China Is Structural and Permanent and Leads to a Decline in Coal Consumption by 2016

The once unthinkable — a decline in China coal consumption — will be the reality by 2016, in our view. There are various drivers of this outcome. However, the key one is slowing power consumption growth. Power consumption growth (4.5% in 2012; 3.8% year-to-date) is now lower than power generation growth from hydro, nuclear, gas and renewables. In short, coal is losing growth share.

By 2016, coal will be losing total share too. Deceleration in power consumption growth will not meaningfully reverse in the coming year for the simple reason that China doesn't need that much more power to drive its economy.

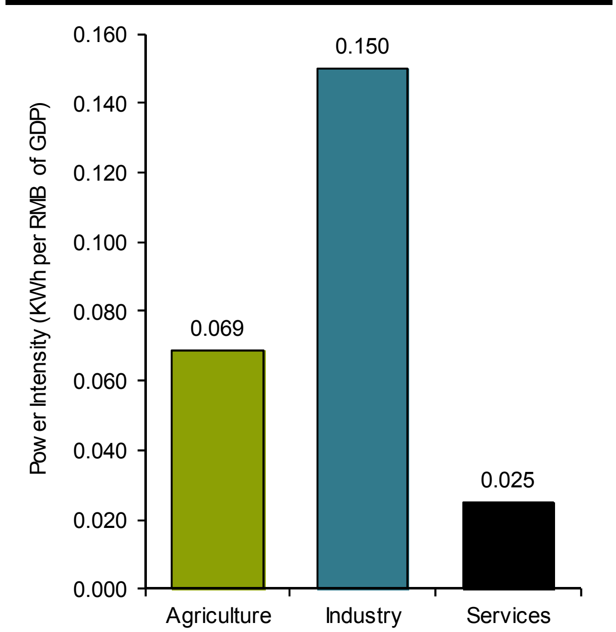
The various edicts that the Chinese government has issued in recent years about reducing energy intensity and not sacrificing the environment for economic growth are aided by one important fact: the change that the Chinese government is attempting to orchestrate is happening organically regardless of the policy.

Exhibit 19 China: GDP Share by Sector (2000-12)



Source: NBS, CEIC and Bernstein analysis.

Exhibit 20 China: Power Intensity by Sector (2011)

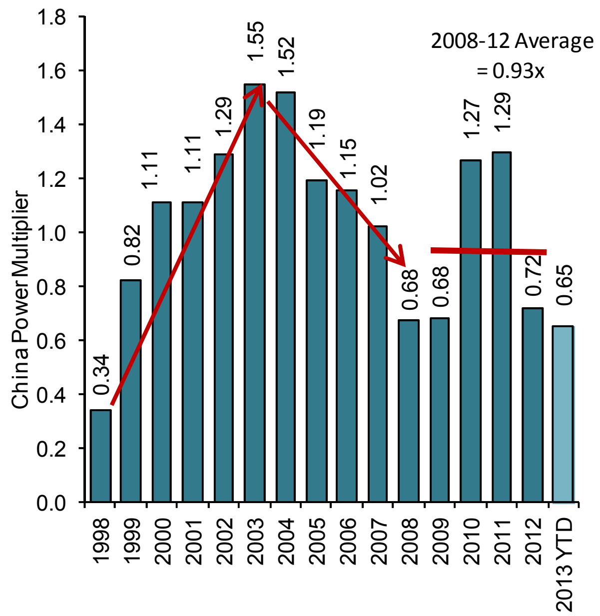


Source: NBS, CEIC and Bernstein analysis.

Over the past decade, China's economic growth has been shifting towards the less energy-intensive services sector. The services sector's share of GDP has increased to 44.6% in 2012 from 39% in 2000 (see Exhibit 19), while the industrial sector's share of GDP has trended down slightly since the middle of the last decade. The industrial sector in China is roughly 6x more power intensive than the services sector (see Exhibit 20). Therefore, a slight share shift away from the industrial sector serves to reduce power production growth significantly.

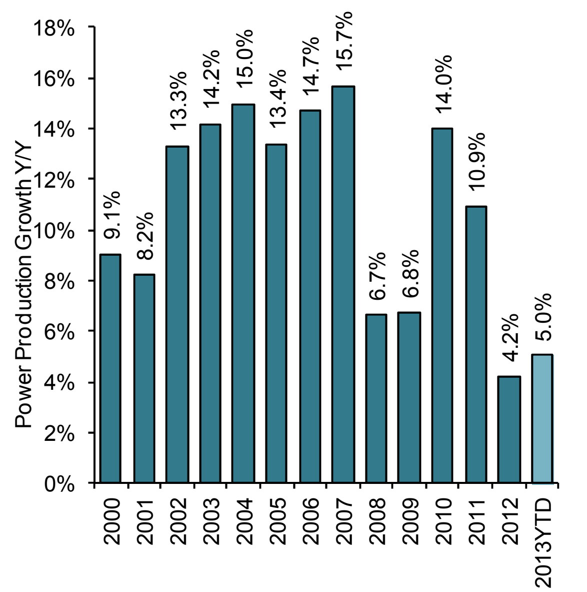
This evolution is entirely predictable given Chinese economic development but was thrown off-course in 2008 by the global financial crisis, the Chinese stimulus that followed, and the heightened levels of spending on infrastructure and construction that inflated power and coal demand in 2010 and 2011. Chinese power consumption growth is slowing structurally and is now below 1x GDP growth and falling. In our view, this is a continuation of a long-term structural shift that started in 2004 (see Exhibit 21), when China's power multiplier (power production growth divided by GDP growth) first started to fall. In 2013, this implies a power consumption growth rate slightly below GDP growth (see Exhibit 22).

Exhibit 21 China Power Intensity (1998-2013 YTD)



Source: CEIC, NBS and Bernstein analysis.

Exhibit 22 China Power Production Growth Y/Y

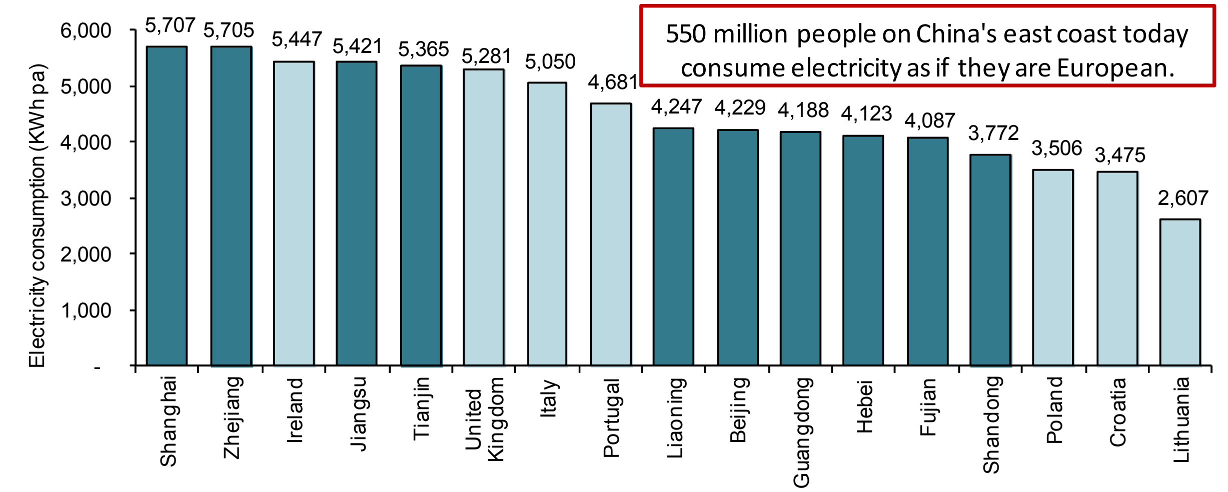


Source: CEIC, NBS and Bernstein estimates and analysis.

The falling power multiplier is a reflection that China is shifting away from heavy industries to less energy-intensive sectors to drive future economic growth. Power represents roughly half of Chinese coal consumption. However, the trend throughout the key end markets is largely the same. As with every other economy, as the Chinese economy becomes more developed, it is becoming more energy efficient: the same amount of power production growth is creating more GDP growth. This is consistent with the natural evolution of any economy going through the middle innings of economic development.

The rapid acceleration in power production in China over the last decade means that the country is today tremendously power intensive. Some 550 million people on the east coast of China now consume electricity as if they are European (see Exhibit 23). Power consumption in Shanghai (a city of 23 million) and Zhejiang (a province of 55 million) are now higher than power consumption on a per capita basis in Ireland. Tianjin and Jiangsu have eclipsed Italy and the United Kingdom.

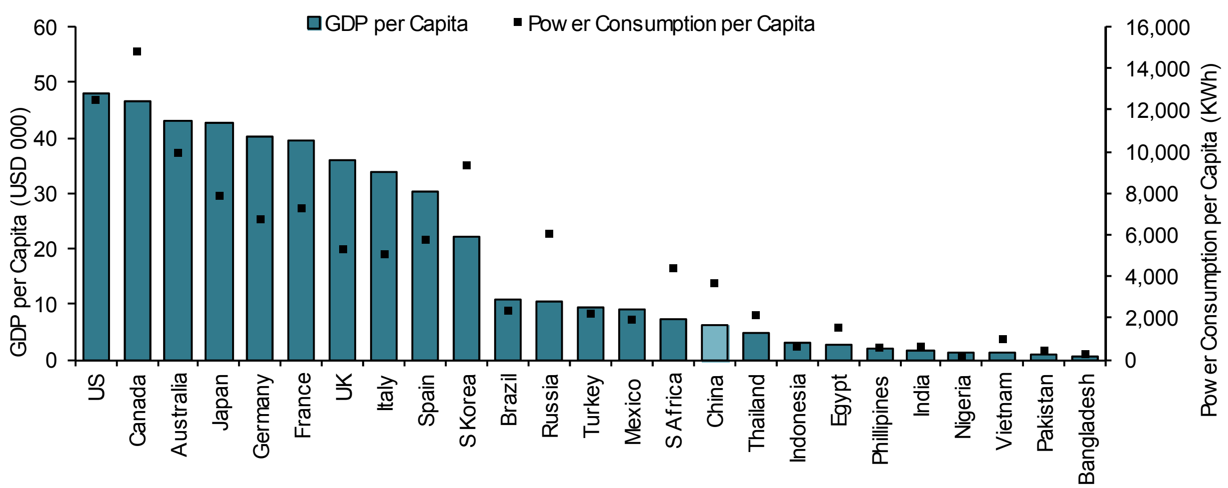
Exhibit 23 **Chinese Electricity Consumption per Capita Relative to Selected EU Member States**



Source: World Bank, NBS, CEIC, EIA and Bernstein analysis.

And it is not simply the industrialized east where power consumption is high on a per capita basis (see Exhibit 24).

Exhibit 24 **Power Consumption per Capita and GDP per Capita — Selection of 25 Developed and Developing Nations (2010)**

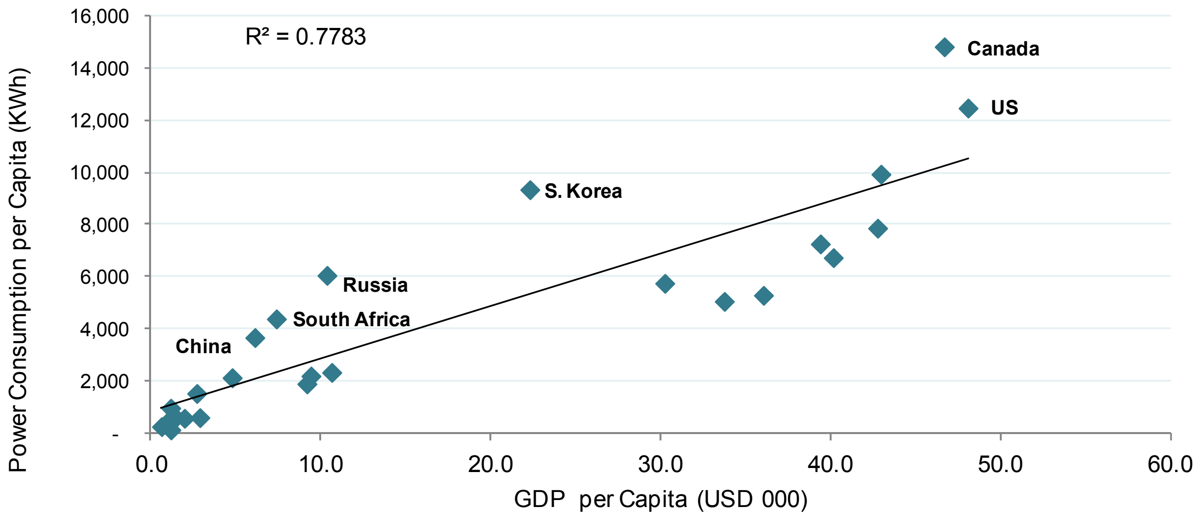


Note: China and Korea data is for 2012, and the U.S. is for 2011.

Source: EIA, World Bank and Bernstein estimates and analysis.

Overall, Chinese power consumption per capita is roughly 3,700KWh or approximately the same level as Poland. Poland's GDP per capita (on a PPP basis) was roughly $20,000 in 2011; China's was $8,400, according to the World Bank (see Exhibit 25).

Exhibit 25 **Correlations Between Power Consumption per Capita and GDP per Capita — Selection of 25 Developed and Developing Nations (2010)**



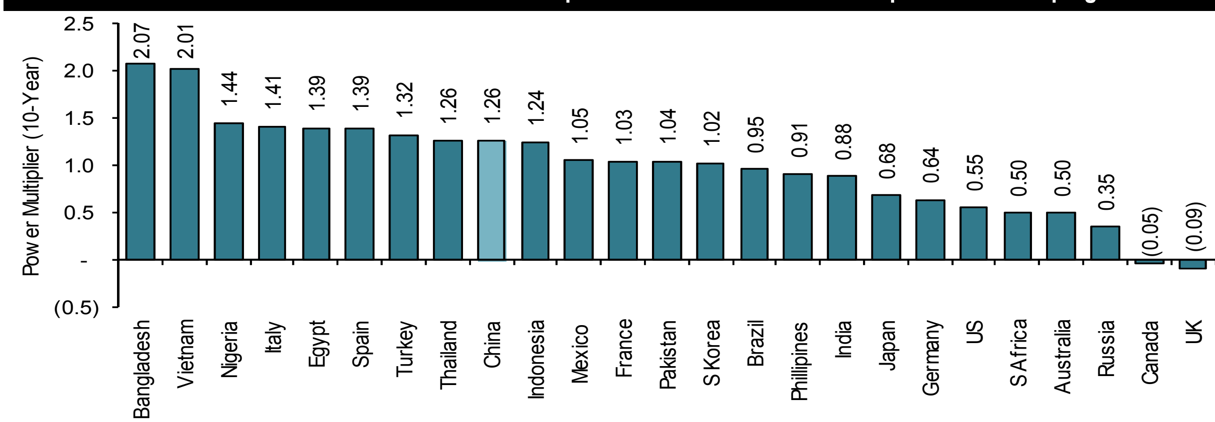
Note: China and Korea data is for 2012, and the U.S. is for 2011.

Source: EIA, World Bank and Bernstein estimates and analysis.

In short, it isn't just the east coast that is consuming electricity at levels far above its income; it is the whole country. A deceleration in power consumption growth is overdue. In short, we believe that Chinese GDP growth and its power multiplier are structurally slowing and falling, respectively (see Exhibit 26). This means that a mid-single-digit growth rate in power is likely to remain the norm over the next several years. Given hydro, renewables, nuclear and gas-fired power generation growth are all higher than that, coal-fired demand will continue to decelerate. By 2016, we believe it will be negative.

The remaining end markets for coal (steel, cement, fertilizer and the mining sector itself being the most prominent) will see a similar deterioration.

Exhibit 26 **10-Year Power Multipliers — Selection of 25 Developed and Developing Nations**



Source: EIA, World Bank and Bernstein estimates and analysis.

We believe that by 2015, Chinese net imports of coal will be close to zero, and by 2016, Chinese coal consumption will be falling too (see Exhibit 27 and Exhibit 28).

Exhibit 27 China Power Demand Model (2011-20E)

China Power Demand Model	2011	2012	2013E	2014E	2015E	2016E	2017E	2018E	2019E	2020E
GDP Growth	9.3%	7.8%	7.5%	7.0%	6.5%	6.0%	5.0%	5.0%	4.0%	4.0%
Power Multiplier	1.17x	0.54x	0.80x	0.80x	0.80x	0.70x	0.60x	0.50x	0.40x	0.40x
Power Consumption per Capita (KWh	3,521	3,670	3,890	4,108	4,322	4,503	4,639	4,755	4,831	4,908
Installed Capacity (MW)										
Coal	735,643	776,520	807,479	831,884	839,774	814,581	781,998	742,898	698,324	650,000
Gas	32,650	42,650	47,650	57,650	67,650	82,650	97,650	112,650	132,650	150,000
Hydro	229,917	248,900	253,900	268,900	290,000	302,000	314,000	326,000	338,000	350,000
Nuclear	11,915	12,570	20,048	30,416	40,770	40,770	40,770	49,770	61,770	75,000
Wind	47,001	60,830	78,830	98,830	120,000	150,000	180,000	205,000	230,000	250,000
Solar	4,943	8,300	18,300	30,300	45,300	70,300	100,300	135,300	170,300	204,860
Total Installed Capacity	**1,062,069**	**1,149,770**	**1,226,207**	**1,317,980**	**1,403,494**	**1,460,301**	**1,514,718**	**1,571,618**	**1,631,044**	**1,679,860**
Installed Capacity Growth (%)										
Coal	9.2%	5.6%	4.0%	3.0%	0.9%	-3.0%	-4.0%	-5.0%	-6.0%	-6.9%
Gas	-8.7%	30.6%	11.7%	21.0%	17.3%	22.2%	18.1%	15.4%	17.8%	13.1%
Hydro	6.4%	8.3%	2.0%	5.9%	7.8%	4.1%	4.0%	3.8%	3.7%	3.6%
Nuclear	10.0%	5.5%	59.5%	51.7%	34.0%	0.0%	0.0%	22.1%	24.1%	21.4%
Wind	58.9%	29.4%	29.6%	25.4%	21.4%	25.0%	20.0%	13.9%	12.2%	8.7%
Solar	1639.1%	67.9%	120.5%	65.6%	49.5%	55.2%	42.7%	34.9%	25.9%	20.3%
Total	**9.9%**	**8.3%**	**6.6%**	**7.5%**	**6.5%**	**4.0%**	**3.7%**	**3.8%**	**3.8%**	**3.0%**
Utilization Rates (%)										
Coal	59.9%	55.4%	55.8%	55.4%	54.8%	54.8%	56.6%	58.9%	60.0%	61.2%
Gas	25.0%	25.0%	24.0%	24.0%	24.0%	24.0%	24.0%	24.0%	24.0%	24.0%
Hydro	31.2%	35.6%	35.6%	35.6%	35.6%	35.6%	35.6%	35.6%	35.6%	35.6%
Nuclear	91.1%	89.8%	60.0%	80.0%	80.0%	90.0%	95.0%	95.0%	95.0%	95.0%
Wind	21.4%	19.3%	20.0%	24.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%
Solar	n/a	n/a	10.0%	13.0%	13.0%	13.0%	13.0%	13.0%	13.0%	13.0%
Power Generation (TWh)										
Coal	3,698	3,667	3,872	3,975	4,014	3,974	3,958	3,935	3,786	3,617
Gas	75	82	95	111	132	158	190	221	258	297
Hydro	609	747	785	816	872	924	961	999	1,036	1,074
Nuclear	86	94	86	140	213	321	339	339	414	514
Wind	72	91	122	187	259	319	390	455	514	568
Solar/Other	37	90	98	112	129	158	192	232	272	311
Total Power Generation	**4,577**	**4,771**	**5,058**	**5,341**	**5,619**	**5,855**	**6,030**	**6,181**	**6,280**	**6,380**
Memo: *Y/Y Growth*	*10.9%*	*4.2%*	*6.0%*	*5.6%*	*5.2%*	*4.2%*	*3.0%*	*2.5%*	*1.6%*	*1.6%*
Power Generation Growth										
Coal	14.7%	-0.8%	5.6%	2.7%	1.0%	-1.0%	-0.4%	-0.6%	-3.8%	-4.5%
Gas	5.8%	10.1%	15.1%	16.6%	19.0%	20.0%	20.0%	16.6%	16.6%	15.2%
Hydro	-7.6%	22.7%	5.0%	4.0%	6.9%	5.9%	4.1%	3.9%	3.8%	3.6%
Nuclear	17.1%	8.5%	-8.5%	63.9%	51.7%	50.8%	5.6%	0.0%	22.1%	24.1%
Wind	69.7%	26.5%	34.5%	52.7%	38.6%	23.4%	22.2%	16.7%	13.0%	10.3%
Solar/Other	-33.7%	141.9%	9.8%	13.9%	15.2%	22.0%	21.7%	20.8%	17.2%	14.5%
Total Power Generation Growth	**10.9%**	**4.2%**	**6.0%**	**5.6%**	**5.2%**	**4.2%**	**3.0%**	**2.5%**	**1.6%**	**1.6%**

Source: SX Coal, CEIC, NBS, China General Administration of Customs and Bernstein estimates and analysis.

The single most common counter-argument we hear to our view that the current weak power consumption growth in China is structural and therefore long term are: China consumes 3,700/KWh per capita while South Korea and the U.S. consume 9,500KWh and 12,500KWh, respectively. Therefore — goes the argument — there is plenty of headroom left. In the following sections, we outline the policy decisions available to the Chinese government, given the imperative to improve air quality and the organic deceleration in coal demand, together with an analysis of why we think the U.S. and South Korea are poor comparables for "mature" Chinese consumption.

Exhibit 28 **China Coal Demand Model (2011-20E)**

China Coal Demand Model	2011	2012	2013E	2014E	2015E	2016E	2017E	2018E	2019E	2020E
Domestic Coal Production (M tons)	3,808	3,940	4,084	4,237	4,292	4,247	4,183	4,120	3,993	3,858
Memo: Incremental Production	395	132	144	152	55	(45)	(64)	(63)	(127)	(135)
Net Imports	169	280	150	50	-	-	-	-	-	-
Total Reported Coal Supply	3,977	4,220	4,234	4,287	4,292	4,247	4,183	4,120	3,993	3,858
Memo: Y/Y Growth	*11.7%*	*6.1%*	*0.3%*	*1.2%*	*0.1%*	*-1.0%*	*-1.5%*	*-1.5%*	*-3.1%*	*-3.4%*
Coal Consumption by Sector (M tons)										
Power	1,856	1,841	1,943	1,995	2,014	1,995	1,986	1,975	1,900	1,815
Memo: Y/Y Growth		*-0.8%*	*5.6%*	*2.7%*	*1.0%*	*-1.0%*	*-0.4%*	*-0.6%*	*-3.8%*	*-4.5%*
Steel	649	658	695	733	768	799	799	799	799	799
Memo: Y/Y Growth		*1.5%*	*5.6%*	*5.4%*	*4.7%*	*4.1%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*
Cement	303	323	333	343	351	352	350	347	343	337
Memo: Y/Y Growth		*6.6%*	*3.1%*	*3.0%*	*2.4%*	*0.2%*	*-0.5%*	*-0.9%*	*-1.2%*	*-1.6%*
Fertilizer	141	169	203	224	230	234	237	241	245	248
Memo: Y/Y Growth		*20.2%*	*20.0%*	*10.0%*	*3.0%*	*1.5%*	*1.5%*	*1.5%*	*1.5%*	*1.5%*
Mining	274	278	292	295	296	293	288	284	275	266
Memo: Y/Y Growth		*1.5%*	*4.9%*	*1.2%*	*0.1%*	*-1.0%*	*-1.5%*	*-1.5%*	*-3.1%*	*-3.4%*
Residential	115	110	110	105	100	95	90	85	81	77
Memo: Y/Y Growth		*-4.0%*	*0.0%*	*-5.0%*	*-5.0%*	*-5.0%*	*-5.0%*	*-5.0%*	*-5.0%*	*-5.0%*
Other	639	658	658	592	533	479	432	388	350	315
Memo: Y/Y Growth		*3.0%*	*0.0%*	*-10.0%*	*-10.0%*	*-10.0%*	*-10.0%*	*-10.0%*	*-10.0%*	*-10.0%*
Change in Coal Inventory	0	182	0	0	0	0	0	0	0	0
Total Coal Consumption	3,977	4,038	4,234	4,287	4,292	4,247	4,183	4,120	3,993	3,858
Memo: *Y/Y Growth*	*11.7%*	*1.5%*	*4.9%*	*1.2%*	*0.1%*	*-1.0%*	*-1.5%*	*-1.5%*	*-3.1%*	*-3.4%*
Memo: Incremental Consumption	**416**	**61**	**14**	**52**	**5**	**(45)**	**(64)**	**(63)**	**(127)**	**(135)**
EOY Coal Production Capacity	**3,808**	**3,940**	**4,584**	**4,584**	**4,584**	**4,247**	**4,183**	**4,120**	**3,993**	**3,858**

Source: SX Coal, CEIC, NBS, China General Administration of Customs and Bernstein estimates and analysis.

Renewables Are the Only Incremental, Scalable Source of Substitution Between Now and 2020; Wind Could Triple Installed Capacity Over the Next Seven Years; Solar Could Increase 20-Fold

Decelerating power consumption growth is organic; the compounding negative effect of reduced coal consumption is policy driven. Renewables are a significant part of the initiative to reduce coal demand. We believe that gas availability to the Chinese power sector will be limited to 60-70BCM by 2020 (sufficient for only 4-5% of demand). Hydro opportunities are limited. The ramp-up on nuclear is constrained not by safety, technology or uranium but by access to qualified and experienced engineers to run the stations at the end of the quintupling of nuclear capacity by the end of this decade. Solar and wind therefore become the primary sources of power generation and coal substitution that the government can boost.

Distributed solar is the ideal technology for a modern economy facing low reserve margins, high-peak power demand, environmental concerns around the use of coal and economic concerns about the price of LNG. As Pollyannaish as it sounds, we expect coal consumption in China to fall by mid-decade and adoption of renewables to continue to accelerate. Economics aside, the impact on both the environment and greenhouse gas emissions globally is unambiguous if we are right.

Any economic planner responsible for setting targets for Chinese power supply over the rest of the decade faces a dilemma in roughly eight parts.

First, China needs power…and more of it. The economy is slowing but it hasn't stopped. Power demand growth will continue to increase in coming years as a fraction of GDP growth, rather than as a multiple. But power demand is going to continue to go up nonetheless. Further, expectations about reliability of supply are rising as China gets wealthier and a greater share of the economy is dedicated to services. A more sophisticated economy requires higher reserve margins (the percentage of the fleet that is idle but available for dispatch at the moment of peak demand) in order to increase reliability of supply and reduce power cuts throughout the country.

Second, the cheapest and easiest source of power supply in China is coal-fired power stations. China has spent a decade building a modern fleet of coal-fired power stations, and today there is plenty of low-priced coal available throughout China.

Third, despite the attractive economics of coal-fired power generation, the use of coal in east coast cities is being restricted and will be restricted further in coming years. China — like every industrialized economy — is weighing the impact of ever-increasing pollution on its population and is reducing usage. The fact that the simple, short-term economics militate in favor of more coal does not mean that China will use more coal. As economies get richer, the decision making in this regard gets more complex.

Fourth, China is increasing both domestic gas production and imports. Gas supply to the power sector and gas-fired generation as a share of total generation will increase in coming years. However, gas is still constrained and the power sector ranks below residential, commercial, industrial and, potentially, transportation users in terms of priority of supply. If supply to the power sector reaches 70BCM by 2020, it will represent ~5% of total power generation.

Fifth, China continues to expand hydro generation capacity. Total installed capacity at the end of 2012 was ~250GW. However, there are no non-navigable, large, fast-flowing rivers in deep, uninhabited valleys left in China. The easy opportunities were dammed years ago. And large-scale projects like the Three Gorges Dam (given its massive environmental impact and population displacement) are not going to be repeated. That leaves smaller dams. We believe that China will add 100GW of hydro over the rest of the decade. Hydro will represent ~17% of total generation by 2020.

Sixth, nuclear power generation is continuing to ramp. Installed capacity is currently ~14GW and plans are for China to reach 75GW by the end of the decade. This will mean nuclear capacity will go from less than 3% of total generation to ~10%. The limiting factor is not technology, ambition, safety concerns or uranium. The constraint to China expanding its nuclear fleet any faster is the shortage of experienced engineers who can manage these facilities. That is a multi-decade, not a multi-year, development task.

Seventh, wind is currently an under-utilized source of power generation in China. The 61GW of installed capacity operated at a utilization rate of ~19% in 2012. This utilization rate was a function of an inability or unwillingness from State Grid to dispatch all of the electricity being generated. We believe that the normal level of utilization will (by 2015) be 27%. We also believe that State Grid will remain under pressure to connect wind farms and absorb all of the electricity generated.

Eighth, solar is a rounding error within the Chinese power portfolio today. However, with installed cost now approaching $1/W, solar is economic with gas-fired power generation in China and — on a distributed basis — is economic against on-grid power prices.

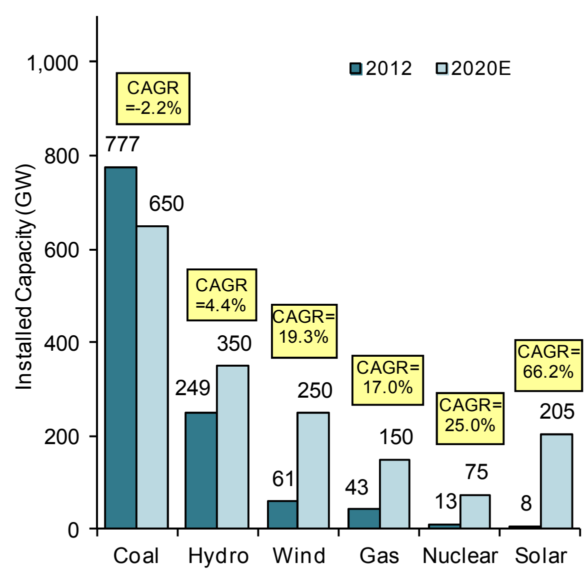
Given those constraints and an objective of increasing reliability of supply, improving environmental impacts and cost control (probably in that order), we believe that the focus within the power sector will be on (i) completing hydro, gas-fired and nuclear projects on time; (ii) decommissioning old and inefficient coal-fired power stations; and (iii) encouraging renewables to the greatest extent possible.

With lower power consumption growth and less coal consumption overall — and in an environment of continuing constrained gas supply — renewables are the source of incremental power supply. We think both wind and solar installed capacity could be over 200GW by the end of the decade (up from 61GW of wind and 8.3GW of solar today).

In short, given the long lead times associated with hydro and nuclear and the supply constraint around gas, the primary levers available to economic planners and to the grid operator is to encourage solar and wind….and hope that the current deceleration in power consumption growth and falling power intensity persist.

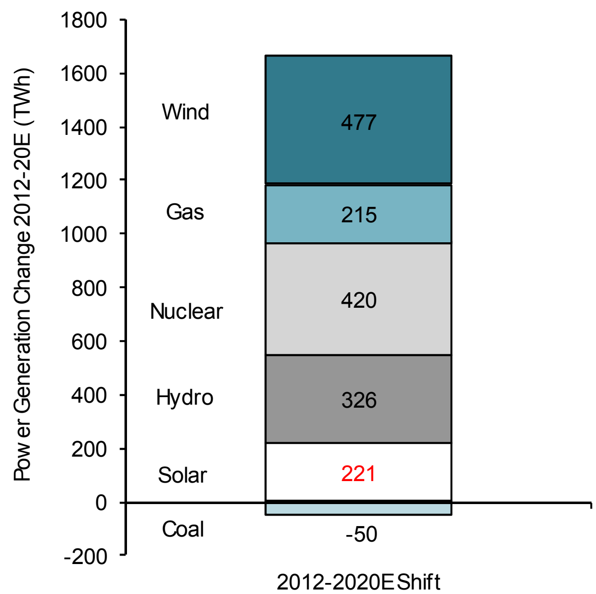
We believe that coal-fired power generation capacity will fall from ~800GW of installed capacity today to 650GW by the end of the decade as inefficient, small, old power stations are decommissioned. Hydro will increase from ~250GW to 350GW. Gas will go from ~40GW to 150GW. Nuclear will increase from 13GW to 75GW. Solar and wind will be 200GW and 250GW by the end of the decade, respectively (see Exhibit 29). Over this period, power demand will increase by 1,323TWh (up one-third compared to 2012) and coal-fired generation will decline (see Exhibit 30).

Exhibit 29 Installed Capacity by Fuel Source (2012 and 2020E)



Source: CEIC and Bernstein estimates and analysis.

Exhibit 30 Share Shift by Fuel Source (2012-20E)



Source: CEIC and Bernstein estimates and analysis.

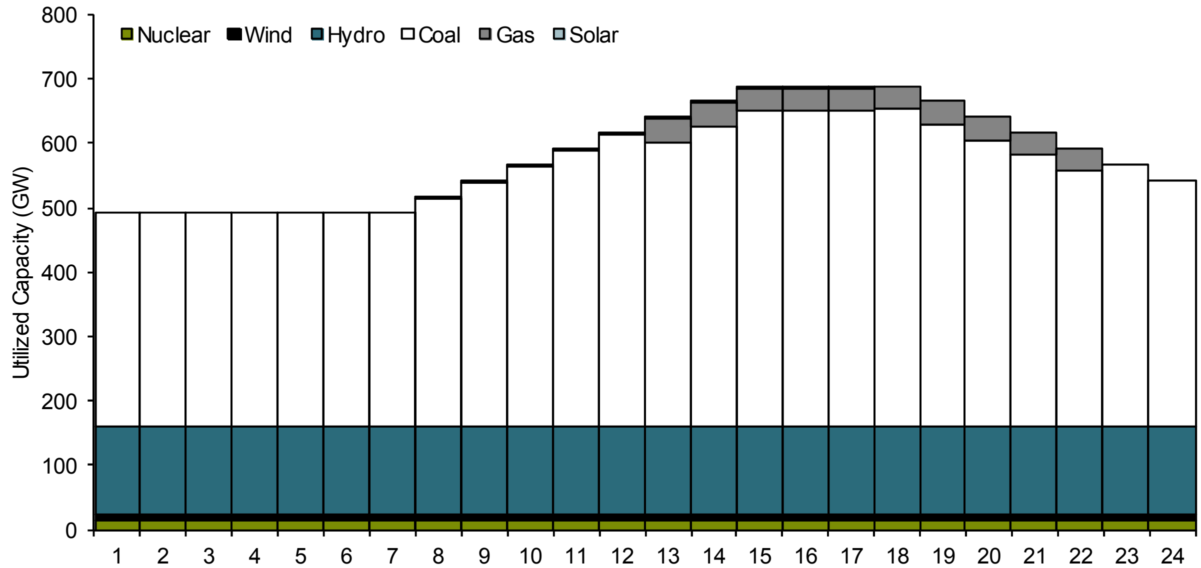
The nature of power demand in any fleet is that consumption is highest during the day. In the summer, thanks to air conditioning, peak demand lasts from early afternoon into the evening. In the winter, peak demand is more focused around the dinner hour (especially in more developed economies where residential consumption represents a more significant share of total consumption).

Currently, coal-fired power stations in China serve both base-load and peak-load demand. The difference is literally putting more coal in the fire. This means that utilization across the fleet is low as some portion of capacity serves peak demand, which — by definition — means the capacity is only necessary for a few hours a day. With more peak capacity available, coal-fired generation becomes more and more base-load only. This should mean higher utilization for the larger, cleaner-burning, more efficient power plants in the fleet and the opportunity to de-commission everything else.

In that transition, three things are clear: First, the lack of gas supply for the power sector limits the options for any economic planner. Nuclear and hydro construction projects run on their own (long) timelines. If coal consumption is going to fall on the east coast, it has to be replaced with either gas or renewables.

Second, utilization for the coal-fired fleet that remains will trend higher. With gas and renewables expanding faster than overall power generation growth and generating in the middle of the day, coal-fired generation capacity will increasingly be retired or will become base-load. The Chinese summer and winter power generation is currently dominated by coal (see Exhibit 31).

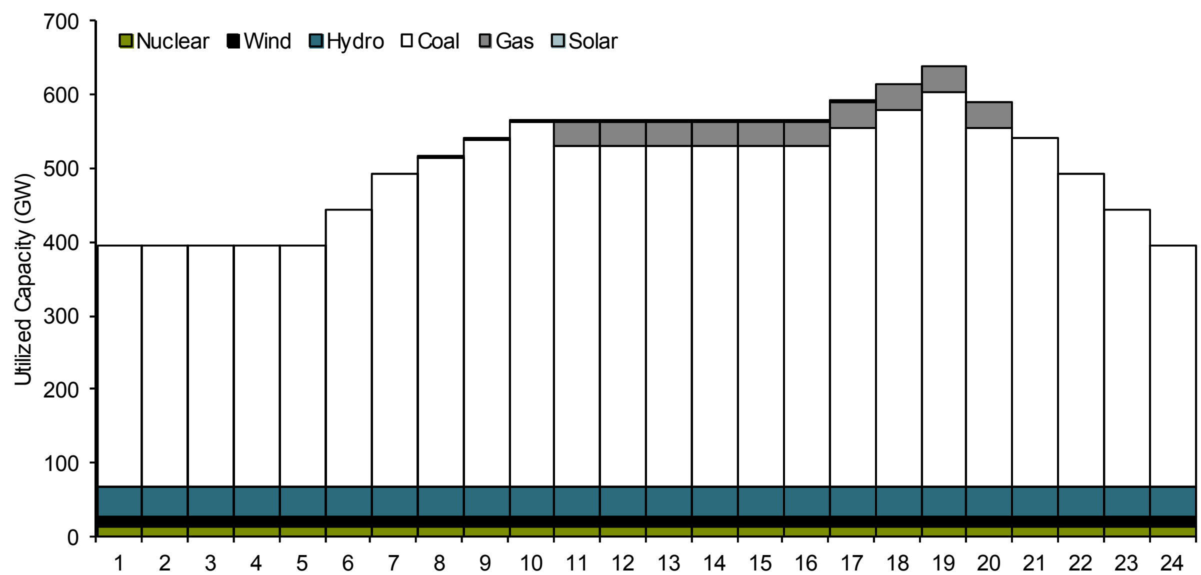
Exhibit 31 **SCB Estimates for 2012 Chinese Summer Power Portfolio Dispatch**



Source: CEIC, NBS and Bernstein estimates and analysis.

In the summer, hydro generation acts as base-load power supply. In the winter, power generation is almost entirely coal-fired (see Exhibit 32).

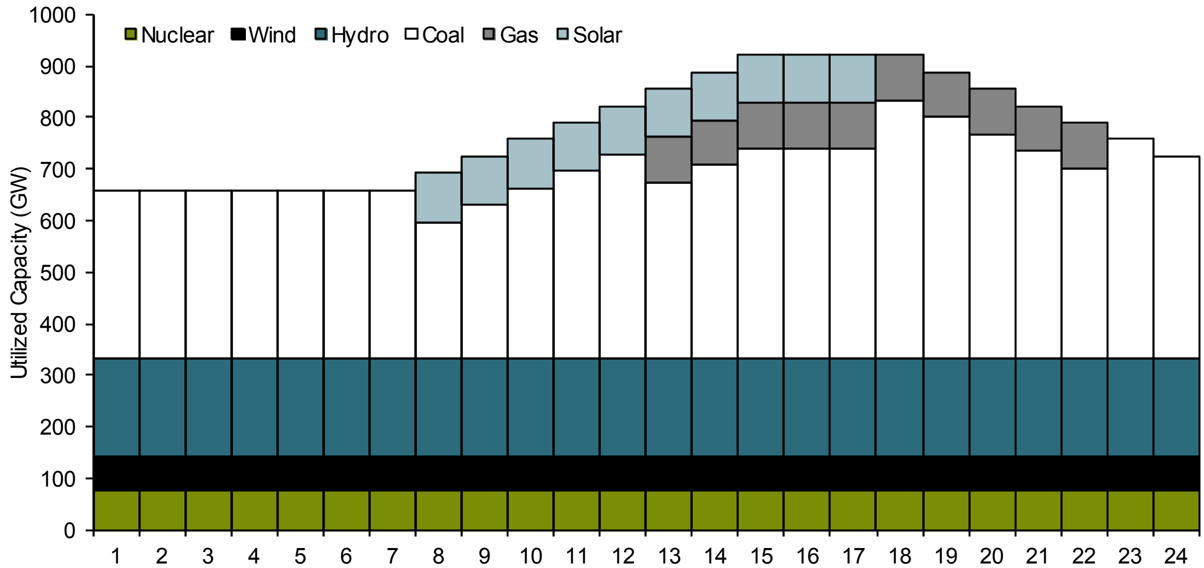
Exhibit 32 **SCB Estimates for 2012 Chinese Winter Power Portfolio Dispatch**



Source: CEIC, NBS and Bernstein estimates and analysis.

By 2020, diversification within the portfolio becomes more evident (see Exhibit 33). Nuclear, wind and hydro are contributing to base-load power demand. Gas and solar are taking out a great deal of peak power demand. Coal becomes the intermediate source of power generation.

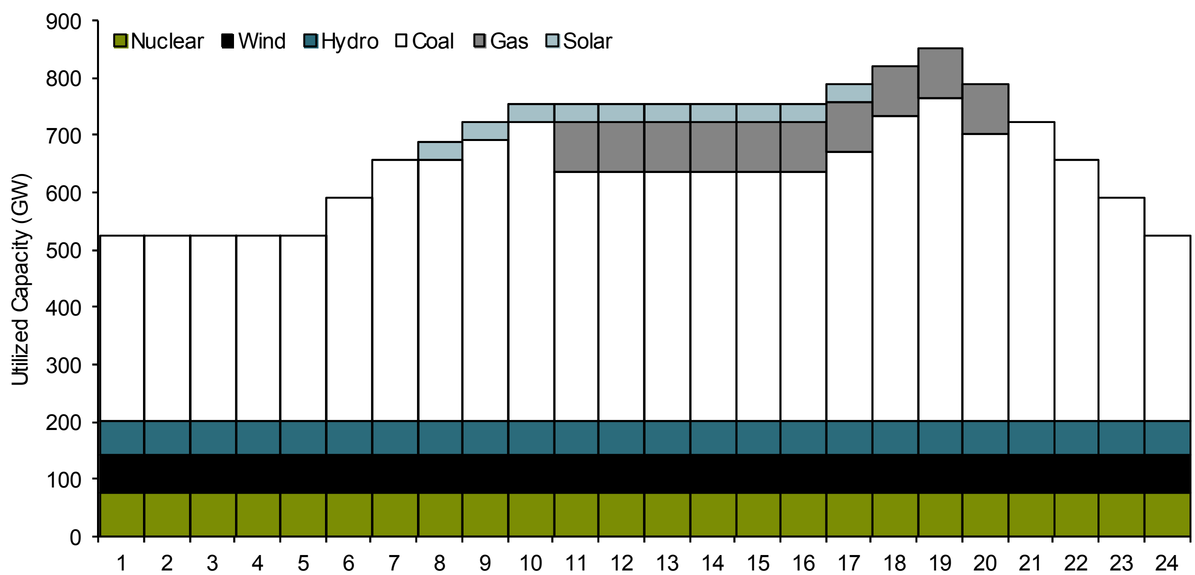
Exhibit 33 **SCB Estimates for 2020 Chinese Summer Power Portfolio Dispatch**



Source: CEIC, NBS and Bernstein estimates and analysis.

In the winter, without hydro and solar contribution, coal remains dominant (see Exhibit 34).

Exhibit 34 **SCB Estimates for 2012 Chinese Winter Power Portfolio Dispatch**



Source: CEIC, NBS and Bernstein estimates and analysis.

Third, solar is the only option to shore up reserve margins, address peak power demand, accelerate the reduction in coal consumption, improve air quality in east coast cities and reduce demand for expensive LNG or domestic gas supply within various other competing end markets.

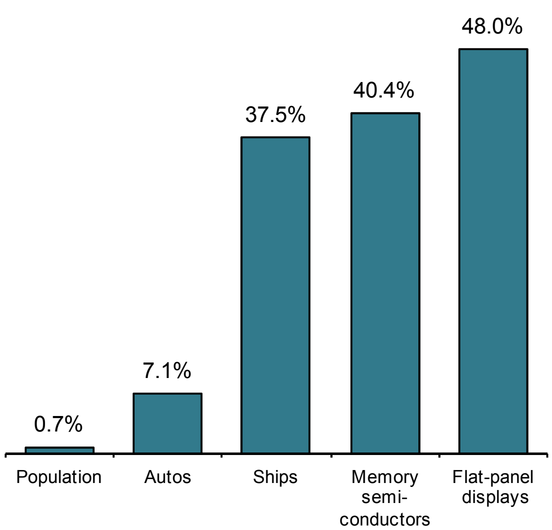
By 2014, we believe that solar will be cost competitive on an unsubsidized basis, with gas-fired power generation. As costs for solar continue to fall, the economics become more attractive. Japan is currently demonstrating how an Asian economy that is, at present, struggling to serve summer peak power demand and is looking to avoid incurring the cost of high-priced LNG can use distributed solar to kill peak demand. We do not believe that this lesson will be lost on China. Given that Italy went from less than 400MW of solar installed capacity additions in 2008 to over 9GW in 2011, we do not believe that there are any real logistical barriers to the rapid deployment of solar in coming years. Once the economics work, installed capacity expansion — as Italy, Spain, Germany, Czech, Romania and Japan have now proved — happens much faster than anyone expects.

The South Korean Model of Export-Focused, Energy-Intensive Growth Is Not Sustainable in China for the Simple Reason That End-Market Demand in the Rest of the Model Is Not Big Enough to Sustain a Chinese-Sized South Korea

South Korea is, in our view, a poor proxy for "mature" per capita Chinese power consumption. South Korean power consumption is largely exported in the form of finished goods. Half of South Korea's GDP is from exports.

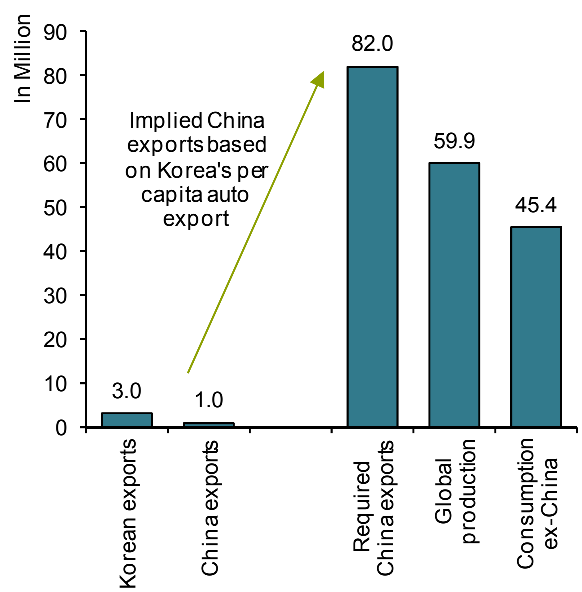
The simplest reason that South Korea makes no sense as a parallel to Chinese economic development is that Korea is a ridiculously energy-intensive economy, and it can maintain that intensity because of the size of its export sector. South Korea is 48 million people building one-third of the world's ships, 40% the world's memory semiconductors, roughly half the world's flat screens and 5 million cars each year (see Exhibit 35 and Exhibit 36).

Exhibit 35 South Korea Share of Global Population; Global Auto, Ship, Memory Semiconductor and Flat-Panel Display Production



Source: DisplaySearch, Gartner, KAMA and Bernstein estimates and analysis.

Exhibit 36 South Korea vs. China Auto Exports

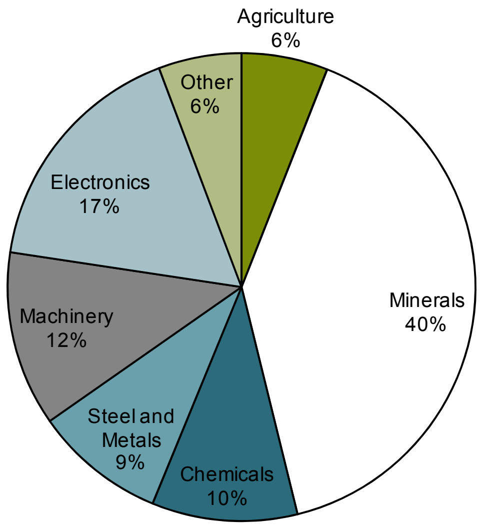


Source: KAMA, CAAM and Bernstein estimates and analysis.

This level of production (and energy consumption) is sustainable — for a country of 48 million people — because of the size of the export market relative to the size of Korea's domestic population. In short, there is an export market ~139x the size of Korea to which Korea can sell cars, ships, semiconductors and TVs. China has an export market that is ~5x its own size…and does not include the single-greatest untapped market opportunity for selling consumer goods of this or any other age: China.

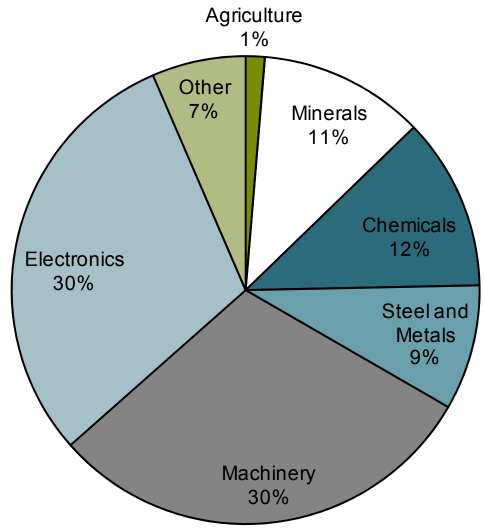
Roughly 40% of South Korea's imports are minerals, coal, gas and oil (see Exhibit 37); 60% of exports are machinery and electronics (see Exhibit 38).

Exhibit 37 South Korean Imports by Category (2012)



Source: Korea Customs Service and Bernstein analysis

Exhibit 38 South Korean Exports by Category (2012)



Source: Korea Customs Service and Bernstein analysis

China is simply too large to replicate that kind of export-dominated, energy-intensive model over the long term…or, more accurately, the rest of the world is too small. Korean power consumption per capita is ~9,500KWh and GDP per capita is $30,000 — roughly Spanish-level income, with 50% more power consumption.

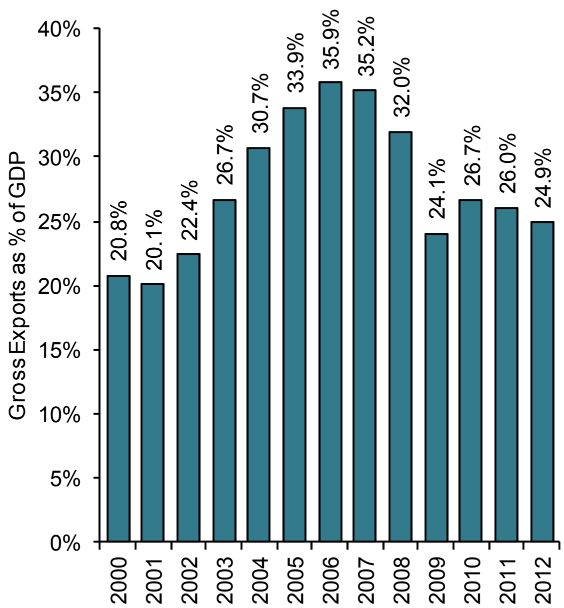
China simply cannot replicate the impact of exports on resource and power consumption measured on a per capita basis. One example: South Korea currently exports ~3 million cars annually, but China exports only ~1 million cars annually. However, for China's auto exports to rise to the level of South Korea's in terms of per capita power consumption contribution, China would need to export 78 million vehicles annually (3 x 26) — 77 million more than it does currently. Total global auto consumption is 80 million cars annually. Adjusting for domestic consumption, China would need to supply 125% of non-Chinese auto consumption if China's auto industry is to replicate South Korea's in terms of contribution to power and resource consumption on a per capita basis. In short, it just cannot happen.

China is not going to end up producing all of the world's cars…or all the world's ships, semiconductors, flat screens or anything else. And, if not, the rest of North Asia is of little relevance in predicting long-term per capita Chinese power consumption. Residential power consumption parity between China (460KWhpa per capita) and South Korea (1,300KWhpa per capita) would mean a 2.5% growth rate in Chinese power consumption annually for the next decade. After that, it is largely domestic consumption of manufactured goods that drives power consumption growth higher.

This seems, to us, the greatest flaw in comparing power consumption and resource use (or even wealth) among the various North Asian economies and then extrapolating that as the long-term outcome for China. Yes, there are very good reasons why Guangdong, Zhejiang or Jiangsu may replicate Taiwan, Korea and Japan in terms of wealth, and energy and resource consumption on a per capita basis one day. But there are also very good reasons why the entire country will *not* see Taiwanese, Japanese or Korean levels of economic development and resource use. The difference is exports. China may not lack for ambition to match Korea economically, and the rest of the world may not lack for resources to supply that ambition…but the problem is there isn't enough demand in the rest of the world to make it happen.

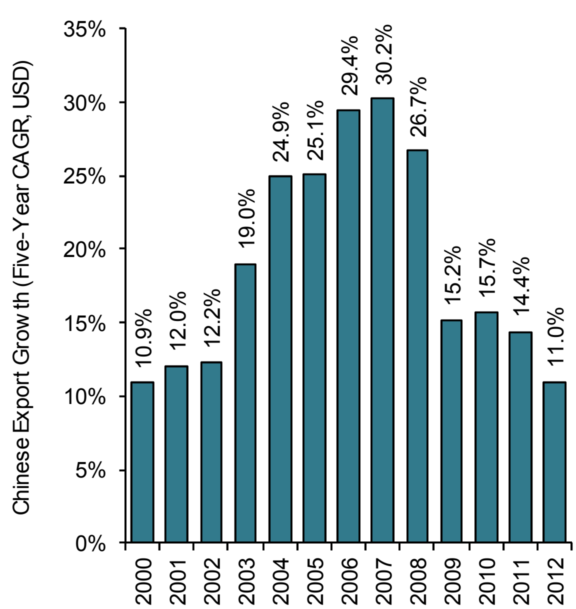
Today, Korean exports (gross) have a ~50% share of GDP. In China, that number was 24% last year and has been trending down since 2006 (see Exhibit 39). In short, China cannot double the size of its economy by 2020 *and* increase exports as a share of GDP (at least if those exports are going to continue to be resource and power intensive). The global economy is simply not big enough or growing fast enough to absorb the output (see Exhibit 40).

Exhibit 39 Chinese Gross Exports as a Percentage of GDP



Source: NBS, CEIC, General Administration of Customs and Bernstein analysis.

Exhibit 40 Chinese Gross Exports Growth — Five-Year CAGR (2000-12)



Source: NBS, CEIC, General Administration of Customs and Bernstein analysis.

We are not arguing that China cannot double the size of its economy over the course of the current decade. We do think it is unlikely that gross exports would be 50% of GDP by 2020 in this circumstance (i.e., where South Korea is today). However, we believe it is simply impossible for China to do these two things *and* establish an export mix that is as power and resource intensive as South Korea's — the global market for cars, ships, phones, TVs and microchips just isn't big enough.

The U.S. Model of Tremendous Energy Intensity Is a Function of High-Residential Power Consumption and Energy-Intensive Infrastructure

The U.S. is also a poor proxy for "mature" per capita Chinese power consumption, in our view. There are two primary reasons for this.

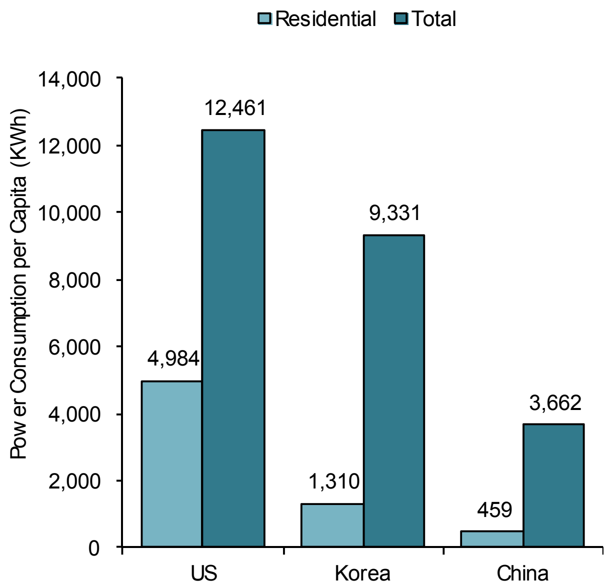
First, the sheer scale of residential power consumption in the U.S. means that U.S. power consumption is disproportionately high. The U.S. consumes 12,500KWh per capita; 40% of that power consumption is residential and is a function of wealth (TVs, computers, set top boxes), home size (air conditioning, lighting, heating), or both. China will not mirror that kind of consumption by 2020.

The 5,000KWh per capita in residential electricity consumption in the U.S. dwarfs Chinese residential usage (see Exhibit 41). This is a function of two things: housing stock and wealth. Wealth levels in China will change over time. However, it is unlikely that the housing stock (in terms of square meters per unit) is going to increase in size dramatically in China as the country continues to urbanize.

Space cooling, lighting and space heating account for 42% of U.S. residential power consumption (see Exhibit 42). This is largely a function of dwelling unit size. The average home size in the U.S. is 2,700 square feet, or 300 square meters.

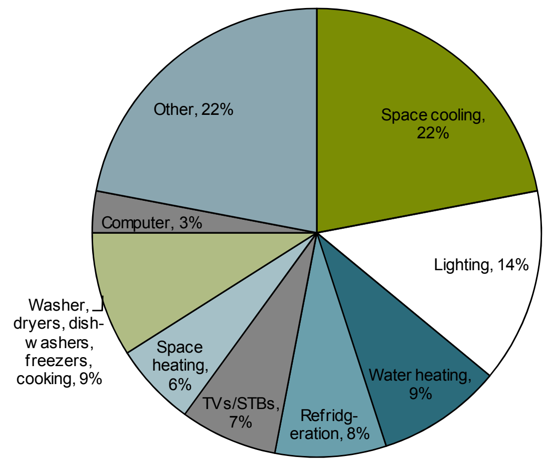
The average Chinese apartment is 80 square meters (based on the combination of commodity and government-built housing stock — see Exhibit 43). At the margin, this may change over the next few decades, but there will not be a fundamental shift in Chinese housing stock area by 2020.

Exhibit 41 Residential and Total Power Consumption per Capita



Source: CEIC, EIA and Bernstein estimates and analysis.

Exhibit 42 U.S. Residential Power Consumption by Use



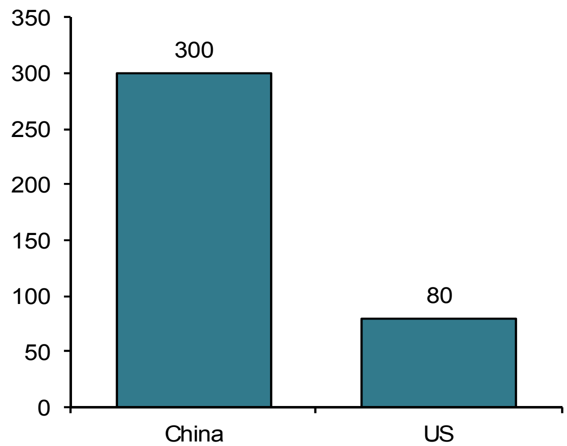
Source: EIA and Bernstein estimates and analysis.

Second, the wealth effect drives the delta in power consumption at the residential level. Flat screens, set-top boxes, washer/dryers, dishwashers and computers all add up. This delta between the U.S. and China should fall in the coming years. However, given the focus on energy efficiency in household appliances, the two trend lines are likely to converge from both ends rather than Chinese consumption simply mirroring U.S. patterns.

Third, power prices at a residential level in China are expensive. Even adjusting for purchasing power parity, GDP per capita in China is still less than one-fifth of GDP per capita in the U.S. (see Exhibit 44). Yet retail residential power prices in China are only 40% cheaper than in the U.S. Not surprisingly, power consumption on a per capita basis is far lower.

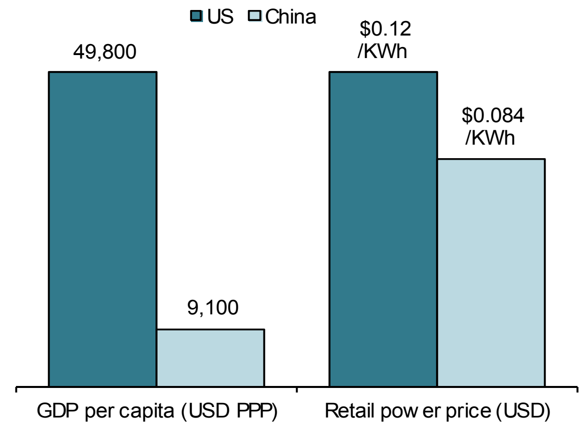
Fourth, the U.S. national infrastructure was largely built at a time when energy in general and power in particular was cheap. As a consequence, there is a legacy of high power consumption that is difficult to turn around.

Exhibit 43 U.S. and Chinese Average Dwelling Unit Size



Source: National Association of Home Builders and Bernstein estimates and analysis.

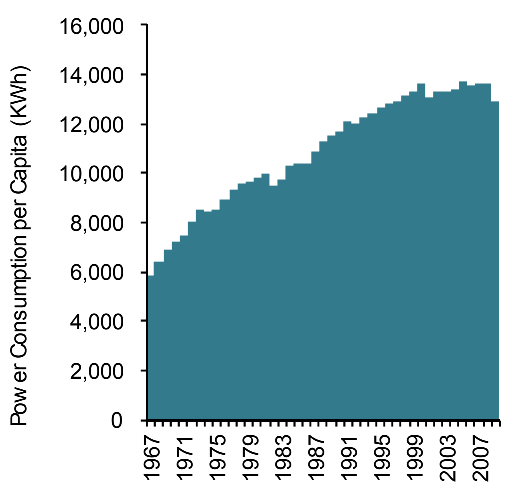
Exhibit 44 U.S. and Chinese GDP per Capita and Power Prices



Source: CIA Factbook, EIA, NBS, CEIC and Bernstein estimates and analysis.

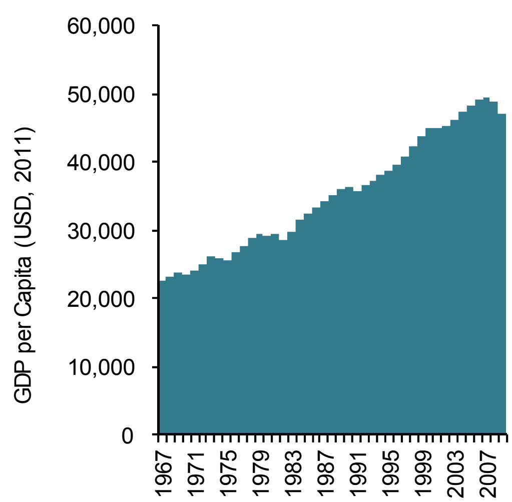
Fly on a clear night across the Midwest from Cleveland to Kansas City and all you see underneath you the entire time are lights. On a direct flight, you are passing over Indianapolis, Indiana and Springfield, Illinois. To the north and south are Columbus, Ohio; Fort Wayne, Indiana; Cincinnati, Ohio; St Louis, Missouri; and Peoria, Illinois. In short, Interstate-70 is not the Great White Way. And yet, this level of light usage and the associated power consumption is not replicated anywhere in the developing world, including China. This century-old legacy of tremendous wealth — and therefore tremendous energy intensity — is hard to shake.

Exhibit 45 U.S. Power Consumption per Capita (1967-2009)



Source: BLS, EIA and Bernstein analysis.

Exhibit 46 U.S. GDP per Capita (1967-2009)



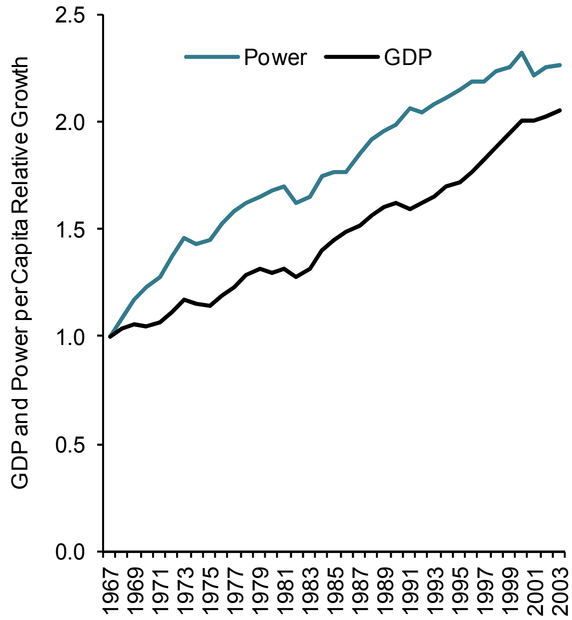
Source: BLS, EIA and Bernstein analysis.

The final point is that power consumption per capita growth and GDP per capita growth have happened largely simultaneously. It is not the case that the U.S. reached 12,500KWh per capita per annum 30 years ago and GDP has since "caught up." Accordingly, the basis to argue that Chinese power consumption growth continues to over-index Chinese GDP growth on a per capita basis is therefore weak.

From 1967 to 1997, U.S. power consumption per capita increased at a CAGR of 2.6% while GDP per capita increased at a rate of 2%. Between 1997 and 2007, power consumption growth increase at a 0.6% CAGR while GDP per capita was up 1.9% (see Exhibit 45 and Exhibit 46).

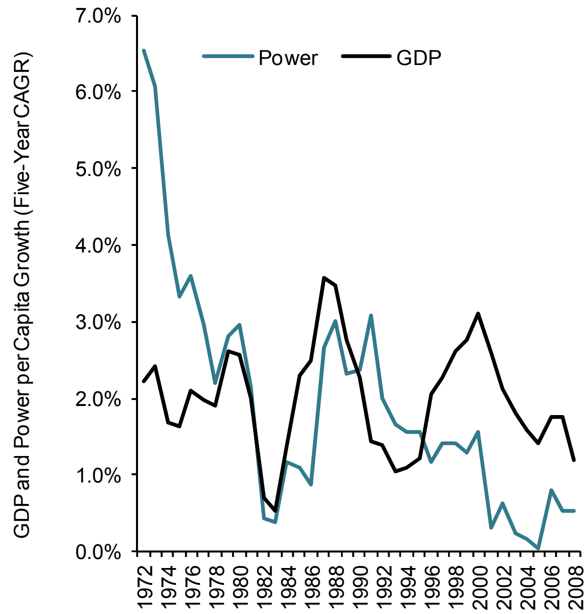
In short, the U.S. started at a high level of power consumption, and it simply got higher as the country became richer (see Exhibit 47 and Exhibit 48).

Exhibit 47 U.S. GDP per Capita and Power Consumption: Indexed Growth (1967-2009)



Source: BLS, EIA and Bernstein analysis.

Exhibit 48 U.S. GDP per Capita and Power Consumption Growth (Five-Year CAGR) — 1967-2009



Source: BLS, EIA and Bernstein analysis.

The "power hungry first, rich later" effect only started in the last 15 years. It was only at the end of the 1990s when power consumption growth on a per capita basis fell beyond GDP growth on a similar basis. Since 2007, power consumption growth has trailed GDP growth.

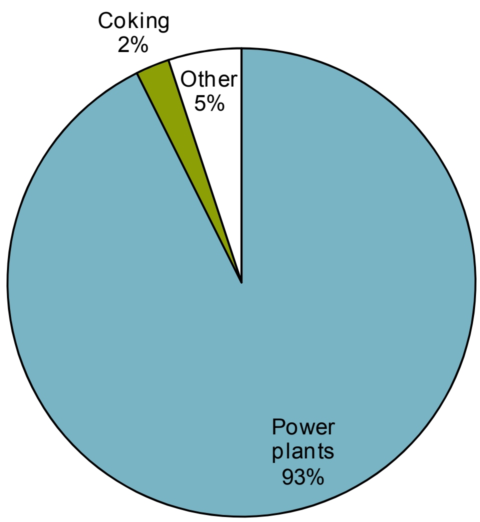
In short, for a variety of historical and economic reasons, we do not believe that China is going to replicate the U.S. in terms of power consumption per capita — at least not by 2020.

Growth (or Lack Thereof) in Other End Markets for Coal

When it comes to coal, the power sector is only half the story…but not for long.

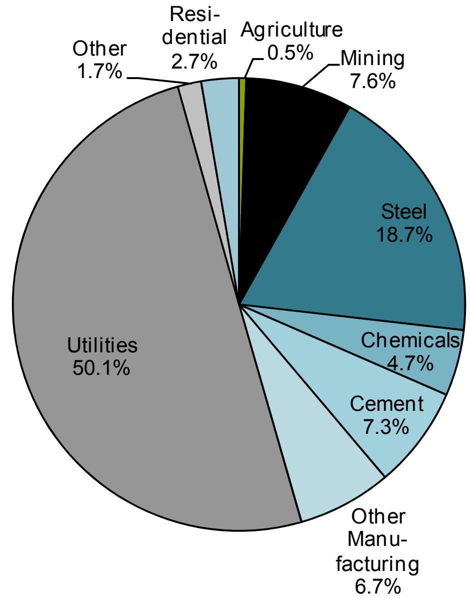
The steel, cement and fertilizer sectors account for another ~30% of consumption. The remainder is mining itself, manufacturing, residential use, agriculture and other (see Exhibit 50). Efforts to curb coal consumption outside of the four key end markets have already begun. The ultimate composition of coal usage is clear too: in developed economies, coal is used in power generation and coke production. And that is it (see Exhibit 49).

Exhibit 49 U.S. Coal Consumption by End Market (2012)



Source: EIA and Bernstein estimates and analysis.

Exhibit 50 Chinese Coal Consumption by End Market (2011)



Source: CEIC and Bernstein estimates and analysis.

Coal use in factories and for water heating and steam in large east coast cities is going to be phased out over the rest of the decade (at least in instances where there is no remediation of pollutants). Coal demand growth in the steel, cement and fertilizer sectors will moderate. Coal demand in the manufacturing, mining, residential sectors and in other industries will fall between now and 2020.

Six months ago, the general consensus was that China would move to a developed-market model of coal consumption over perhaps 30 years. Instead, that transition is likely to occur over the course of the next decade, in our view. Demand growth for coal from the steel, cement and fertilizer sectors is likely to be in the low-single-digit range over the next few years. For factory usage, mining, agriculture, residential and other end markets, growth will be negative, in our view, as first Beijing and then the rest of the east coast eliminate non-power and steel coal usage.

The Once Unthinkable Eventually Becomes Thinkable

The once unthinkable — a decline in China coal consumption — will be the reality by 2016, in our view. The key driver is slowing power consumption growth.

Power consumption growth (4.5% in 2012; 3.8% year-to-date) is now lower than power generation growth from non-coal sources. Coal is therefore losing growth share currently. As these trends continue to diverge, by 2016, coal will be losing total share too. The deceleration in power consumption growth will not meaningfully reverse in coming years for the simple reason that China doesn't need that much more power to drive its economy.

China now consumes as much power as Poland on a per capita basis but is half as wealthy (again, on a per capita basis). Coastal provinces consume power at the same levels — on a per capita basis — as western European countries. The model of the energy-intensive North Asia tiger cannot apply for all of China. Jiangsu may become South Korea in terms of energy intensity, but the entire country will not. Global demand is simply not big enough for China to export its energy consumption in the form of finished goods — the way Korea does. Power consumption growth will now continue to moderate, and with it coal demand.

By our estimates, China will cease to import coal in 2015 and will see a decline in coal consumption in absolute terms in 2016 as hydro, nuclear, renewables and gas-fired generation take market share in the power sector; steel, cement and fertilizer demand growth will continue to moderate; and other uses for coal in China (municipal boilers used for winter heating and factory furnaces, for example) will decline. We expect that China will start aggressively decommissioning coal-fired power stations and replacing them with nuclear or renewables by the latter half of this decade.

The economics of this energy evolution are not compelling. Coal prices have now fallen permanently. Nuclear and hydro are cheaper than coal-fired power generation in China, but gas, wind and solar are far more expensive. But what we are witnessing is not simply driven by economics: China is transitioning through the same environmental and public-health crisis that has seen every industrialized nation take steps to constrain its use of coal in the interest of something other than short-term economic growth.

Renewables: A Slow, Relentless Attack on Coal

All of a Sudden, an Overnight Success

Wind and solar represent a tiny share of Chinese power generation and installed capacity today. This is a legacy of three factors: historically high installed costs; poor transmission capacity in remote — but windy and sunny — parts of the country; and an absence of regulatory support for renewables in China.

Yet, because of heightened concerns about air quality in northeast China and pollution concerns generally since the start of 2013, things are changing, in our view.

The ~61GW of installed wind power generation capacity in China has gone from an albatross around the neck of State Grid to the only source of under-utilized existing power generation capacity in the whole country that consumes no coal, emits no carbon and creates no pollution. Wind is now part of the solution to the inter-related problems of China's reliance on coal and east coast air quality.

Solar — and distributed solar in particular — represents the ideal technology for any economy with a high-peak power demand spike due to air conditioning usage, low reserve margins, an environmental sensitivity towards the use of coal, a high gas price and good levels of summer sunshine. In other words, distributed solar, given current cost, is attractive in almost any Asian market. Japan's new solar feed-in tariff is driving adoption with the explicit purpose of lowering peak demand, lowering the gas bill, improving reserve margins and buying the government time to decide what to do on nuclear.

China — and India and Korea — is no doubt watching. We expect China to be the largest end market for wind and solar installed capacity globally over the next few years.

Chinese Wind and Solar Capacity Expansion Is Just Getting Started

We believe wind and solar will expand from roughly 61GW and 8.3GW of installed capacity currently to 250GW and 200GW, respectively, by the end of the decade (see Exhibit 51). In combination, wind and solar will account for roughly half of incremental power generation over the rest of the decade, by our estimates (see Exhibit 52).

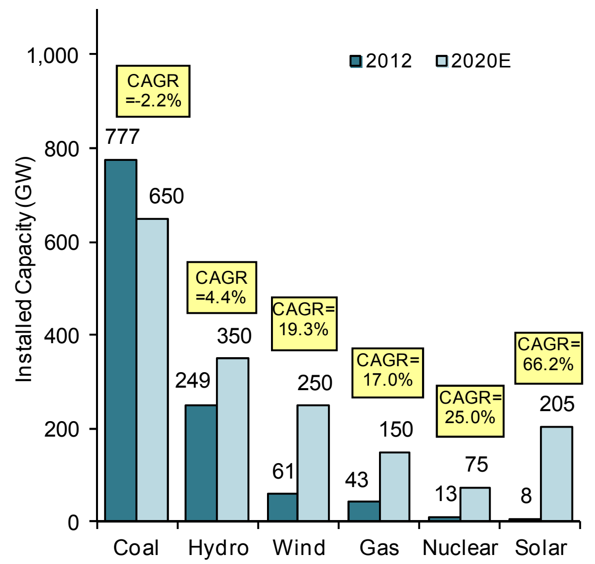
Wind is currently an under-utilized source of power generation in China. The 61GW of installed capacity operated at a utilization rate of ~19% in 2012. This utilization rate was due to an inability or unwillingness of State Grid to dispatch all of the electricity being generated. We believe that the normal level of utilization will (by 2015) be 27%. We believe that State Grid will remain under pressure to connect wind farms and absorb all of the electricity generated as part of the push towards improving air quality in northeastern China.

Solar is a rounding error within the Chinese power portfolio today. However, with installed cost now approaching $1/W, solar is economic with gas-fired power generation in China, and — on a distributed basis — is economic against on-grid power prices.

Today, solar is at or near "grid parity" in China: the unsubsidized cost to generate electricity from solar is the same as the cost of electricity from the marginal unit of power generation. No subsidies are required. In short, solar is entering the global — or at least the Chinese — energy market (see Exhibit 53). And since costs in the technology sector tend to fall over time and costs for extractive industries tend to rise over time, the competitive position of solar versus fossil fuels as a source of power generation is likely to improve in coming years.

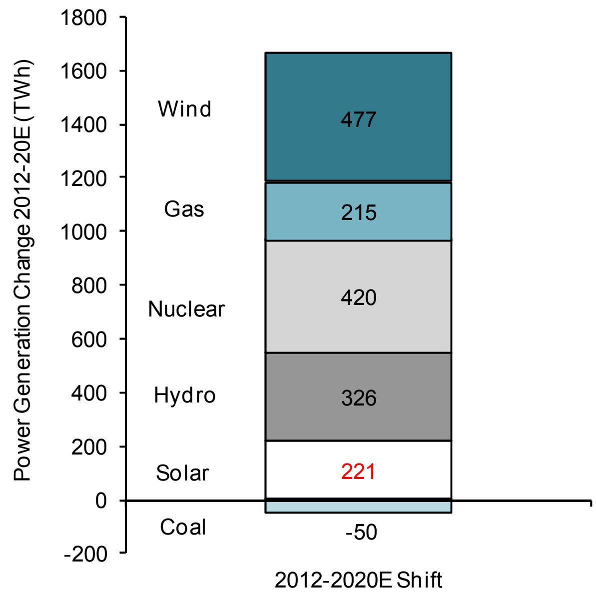
In this chapter, we set out the basis for our bullish view on wind and solar expansion in China over the remainder of the decade. The three limiting factors for renewables in China to date — installed cost, a refusal from the regulator to force State Grid's hand and an indifference to the environmental impacts of ever more coal — have, after years of false starts, suddenly disappeared.

Exhibit 51 Installed Capacity by Fuel Source (2012 and 2020E)



Source: CEIC and Bernstein estimates and analysis.

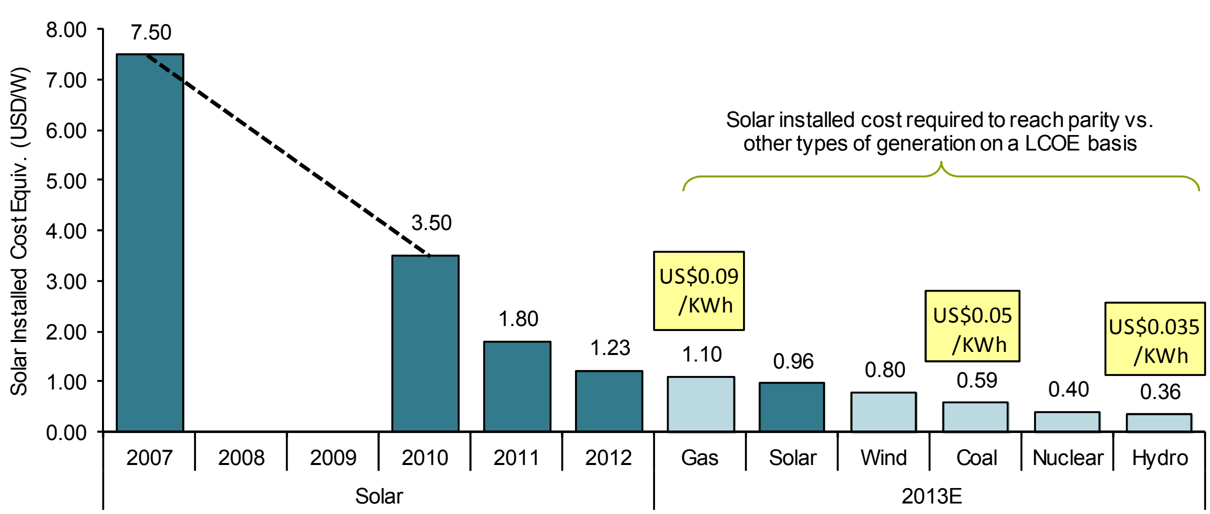
Exhibit 52 Power Generation Shift by Fuel Source (2012-20E)



Source: CEIC and Bernstein estimates and analysis.

Solar and wind are now a permanent and important part of both Chinese industrial and energy policy. As such, we expect China to embrace both technologies as a means of displacing coal from both peak- and base-load power supply.

Exhibit 53 Solar Installed Cost Required to Reach Parity vs. Other Types of Clean Energy Generation on a LCOE Basis

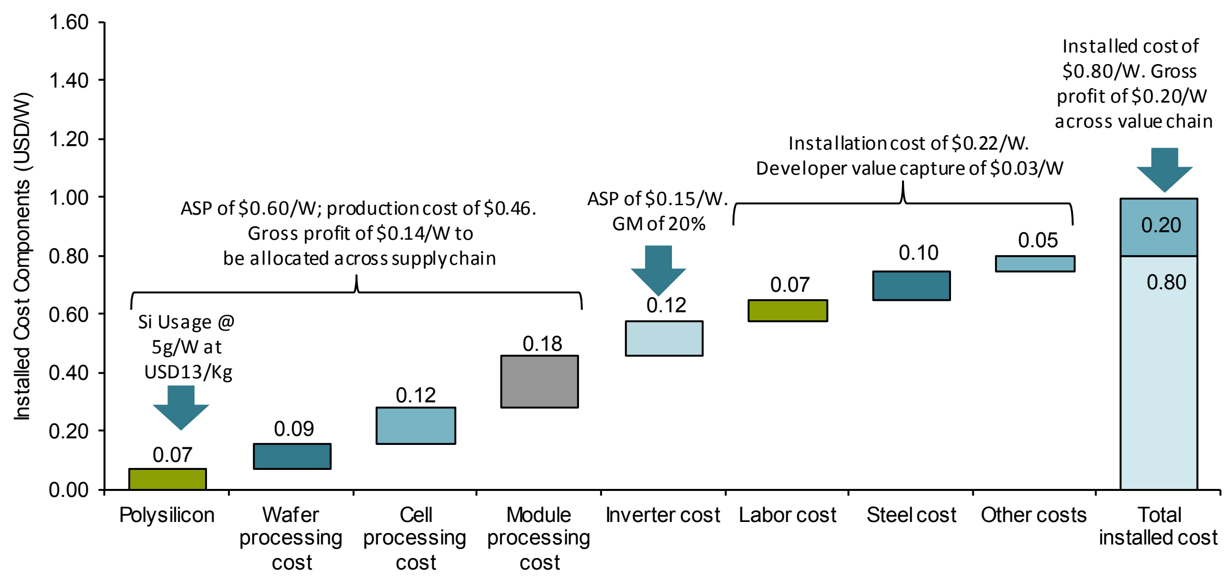


Source: Government announcements, media reports, World Nuclear Association, corporate reports and Bernstein estimates and analysis.

Solar Is the Ideal Power Source for Urbanizing China

Demand for solar — at the 2013 levelized cost of energy in developing markets implied in Exhibit 53 (US$0.08/KWh) — should continue to ramp up globally. The path to the industry dropping costs further is clear to us (see Exhibit 54), meaning the economic viability of the supply chain is improving.

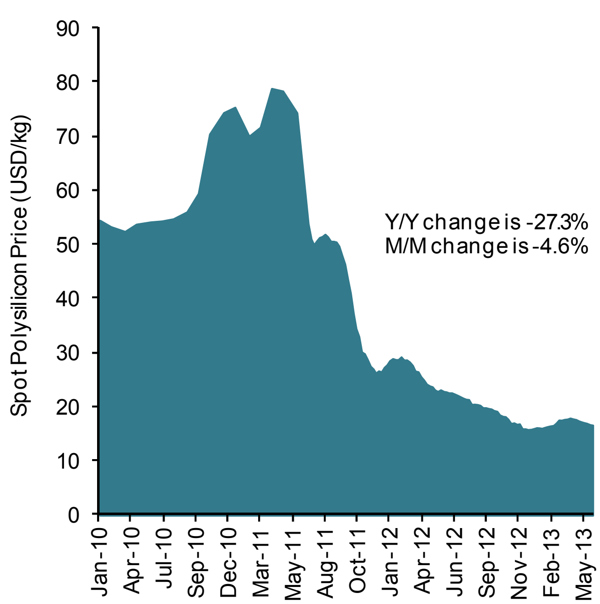
Exhibit 54 **EOY 2013 SCB Estimate of Solar Value Chain Economics for Utility-Scale, Developing Market Solar PV Projects**



Source: Corporate reports and Bernstein estimates and analysis.

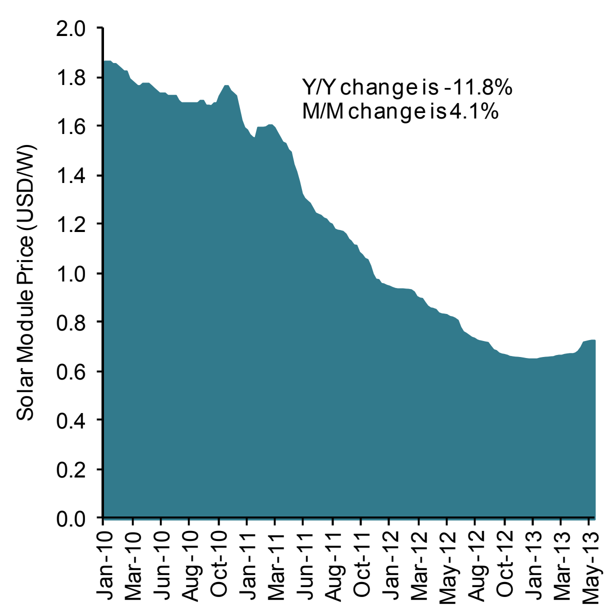
Prices for modules can stabilize and polysilicon price can rise modestly without disturbing demand (see Exhibit 55 and Exhibit 56).

Exhibit 55 **Polysilicon Spot Price**



Source: Bloomberg L.P. and Bernstein analysis.

Exhibit 56 **Silicon Solar Module Spot Price**



Source: Bloomberg L.P. and Bernstein analysis.

The quadrupling of the industry over the last five years happened at a time when subsidies were driving growth, and without any significant participation from China. Growth in demand, now that solar is competitive in the unsubsidized global energy market, should be brisk.

Solar is no longer creating its own market based on incentives offered at a state, provincial or national level. It is instead now part of a US$5 trillion energy market…and it is a tiny part of that market. Demand for solar is — at $1/W — nearly unlimited (see Exhibit 57).

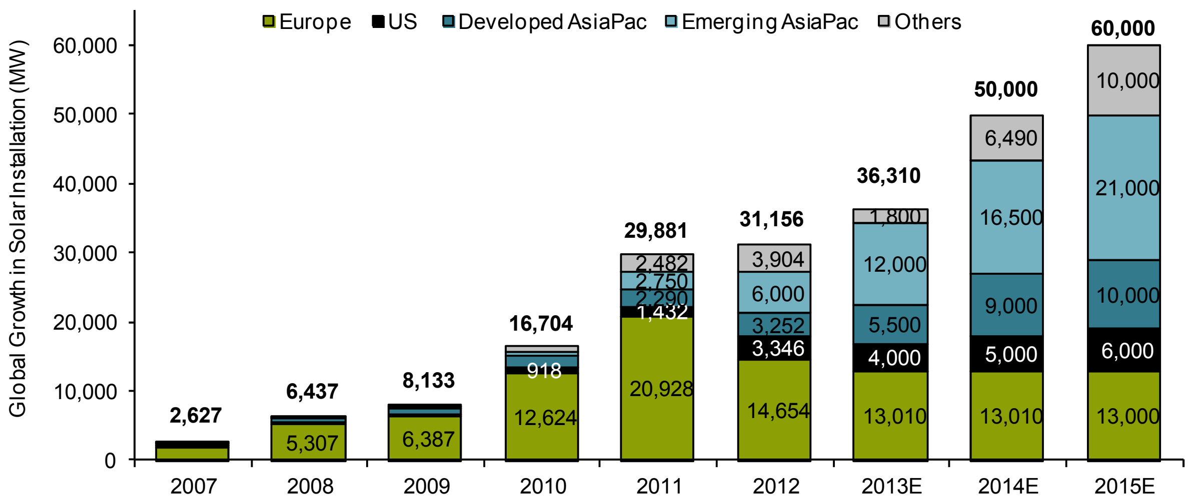
Exhibit 57 **Global Annual Solar Installed Capacity Additions, 2007-15E (in MW)**

Country	2007	2008	2009	2010	2011	2012	2013E	2014E	2015E
China	20	40	160	500	2,500	5,000	10,000	12,500	15,000
Y/Y growth	67%	100%	300%	213%	400%	100%	100%	25%	20%
Germany	1,271	1,950	4,446	6,988	7,485	7,604	7,500	7,500	7,500
Y/Y growth	51%	53%	128%	57%	7%	2%	-1%	0%	0%
US	207	338	448	918	1,432	3,346	4,000	5,000	6,000
Y/Y growth	42%	64%	32%	105%	56%	134%	20%	25%	20%
Japan	210	225	483	991	1,296	2,000	3,000	5,000	5,000
Y/Y growth	-27%	7%	114%	105%	31%	54%	50%	67%	0%
India	16	40	75	125	250	1,000	2,000	4,000	6,000
Y/Y growth	100%	150%	88%	67%	100%	300%	100%	100%	50%
Italy	70	338	723	2,321	9,301	3,438	2,000	2,000	2,000
Y/Y growth	462%	382%	114%	221%	301%	-63%	-42%	0%	0%
Australia	12	22	83	383	837	1,000	1,500	2,000	3,000
Y/Y growth	26%	80%	278%	361%	118%	19%	50%	33%	50%
France	31	105	201	817	1,463	1,032	1,200	1,200	1,200
Y/Y growth	187%	234%	92%	308%	79%	-29%	16%	0%	0%
South Korea	45	276	167	131	157	252	1,000	2,000	2,000
Y/Y growth	104%	509%	-40%	-21%	19%	61%	297%	100%	0%
Greece	1	10	37	143	426	912	900	900	900
Y/Y growth	-50%	900%	270%	286%	198%	114%	-1%	0%	0%
Belgium	23	81	519	428	996	599	500	500	500
Y/Y growth	1050%	252%	541%	-18%	133%	-40%	-17%	0%	0%
United Kingdom	4	4	4	44	906	679	500	500	500
Y/Y growth	12%	16%	-20%	1151%	1968%	-25%	-26%	0%	0%
Spain	557	2,758	60	392	345	277	400	400	400
Y/Y growth	463%	395%	-98%	553%	-12%	-20%	44%	0%	0%
Czech Republic	2	61	398	1,491	6	113	10	10	-
Y/Y growth	100%	2950%	552%	275%	-100%	1783%	-91%	0%	-100%
Other	157	188	331	1,032	2,482	3,904	1,800	6,490	10,000
Y/Y growth	-2%	20%	76%	212%	141%	57%	-54%	261%	54%
Global	**2,610**	**6,387**	**8,021**	**16,436**	**29,455**	**31,156**	**36,310**	**50,000**	**60,000**
Y/Y growth	**62.3%**	**144.7%**	**25.6%**	**104.9%**	**79.2%**	**5.8%**	**16.5%**	**37.7%**	**20.0%**

Source: BP Energy Survey 2013, EPIA, corporate reports and Bernstein estimates and analysis.

The implication is a massive increase in solar installed capacity in developing markets in general and China in particular in coming years. We estimate emerging Asia-Pacific and other developing markets will be the key drivers of growth in coming years (see Exhibit 58 through Exhibit 60).

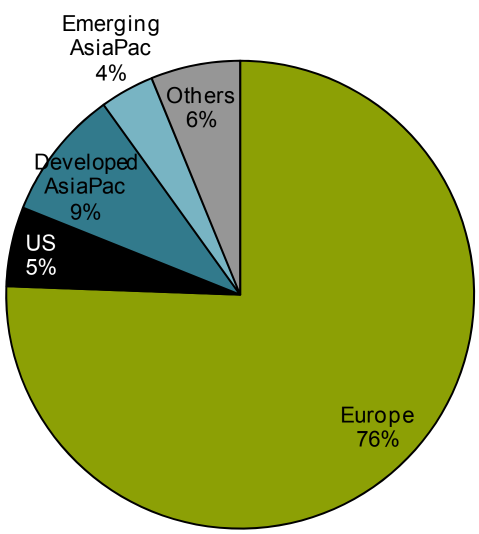
Exhibit 58 Global Annual Solar Installed Capacity Additions, 2007-15E (in MW)



Source: BP Energy Survey 2013, EPIA, corporate reports and Bernstein estimates and analysis.

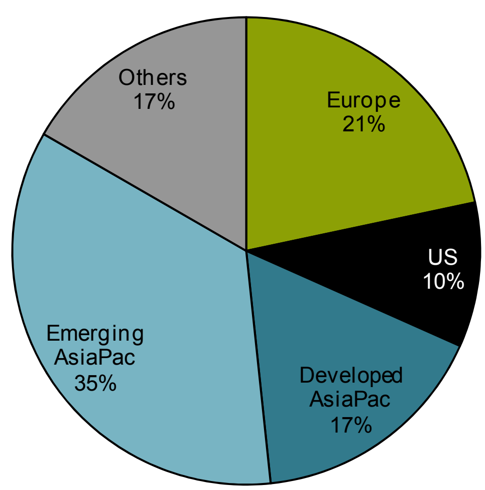
The German, Chinese and Indian markets (totaling 19.5GW or 54% of 2013 newly installed capacities) are all price sensitive. Accordingly, this demand trajectory is premised on the view that solar can achieve and maintain an installed price of $1/W.

Exhibit 59 2010 Solar-Panel Installed Capacity



Source: Corporate reports and Bernstein estimates and analysis.

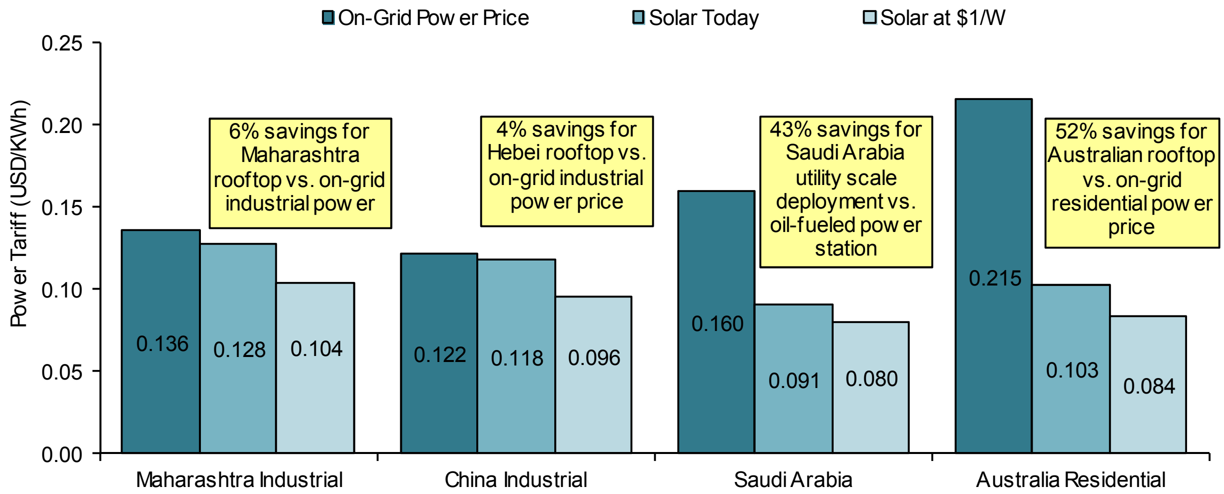
Exhibit 60 2015E Solar-Panel Installed Capacity



Source: Corporate reports and Bernstein estimates and analysis.

At this price point, utility-scale projects in Saudi Arabia, industrial usage in Maharashtra (India), industrial usage in Baoding (China), and residential usage in Australia are all economic on an unsubsidized basis. We compare on-grid electricity prices or opportunity cost with the current solar price and our 2013 target solar installed prices. Unsubsidized solar is economic today in these markets.

Exhibit 61 **Already There…Current on-Grid Tariff vs. Solar Levelized Cost of Energy in China, India, Saudi Arabia and Australia**

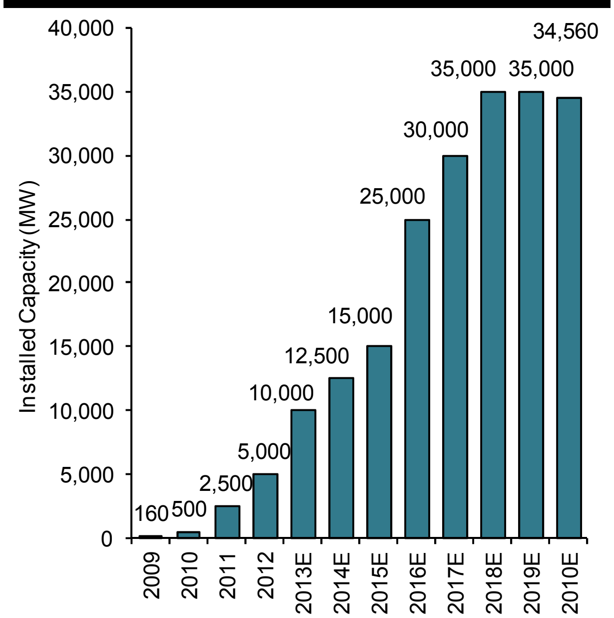


Note: Solar installed cost today is US$1.25/W (distributed), while Saudi Arabia's installed cost today is $1.15/W (utility scale). Assumed solar installed cost is $1/W for all in the year 2013 case.

Source: Corporate reports and Bernstein estimates and analysis.

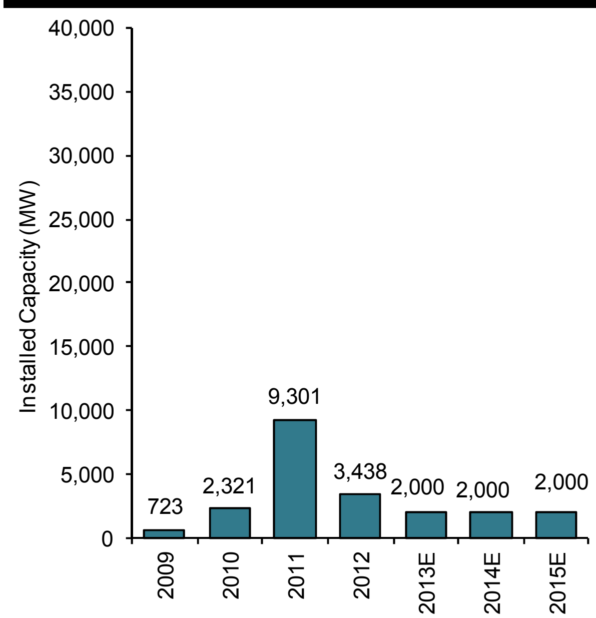
We estimate that at an IRR of 8% and at the current solar installed cost (assuming US$1.15/W for Saudi Arabia's utility-scale installation and US$1.25/W distributed installation), unsubsidized solar in both India and China is slightly below retail power prices. In Saudi Arabia and Australia, at current prices, solar achieves ~40-50% cost savings. Further savings are available at a solar installed cost of US$1/W (our EOY 2013 target level) — see Exhibit 61.

Exhibit 62 **China Installed Capacity (2009-20E)**



Source: NBS, BP Energy Survey and Bernstein estimates and analysis.

Exhibit 63 **Italy Installed Capacity (2009-15E)**



Source: EPIA, BP Energy Survey and Bernstein analysis.

This is exactly the combination of events that led to an explosion in installed capacity in Germany and Spain in 2008 and 2009 and Italy in 2011: falling solar installed costs in a market with a subsidized solar power tariff that suddenly made poor projects economic and viable projects tremendously profitable…and resulted in a spike in demand for solar panels globally. We expect the same in China (see Exhibit 62 and Exhibit 63).

The Driver for Growth Is Now the Attractive Unsubsidized Economics

The economics of solar in China are tremendously attractive today given the current subsidies of RMB1/KWh (US$0.15/KWh).

Exhibit 64 China Solar Economics at $1.20/W (Installed, Distributed) Based on Subsidy

Revenue (RMB)	1,009
Capital expense	7,560
Depreciation (20 year SL)	378
O&M charge (RMB4500/KW)	45
Debt as percentage of total cost	80.0%
Interest expense	5.50%
Tax rate	25.0%

On-grid tariff (ex-VAT; RMB/KWh)	0.850
Solar Insolation (KWh/m^2/day)	5.00
Net Utilization (AC)	13.6%
Net generation per annum (KWh; AC)	1,188
Panel capital cost per KW	3,326
Panel cost as percentage of construction cost	44%
Total construction cost per KW	7,560

Installed Cost USD/W	1.20
X to KW	1,000
Exchange rate	6.3
Total construction cost per KW (RMB)	7,560

LCOE - Solar	
850.0	RMB/MWh
134.4	USD/MWh

This insolation level would cover most western Chinese provinces. We are assuming growth from utility-scale projects in remote

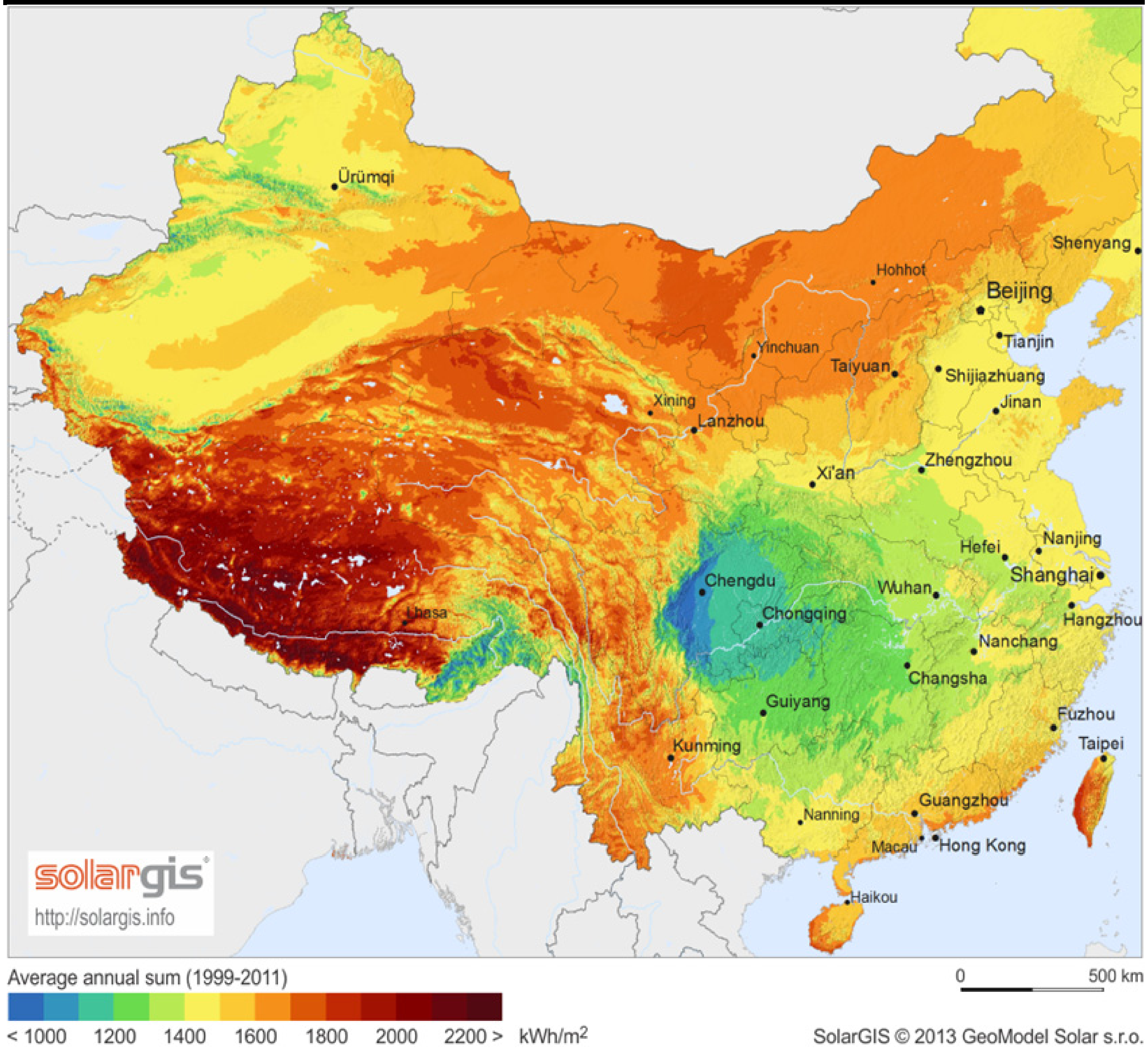
Year	0	1	2	3	4	5	6	7	[illegible]	9	10	11	12	13
Revenue		1,009	1,009	1,009	1,009	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,009	1,009	1,009	1,009
Operating and Maintenance Expense		45	45	45	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	45	45	45	45
Depreciation		378	378	378	378	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	378	378	378	378
Operating income		586	586	586	586	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	586	586	586	586
Interest expense		333	316	299	283	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	183	166	150	133
Net Profit before tax		254	270	287	304	320	337	354	370	387	403	420	437	453
Tax		-	-	-	38	40	42	44	93	97	101	105	109	113
Net Profit after tax		254	270	287	266	280	295	309	278	290	303	315	328	340
Free cash flow to firm														
Operating income		586	586	586	586	586	586	586	586	586	586	586	586	586
Add: Depreciation		378	378	378	378	378	378	378	378	378	378	378	378	378
Less: taxes		-	-	-	(73)	(73)	(73)	(73)	(147)	(147)	(147)	(147)	(147)	(147)
Free cash flow to firm	**(7,560)**	**964**	**964**	**964**	**891**	**891**	**891**	**891**	**818**	**818**	**818**	**818**	**818**	**818**
Project IRR	**9.88%**													
Free cash flow to equity														
Operating income		586	586	586	586	586	586	586	586	586	586	586	586	586
Add: Depreciation		378	378	378	378	378	378	378	378	378	378	378	378	378
Less: interest		(333)	(316)	(299)	(283)	(266)	(249)	(233)	(216)	(200)	(183)	(166)	(150)	(133)
Less: taxes		-	-	-	(38)	(40)	(42)	(44)	(93)	(97)	(101)	(105)	(109)	(113)
Less: Repayment of loan principal		(302)	(302)	(302)	(302)	(302)	(302)	(302)	(302)	(302)	(302)	(302)	(302)	(302)
Free cash flow to equity	**(1,512)**	**329**	**346**	**363**	**341**	**356**	**370**	**385**	**353**	**366**	**378**	**391**	**403**	**416**
Equity IRR	**23.44%**													

Source: Corporate reports and Bernstein estimates and analysis.

We think it is significant that two months after China announced (on January 9, 2012) that it will be the largest solar end market in the world this year with 10GW of installed capacity, there were press reports that Chinese solar tariffs are to be cut. We interpret this as a sign that installed cost has already fallen to such an extent that the NDRC clearly believes it can cut tariffs *and* still achieve its 10GW expansion target.

We estimate that installed cost is close to $1.20/W in China currently. Various companies we have talked to have put the cost closer to $1.40/W but we believe this to be a retrospective estimate…or just plain conservative. At RMB1/KWh and $1.20/W to install, utility-scale projects in western China look, by our estimate, to be tremendously attractive with equity IRRs of ~23% (see Exhibit 64). In short, the fact that the NDRC is reportedly reducing tariffs in parts of Qinghai by 25% is, in our view, not at all surprising (see Exhibit 65).

Exhibit 65 **China — Global Horizontal Irradiation (KWh/M2/pa)**



Source: SolarGIS © 2013 GeoModel Solar s.r.o and Bernstein analysis.

State Grid has not covered itself in glory in building transmission capacity to evacuate power generated by wind farm operators in Inner Mongolia and throughout northeastern China. However, we believe that transmission capacity is improving in China as State Grid is adding 30,000 km of high-voltage transmission capacity currently. Further, the imposition of a Renewable Portfolio Standard in China (long rumored and now potentially imminent) and additional requirements on State Grid in terms of supporting solar power are likely to lower site preparation costs as outlined earlier.

And distributed solar, which addresses all of the weaknesses within China's east coast power market (low reserve margins, high peak demand, sensitivity to environment impacts and therefore coal; high gas prices; and falling tolerance for disruptions to power supply), is a tailor-made solution for Chinese power needs over the next decade. And its adoption supports Chinese industrial policy — the focus on clean technologies with the current five-year plan — at the same time.

Inner Mongolia — An Enigma Wrapped in a Wind Cheater

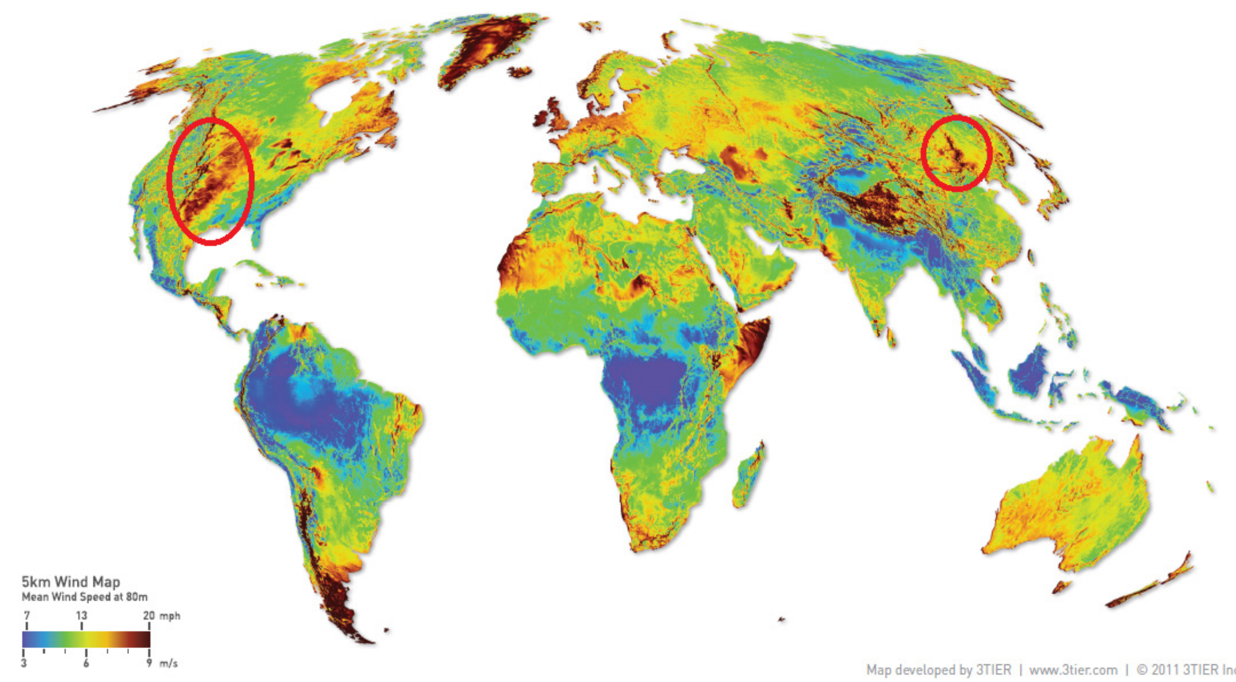
The provincial tariff structure established for wind power in China in 2009 was configured so that provinces with high wind speeds and therefore high levels of utilization also had lower tariffs. On that basis, any project — no matter where it was located — would achieve a broadly similar return.

Accordingly, Inner Mongolia — which has good wind speeds — has a tariff that is RMB0.10/KWh lower than most of the country. However, the tariff differential was clearly not great enough to drive the desired behavior. Inner Mongolia installed capacity — and that in Jilin, Liaoning and Heilongjiang (the northeast) — has outstripped transmission capacity in recent years leading to curtailment and low utilization in these low-tariff areas.

The companies have taken note. Longyuan added wind generation capacity of 1,946MW in 2012. But the expansion was predominantly in parts of the country without curtailment problems. Longyuan is organically reducing its curtailment exposure, while State Grid solves the problems directly in Inner Mongolia and the northeast.

The attraction to Inner Mongolia (at least for operators of wind farms) is clear. The windiest part of the U.S. is from west Texas to North Dakota. Utilization on west Texas wind farms is routinely in the low-30% range. Inner Mongolia has similar wind speeds, and therefore should — once utilization issues are resolved — offer similar levels of utilization (see Exhibit 66).

Exhibit 66 **Global Wind Map — Texas Through North Dakota in the U.S. Has the Same Wind Speed as Inner Mongolia in China**



Source: Copyright © 2013 3TIER, Inc and Bernstein analysis.

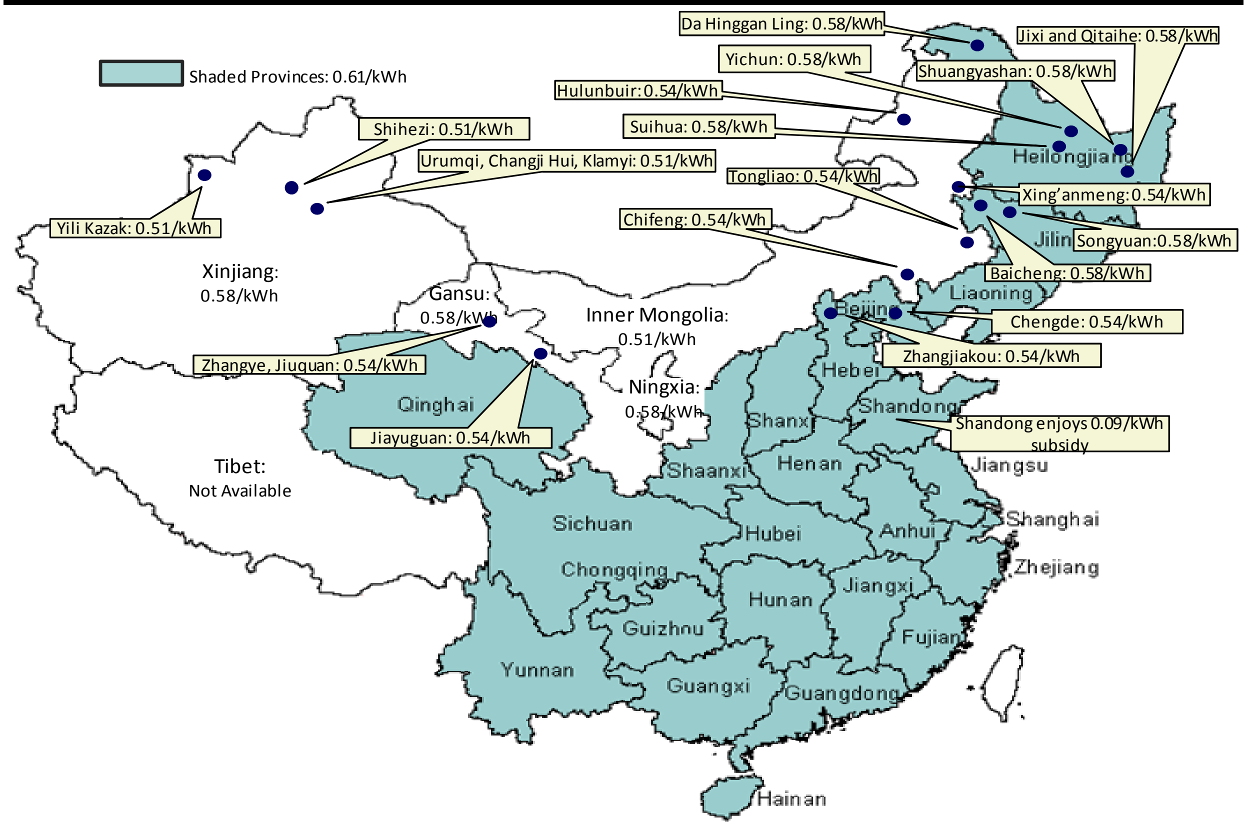
Wind power generation of Longyuan in the first quarter of 2013 increased 32.7% year-over-year. Wind power generation in Heilongjiang, Jilin, Liaoning and Inner Mongolia was up 52%, 33%, 7% and 21% year-over-year, respectively. These growth rates exceed installed capacity growth by a wide margin everywhere but Liaoning. According to the company, the wind power curtailment rate in the first quarter was 17%, compared to 22% in the same period last year. Curtailment rate further improved to 14% in March 2013, and was the best month in the first quarter.

China's wind power feed-in tariff policy introduced in 2009 established fixed benchmark tariffs for all onshore wind power projects (see Exhibit 67).

The policy splits China into four main wind resource regions and sets benchmark prices for each region according to wind resource and project development conditions.

A simple analysis of the China wind tariff map alongside a wind speed map (see Exhibit 66) leads to a clear conclusion: build as much as wind capacity you can in Inner Mongolia, Heilongjiang, Liaoning and Jilin. Yes, tariffs are lower in Inner Mongolia than in the rest of the country, but the differences in wind speed make up for it.

Exhibit 67 **China Wind Tariff Map by Zone (Including VAT)**

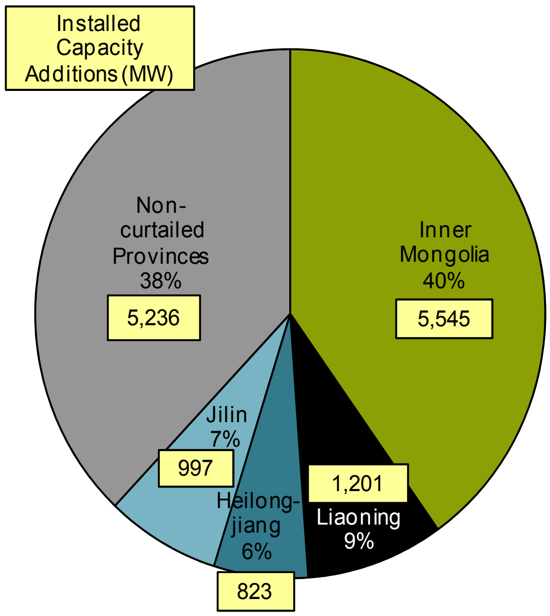


Source: "Circular on Improving Wind Power On-grid Tariff Policy" (NDRC Price [2009] No.1906), corporate reports and Bernstein analysis.

And so from 2009 until 2011, that is what all of the companies that we cover did: they built most of the new capacity in the windiest parts of the country, and most acutely in western Inner Mongolia. Roughly 60% of all new wind capacity in 2009 was built in one of those four provinces (see Exhibit 68). The problem with this approach is that there is nothing else in western Inner Mongolia. And so, once the wind farms were completed, there were no cities or industrial centers to draw the electricity and insufficient inter-provincial transmission capacity to take the electricity anywhere else.

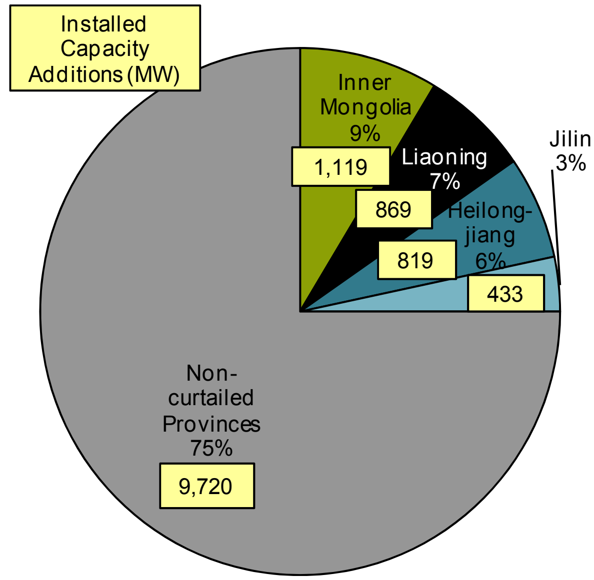
The industry is learning. In 2012, additions in the four curtailed provinces were only 25% of industry growth (see Exhibit 69). On the other hand, the high utilization and high-tariff regions have recorded high installed capacity growth in 2012. Yunnan's installed capacity increased by 111% year-over-year, Guizhou was up by 160%, Henan was up by 64% and Shanxi was up by 55%.

Exhibit 68 Chinese Wind Power Installed Capacity Additions 2009



Source: CWEA and Bernstein analysis.

Exhibit 69 Chinese Wind Power Installed Capacity Additions 2012



Source: CWEA and Bernstein analysis.

Today, curtailment is still a problem. China still has most of its capacity installed in provinces with high wind speeds but low levels of utilization, including Inner Mongolia, Heilongjiang, Jilin and Liaoning. Curtailment is now falling and utilization is going up. In short, this dysfunctional, upside-down outcome will eventually reverse.

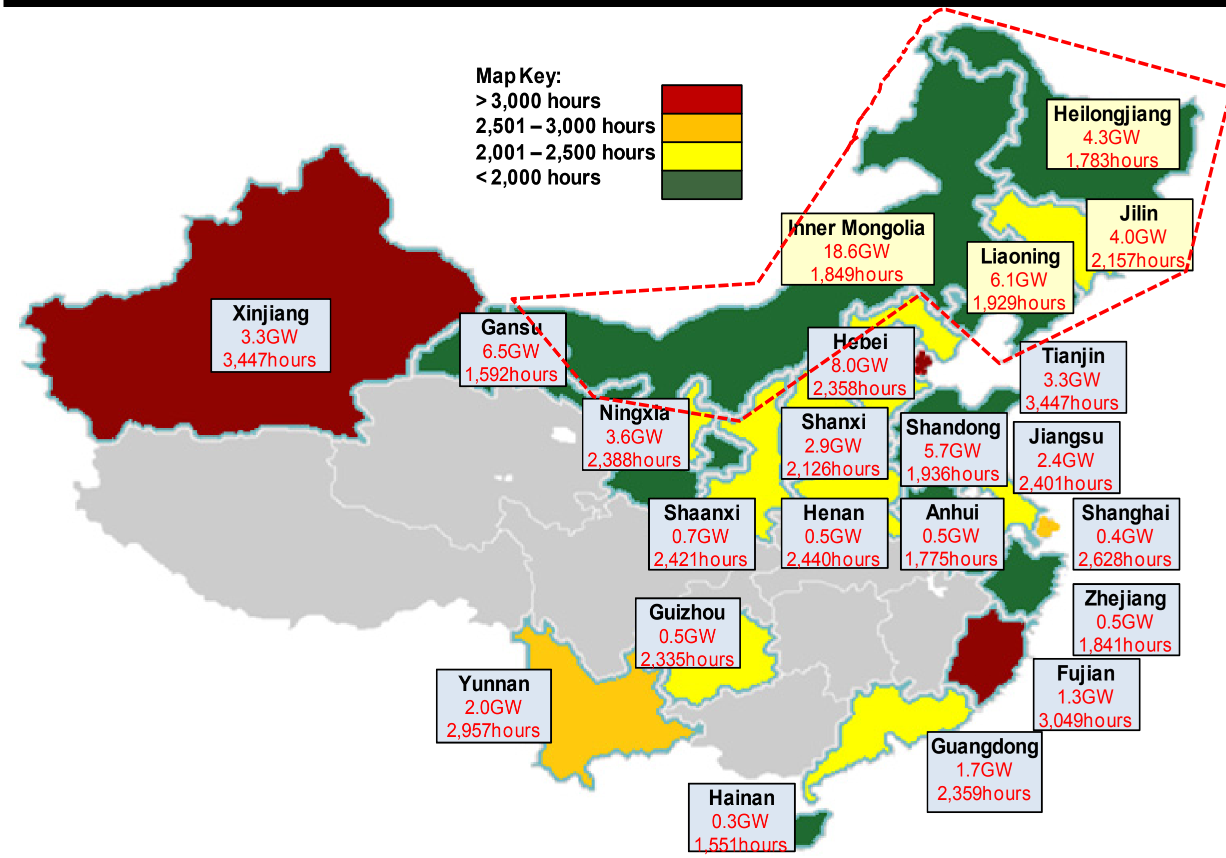
Exhibit 70 and Exhibit 71 set out the utilization for the best-performing portfolios among the three operators (Longyuan, Huaneng Renewables and Datang Renewable) on a per-province basis.

We estimate that the maximum weighted average utilization for China nationwide could reach ~2,382 hours, or 27% in 2015.

Our methodology is simple: the best-performing portfolios in each of the non-curtailed provinces is likely to become the industry standard over time: there is trial and error associated with site selection everywhere, which will improve over time; some level of curtailment is likely to have been experienced in most parts of the country, operational problems in the early stages of some projects is likely. Accordingly, we believe that the "best" portfolio performance is likely to be matched and become the industry average in each province in coming years.

Second, for the four curtailed provinces (Inner Mongolia, Heilongjiang, Jilin and Liaoning), utilization hours of Longyuan, Huaneng Renewables and Datang Renewable averaged 1,715 (19.5%); 1,457 (16.6%) and 1,719 (19.6%), respectively, in 2012. We assume that the curtailed provinces can — if transmission problems are resolved — exceed utilization in non-curtailed provinces by 10% (this is little more than a naïve guess but the fact that the Inner Mongolia tariff is 16% lower than the rest of the country implies that the policy makers, who set the tariff, expected Inner Mongolia utilization to be roughly 20% higher).

Exhibit 70 **Wind Installed Capacity and Maximum Utilization Hours by Province for the Three Renewable Energy Operators**



Source: Wikimedia commons, CWEA, corporate reports and Bernstein estimates and analysis.

We reach our target using "best-in-class" utilization by the three operators in non-curtailed provinces currently (see Exhibit 71 and Exhibit 72), our expectation that roughly half of the national fleet will be in currently curtailed provinces over time, and our expectation that performance in those currently curtailed areas will be 10% higher than in non-curtailed areas. This means that over the next two and a half years, we expect to see improving utilization based on the efforts of both State Grid and the companies themselves in organically growing away from problem areas.

Exhibit 71 China Wind Power Utilization Hours of the Non-Curtailed Provinces by Company

Province	2012 Installed Capacity (MW)	Longyuan Utilization Hours	Huaneng Renewables Utilization Hours	Datang Renewable Utilization Hours	Maximum Utilization Hours
Anhui	494	**1,775**			1,775
Fujian	1,291	**3,049**			3,049
Gansu	6,479	1,578		**1,592**	1,592
Guangdong	1,691		**2,359**	2,060	2,359
Guizhou	507	2,144	**2,335**		2,335
Hainan	305	**1,551**			1,551
Hebei	7,979	**2,358**	1,952	1,693	2,358
Henan	493			**2,440**	2,440
Jiangsu	2,372	**2,401**			2,401
Ningxia	3,566	**2,388**		1,625	2,388
Shaanxi	710		**2,421**	1,850	2,421
Shandong	5,691	1,661	**1,936**	1,656	1,936
Shanghai	352		2,044	**2,628**	2,628
Shanxi	2,907	1,976	**2,126**	2,084	2,126
Tianjin	278	**2,067**			2,067
Xinjiang	3,306	2,540	**3,447**		3,447
Yunnan	1,964	**2,957**	2,758	2,824	2,957
Zhejiang	482	**1,841**			1,841
Other	1,455				2,111
Non-Curtailed Provinces	**42,320**				**2,282**

Source: CWEA, corporate reports and Bernstein estimates and analysis.

The companies are now also focusing on areas outside of the curtailed provinces. Longyuan's installed capacity additions dropped sharply overall and especially in curtailed regions between the second half of 2010 and the second half of 2012.

Exhibit 72 Expected Utilization Levels of the Curtailed and Non-Curtailed Provinces in 2015

Province	2012 Installed Capacity (% / MW)	2012 Maximum Utilization Hours	2015 Expected Utilization Hours
Heilongjiang	5.7%	1,783	2,510
Inner Mongolia	24.7%	1,849	2,510
Jilin	5.3%	2,157	2,510
Liaoning	8.1%	1,929	2,510
Non-Curtailed Provinces	56.2%	2,282	2,282
China Nationwide	**75,324**	**2,111**	**2,382**

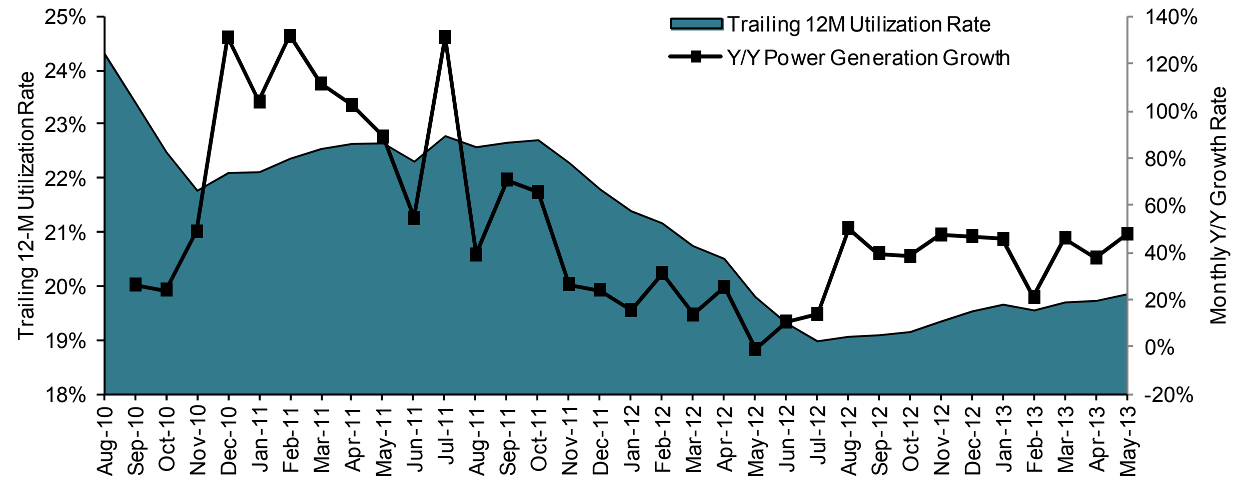
Curtailed provinces at 10% higher utilization than non-curtailed provinces

Non-curtailed provinces at 2012 maximum utilization

Source: CWEA, corporate reports and Bernstein estimates and analysis.

Utilization for China wind fleet is now trending up, off a low, low base (see Exhibit 73). Based on our adjusted capacity estimate for May 2013 (assuming 4.7GW added year-to-date), we calculate the average rolling 12-month utilization for wind power generation as 19.9% in May.

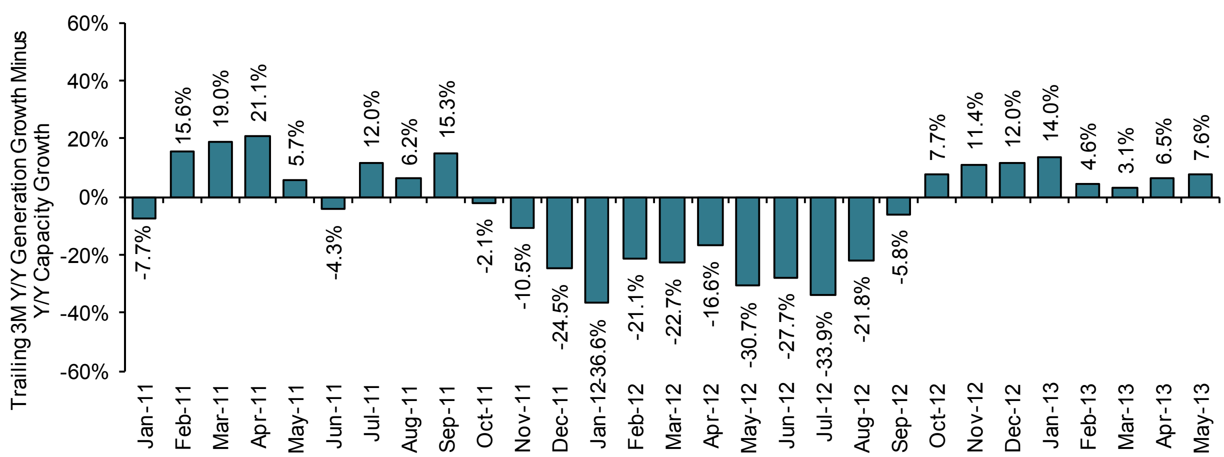
Exhibit 73 **Rolling 12-Month Average Utilization and Y/Y Generation Growth**



Source: CEIC, NBS and Bernstein estimates and analysis.

In the last nine months, generation growth has outstripped installed capacity growth, implying higher utilization as a result of improving transmission in Inner Mongolia and the northeast and more judicious placement of new wind farms in parts of the country, with fewer curtailment problems.

Exhibit 74 **Trailing Three-Month Y/Y Generation Growth vs. Trailing Three-Month Y/Y Capacity Growth**



Note: Trailing April 2013 data is reduced to two months to adjust for the effect of February 2013/January 2012 Chinese New Year.

Source: CEIC, NBS and Bernstein estimates and analysis.

Looking at the trailing three-month year-over-year generation growth minus year-over-year capacity growth, the result turned positive in October and improved further since (see Exhibit 74).

The curtailment issues being faced in four north and northeastern provinces — Inner Mongolia, Liaoning, Jilin and Heilongjiang — are the major reason for lower utilization hours. The year 2013 is a big improvement but the project to build more transmission is still a work in progress. That said, we believe that utilization is going to steadily improve over the next two and a half years and that by 2015 State Grid will have completed large, high-voltage transmission projects to address specific bottlenecks in transmitting wind power around the country, curtailment will be reduced, and the true or normal long-term utilization rates across the country will be realized. At that point, utilization should settle in the high-20% range. And wind and solar will continue to see an increase in installed capacity additions.

With each 1GW of wind installed, coal consumption falls by 1 million tons. The insidious aspect of renewable energy investment for other sources of power supply is that the 1 million tons of demand never returns. With zero variable cost and a 20-year life, renewables — once installed — are, for practical purposes, forever.

The Nuclear Option: China's Energy Future…With French Characteristics

Godzilla Risk Minimal in China's Nuclear Ramp

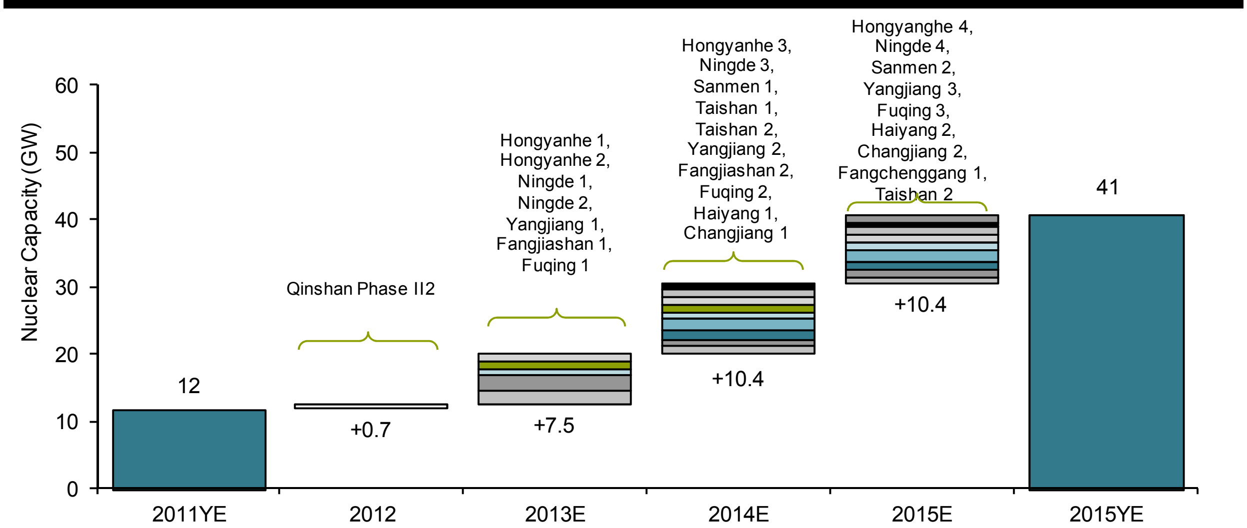
Nuclear power generation within China is a tiny part (currently less than 2%) of overall power production. Even under an aggressive expansion scenario, nuclear power generation will struggle to exceed 5% of total power generation by 2020. However, given the slowdown in power production growth that China is currently experiencing, share of incremental production absorbed by the growing nuclear fleet is significant, roughly one-quarter, in our view. For the coal sector, this is further incrementally negative.

The Post-Fukushima, existential risk to nuclear is minimal in our view. The risk that air quality in Beijing deteriorates further next winter from last winter level is far more important than concerns about events at yet-to-be-built power stations that rely on a technology that China has several decades of experience managing: *what might kill you is less important than what will kill you.*

China on Track to Reach at Least 40GW of Nuclear Capacity by 2015

The Chinese government is currently targeting 40GW of nuclear power capacity by the end of 2015, representing a CAGR of ~30% from 2010. Based on a plant-by-plant analysis of China's nuclear power projects (see Exhibit 75), the country could even exceed this target and reach 41GW of capacity if all of its projects are commissioned on time. In any event, China is almost certain to have the fourth-largest nuclear installed capacity base in the world by 2015.

Exhibit 75 **China Nuclear Power — 2011-15E Expansion Plan**



Source: CEIC, NBS, NEA, Ministry of Environmental Protection and Bernstein estimates and analysis.

In 2012, China commissioned one unit at the Qinshan nuclear power station in Zhejiang. Two units (Hongyanhe 1 in Liaoning and Ningde 1 in Fujian) have already been commenced in February and April this year, respectively. The announced nuclear capacity target of 40GW by 2015 would be a 35% CAGR from 2011 and requires ~7GW of incremental generation capacity per year from 2012. Until this year, China had never added more than ~2GW of nuclear capacity in a single year. We believe that with the commissioning of units at Ningde and

Hongyanhe earlier this year, the acceleration in China's nuclear expansion has officially begun.

Roughly 1GW of nuclear generation capacity (operating at standard utilization) displaces ~4 million tons of coal. With ~8GW of nuclear capacity coming on line in 2013, 30 million tons of coal will be displaced. In the context of an overall market of almost 4 billion tons of coal consumption, 30 million tons is nothing. But in the context of a market that is expanding coal consumption at 100 million tons per year, displacing 30 million tons is significant…in an already oversupplied market.

And the effect is compounding. According to the World Nuclear Association, roughly 200GW of nuclear installed capacity is planned for construction in China within the next two decades: that is, 800 million tons of annual consumption of coal will potentially be displaced by nuclear alone by 2030, ~30 million tons at a time.

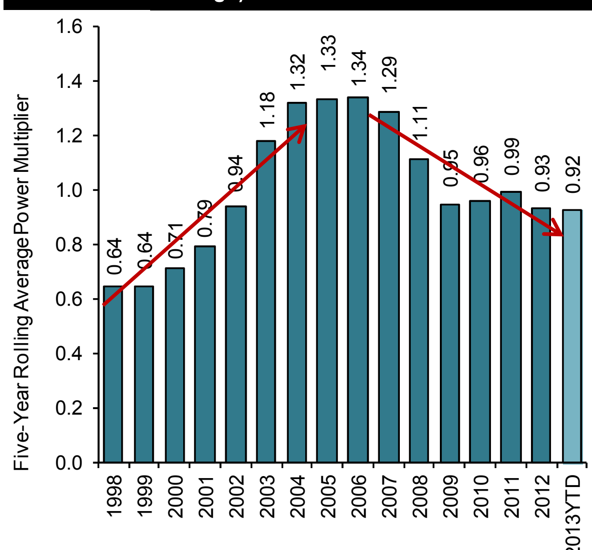
The progress being made in the Chinese nuclear fleet is another headwind for coal prices and the coal mining sector. China is going to become less coal intensive over this decade. And we believe the transition is happening incrementally right now. The power sector is the beneficiary of falling coal prices. However, the extent to which the publicly traded power companies will invest in nuclear power stations (the economics of which are murky) could become an overhang.

Nuclear Is Currently a Tiny Part of Overall Energy Consumption in China

The causes of potential idiosyncratic supply shocks within the global coal market are well known: floods in Queensland, mining strikes in South Africa or Colombia, increasing U.S. gas supply, Daqin rail maintenance, etc. Less focus is placed on the impact of permanent displacement of Chinese coal demand by gas, renewables, hydro…and nuclear.

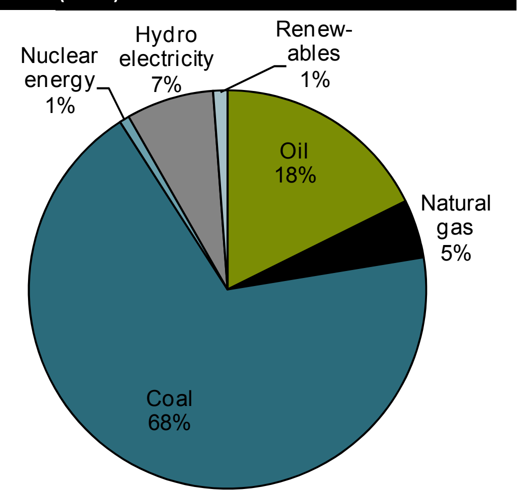
Chinese power consumption growth is likely to come in at ~5% this year and next. With the trend at less than 1x GDP growth currently, small changes in alternate sources of energy can rapidly add up. On a rolling five-year average basis, the power multiplier is ~0.9x through the recent cycle (see Exhibit 76). Energy consumption in China remains heavily dominated by coal, with non-fossil fuels accounting for only ~9% share (see Exhibit 77). The Chinese government is looking to increase this share to 11.4% by 2015 and ~15% by 2020. This share shift reflects an aggressive expansion in China's renewables and nuclear installed capacity, which will hurt incremental coal consumption over the next several years.

Exhibit 76 China Power Multiplier (Five-Year Rolling Average)



Source: CEIC, NBS and Bernstein analysis.

Exhibit 77 China Energy Consumption by Source (2012)

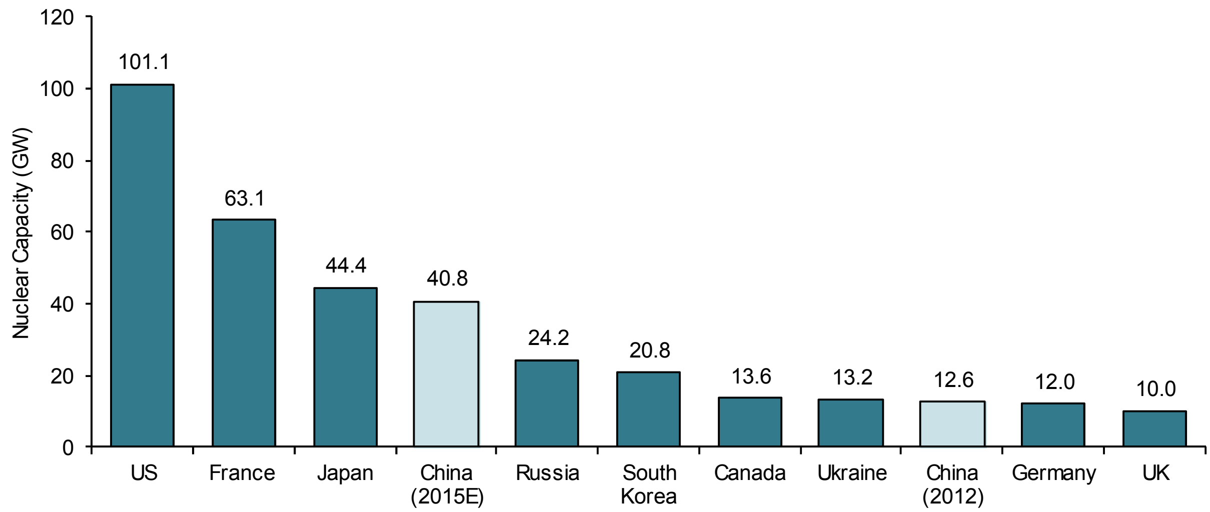


Source: BP Energy Survey 2013 and Bernstein analysis.

Plant-by-Plant Analysis of China's Nuclear Fleet Expansion

The Chinese government is currently targeting 40GW of nuclear power capacity by the end of 2015, representing a CAGR of ~30% from 2010. Based on a plant-by-plant analysis of China's nuclear power projects, the country could even exceed this target and reach 41GW of capacity if all of its projects are commissioned on time (see Exhibit 78). In any event, China is almost certain to have the fourth-largest nuclear installed capacity base in the world by 2015.

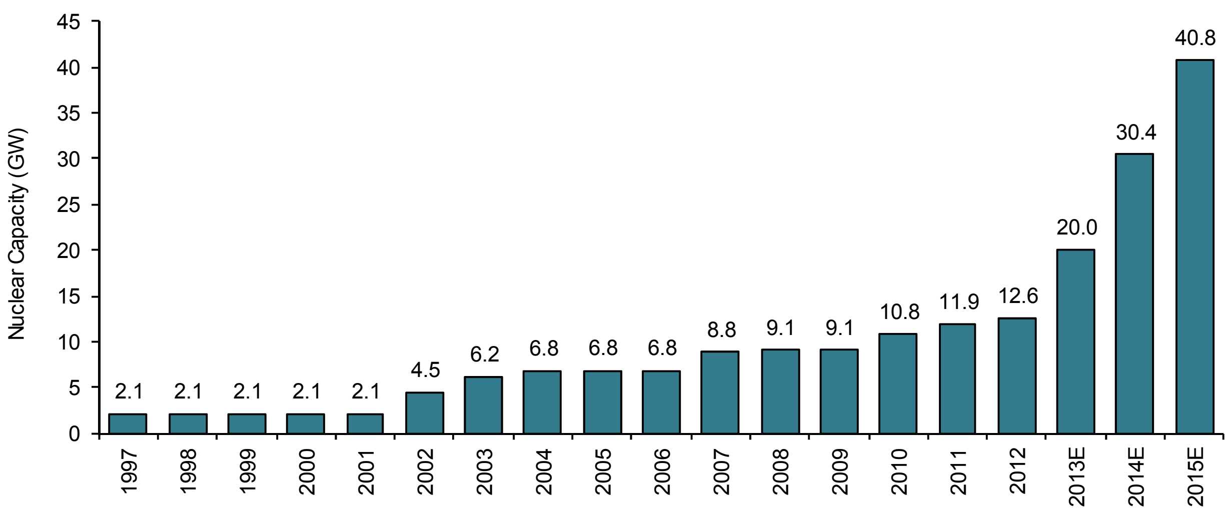
Exhibit 78 **Global Nuclear Power Fleet (2012)**



Source: CEIC, NBS, World Nuclear Association and Bernstein estimates and analysis.

China has never added more than 2.4GW of nuclear capacity in a single year — until this year (we are writing in early June) — see Exhibit 79.

Exhibit 79 **China Nuclear Fleet (1997-2015E)**



Source: CEIC, NBS, government reports and Bernstein estimates and analysis.

The Fleet Today and Near-Term Expansion

After the Fukushima disaster in March 2011, China suspended approvals for new nuclear power projects. Most of the projects that are currently in the pipeline have been under construction since 2008, and were therefore not caught by the suspension. However, they have been subject to engineering reviews.

On May 31, 2012, the State Council approved in principle the NEA and Ministry of Environmental Protection's *National Civilian-Use Nuclear Power*

Safety Inspection Report as well as the *Nuclear Safety Twelfth Five-Year Plan and 2020 Long-Term Target*, which reaffirmed the expected operational dates of 10 nuclear power station projects. Later, on October 24, 2012, the State Council approved the *Nuclear Safety Plan 2011-2020,* the *Nuclear Power Medium-Long Term Development Plan 2011-2020* and the *China Energy Policy White Book*, which also reaffirmed the 40GW target by 2015.

Currently, we estimate that China has about 14GW of nuclear capacity, including the 650MW expansion in Qinshan Phase II that was commissioned in April 2012, and Ningde 1 and Hongyanhe 1 commissioned earlier in 2013 (see Exhibit 80). Note that currently, all the operational nuclear power stations are owned and operated by either China Guangdong Nuclear Power Corporation (CGN) or China National Nuclear Corporation (CNNC), although the five IPPs and local governments may have minority stakes in these projects.

Exhibit 80 **Chinese Nuclear Power Projects — Operational**

Units	Province	Operator	Net Capacity (MW)	Commissioning	Reactor Design
Daya Bay 1&2	Guangdong	CGN	1,888	1994	M310 (Areva)
Qinshan Phase I	Zhejiang	CNNC	298	1994	CNP-300 (Domestic)
Qinshan Phase II, 1-4	Zhejiang	CNNC	2,440	2002-2012	CNP-600 (Domestic)
Qinshan Phase III, 1&2	Zhejiang	CNNC	1,300	2002-2003	Candu 6 (Canada)
Ling Ao Phase I, 1&2	Guangdong	CGN	1,876	2002-2003	M310 (Areva)
Tianwan 1&2	Jiangsu	CNNC	1,980	2007	VVER-1000 (Russia)
Ling Ao Phase II, 1&2	Guangdong	CGN	2,040	2010-2011	CPR-1000 (Domestic)
Ningde 1	Fujian	CGN	1,020	Apr-13	CPR-1000 (Domestic)
Hongyanhe 1	Liaoning	CGN-CPI	1,000	2013	CPR-1000 (Domestic)
Total			**13,842**		

Source: NEA, Ministry of Environmental Protection, World Nuclear Association and Bernstein estimates and analysis.

We expect the second units of the Hongyanhe and Ningde projects to become operational by the end of 2013 (see Exhibit 81). Currently, based on the 12 projects that we track, we estimate that China has a pipeline of ~56GW of new nuclear capacity that is under construction through the end of this decade.

There are key design differences between currently operational nuclear power stations and the ones that are currently under construction.

First, the new power stations will use significantly larger reactors, with most projects using units with at least 1GW in capacity (the largest being Areva's 1.75GW EPR units at the Taishan project in Guangdong).

Second, most new projects will use CPR1000 reactors that are mainly domestically produced. The CPR1000 is designed by the China Nuclear Engineering Corporation (a part of CGNPG) based on Areva's 900MWe M310 units used in Daya Bay. Areva still maintains the intellectual property rights to the CPR1000, according to the World Nuclear Association. However, manufacturing is mainly done domestically.

Exhibit 81 Chinese Nuclear Power Projects — Under Construction

Project	Province	Operator	Capacity	Commissioning	Reactor Design	Details
Hongyanhe	Liaoning	CGN-CPI	5,517	2013-2016	CPR1000 (Domestic)	Project began construction in August 2007. First unit started up in January 2013 and was connected to the grid in Feb 2013. Commercial operation planned in 2013. CPI and Dalian city also have shares in the project. Nuclear island component and generation equipment manufactured by Shanghai Electric with the help of CGNPG and the Nuclear Power Institute of China. The first two units will be at least 70% domestically produced, and the third and fourth units will be at least 80% domestically produced. Turbine units for units 5 and 6 will be manufactured by Dongfang Electric. Safety equipment supplied by Harbin Electric.
Ningde	Fujian	CGN-Datang	5,427	2013-2015	CPR1000 (Domestic)	Project began construction in February 2008. First unit was grid connected in late 2012 and commercially operated in April 2013. As of October 2012, Unit 3 has completed construction. Main nuclear island and boiler equipment manufactured by Dongfang Electric. Reactor pressure vessel produced by Shanghai Electric. Safety equipment produced by Harbin Electric. This is CGNPG's first power station outside Guangdong.
Sanmen	Zhejiang	CNNC	6,760	2014-2020	AP1000 (Westinghouse) / BN-800 (Domestic)	Project began construction in April 2009, and will be the world's first power station to use Westinghouse's third generation AP1000 reactor. First unit is expected to be commissioned in March 2014 and the second unit is expected to be in operation in 2015. Shanghai Electric responsible for building the nuclear island. Some auxiliary equipment is manufactured by Harbin Electric. Zhejiang Power Development Company, CPI and China Huadian have minority interest in the project.
Taishan	Guangdong	CGN	3,500	2014-2015	EPR (Areva)	Project began construction in December 2009. First unit expected to be commissioned by the early 2014 and second unit in 2015. The power station will use Areva's third generation EPR reactor, as well as turbines and other equipment from Dongfang Electric and Alstom. The EPR reactor is currently the largest in the world at 1,750MW. Power station will be jointly operated by CGNPG and Areva. Shanghai Electric responsible for building the nuclear island. Some auxiliary equipment is manufactured by Harbin Electric. Total investment for the project is expected to be RMB50.2B.
Yangjiang	Guangdong	CGN	6,504	2013-2017	CPR1000 (Domestic)	Main construction for the project began in December 2008. Construction for unit 1 has completed as of July 2012, and the unit is currently in testing phase. Unit 2 is undergoing equipment installation, while unit 3 completed construction of its outer structure as of June 2012. Units 1 and 2 are expected to become operational in 2013-2014. Main nuclear island equipment built by Shanghai Electric, steam generators provided by Dongfang Electric and some auxiliary equipment provided by Harbin Electric.
Fangjiashan/ Wanjianshan	Zhejiang	CNNC	2,174	2013-2014	CPR1000 (Domestic)	An expansion of the Qinshan power station in Zhejiang, the project is located 600m away from Qinshan Phase I and began construction in March 2008. As of October 2012, fuel loader for unit 1 has been installed. This is China's first self-produced fuel loader (produced by China Nuclear Engineering Corp, XI'an Nuclear Equipment Co. and CNNC). Other main equipment supplied by Dongfang Electric.
Fuqing	Fujian	CNNC	6,534	2013-2016	CPR1000 (Domestic) / ACP1000 (Domestic)	Units 1 and 2 are currently in the installation phase. Main equipment supplied by Dongfang Electric. Media reports suggest that units 5 and 6 may use the ACP1000 design, China's domestic third-generation reactor. First unit is expected to be commissioned in November 2013, while units 2 and 3 are expected to operate in 2014-2016.
Haiyang	Shandong	CPI	5,000	2014-	AP1000 (Westinghouse)	Power station to use Westinghouse's third-generation AP1000 reactor. Shanghai Electric responsible for manufacturing other key equipment in the nuclear island. Some auxiliary equipment is manufactured by Harbin Electric. First unit expected to be commissioned in May 2014, while the second unit will be in March 2015.
Changjiang	Hainan	CNNC-Huaneng	1,300	2014-2015	CNP600 (Domestic)	Construction started in April 2010 in Hainan Island. First unit expected to become operational in end of 2014 and the second unit in 2015. The project is modeled after the Qinshan Phase II project in Zhejiang, and will use a domestically produced Gen 2+ CNP600 reactor. China Huaneng has also invested in this project.
Shidaowan	Shandong	Huaneng	3,010	2016-2018	HTR-PM (Domestic) / CAP1400 (Westinghouse / Domestic)	The project is jointly owned by CHNG (40%), Huaneng International Power Development (30%), and Huaneng Power International (30%).
Tianwan	Jiangsu	CNNC	4,280	2017-2018	WER-1000 (Atomstroyexport) / CPR-1000 (Domestic)	The construction of Tianwan II was included in the 12th Five-Year Plan. The project is a joint venture with Russia's Atomstroyexport. Commercial operation is expected to be in 2018-2019.
Fangchenggang	Guangxi	CGN	6,480	2015-2016	CPR1000 (Domestic)	Construction began in July 2010. Main equipment for units 1 and 2 are currently being installed. First unit is expected to become operational in 2015.
Total			**56,486**			

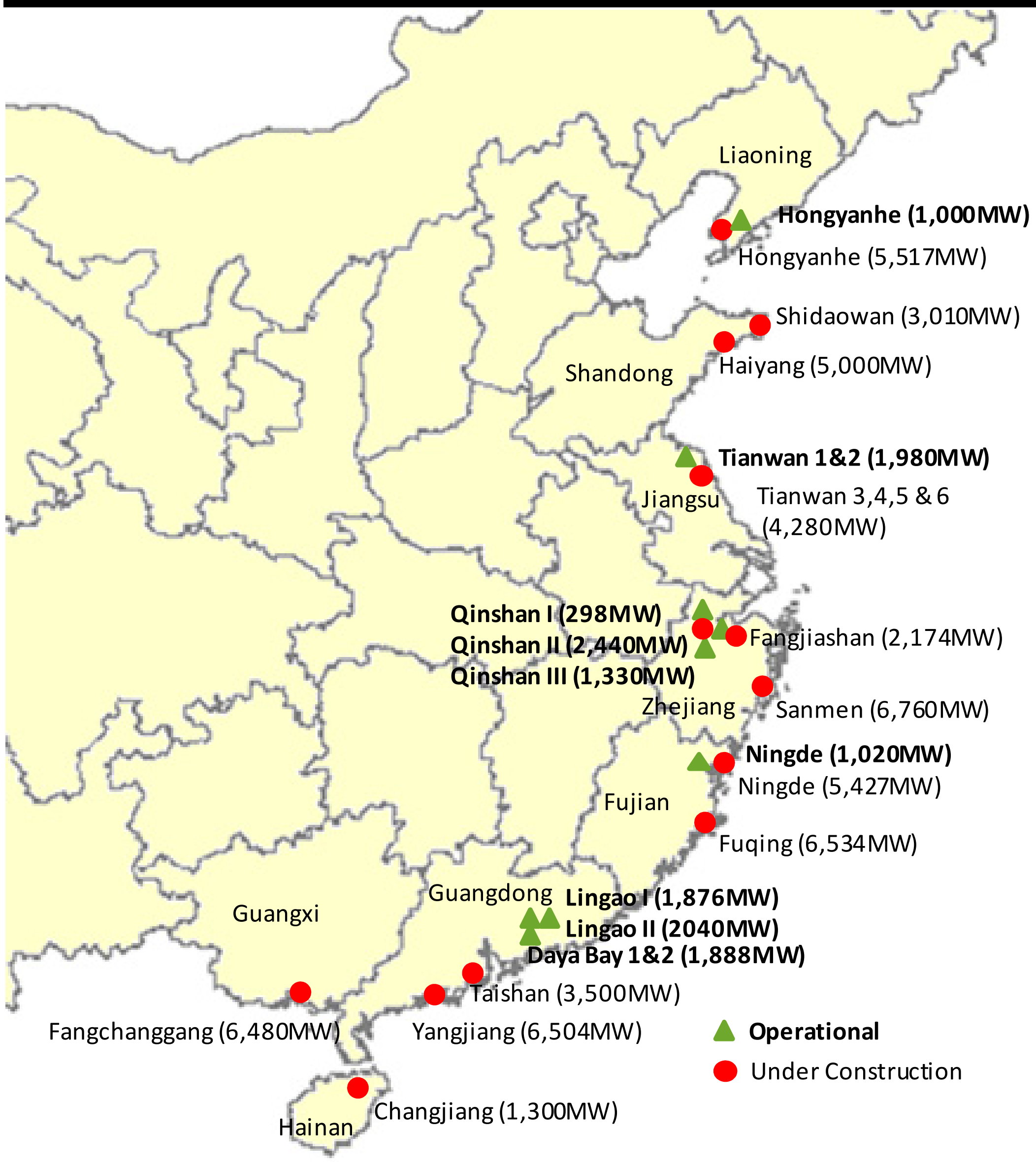
Source: NEA, Ministry of Environmental Protection and Bernstein estimates and analysis.

For example, units 1 and 2 of Hongyanhe project in Liaoning are expected to be at least 70% domestically produced. This share is expected to increase to 80% for units 3 and 4, and we assume the same for other projects that are using CPR1000.

According to government announcements and media reports, manufacturing and production of equipment used at these nuclear power stations are dominated by Shanghai Electric (2727.HK; not covered), Dongfang Electric (1072.HK; not covered) and Harbin Electric (1133.HK; not covered). According to Shanghai Electric, it currently holds a 100% market share for the control rod mechanism, 46% for nuclear islands, 30% for conventional islands and a 37% market share for the main nuclear reactors.

Similar to the past, all these new projects are built along the eastern coast, close to the load centers (see Exhibit 82). Several projects of note are the Sanmen (7,500MW), Haiyang (5,000MW) and Taishan (3,500MW), which will use third-generation reactors produced by either Westinghouse or Areva.

Exhibit 82 **China Nuclear Power Stations: Operational and Under Construction**

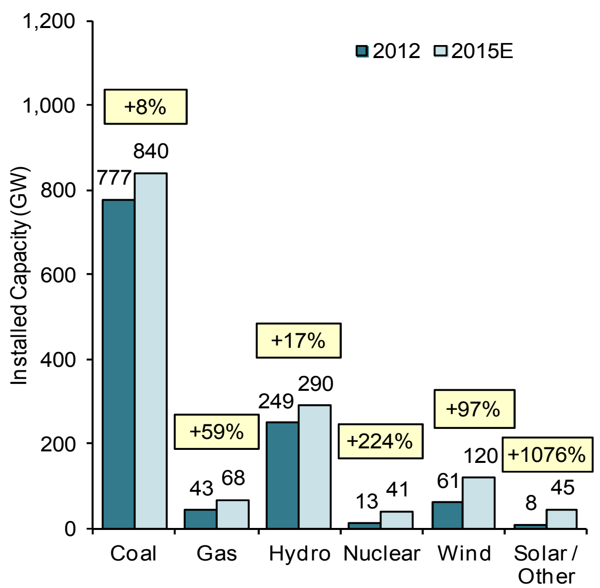


Source: Wikimedia Commons, NEA, Ministry of Environmental Protection and Bernstein estimates and analysis.

We Estimate That 1GW of Nuclear Generation Capacity Displaces ~4 Million Tons of Coal per Annum

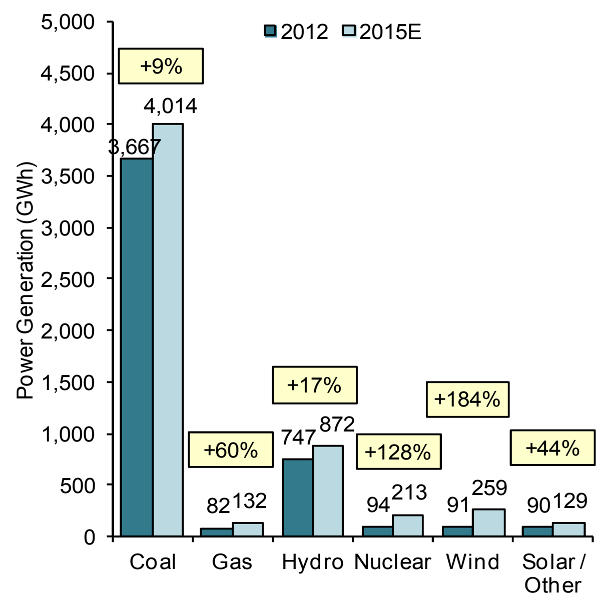
By 2015, we expect nuclear power capacity (see Exhibit 83) and generation (see Exhibit 84) to at least double from current levels. In addition, we expect hydro, wind and solar generation to take share away from thermal power over the next several years. We expect wind and solar installed capacity to reach 120GW and 45GW, respectively, by 2015 — more bullish than the recent government targets of 100GW and 21GW, respectively.

Exhibit 83 China Power Capacity: 2012 vs. 2015E



Source: CEIC, NBS and Bernstein estimates and analysis.

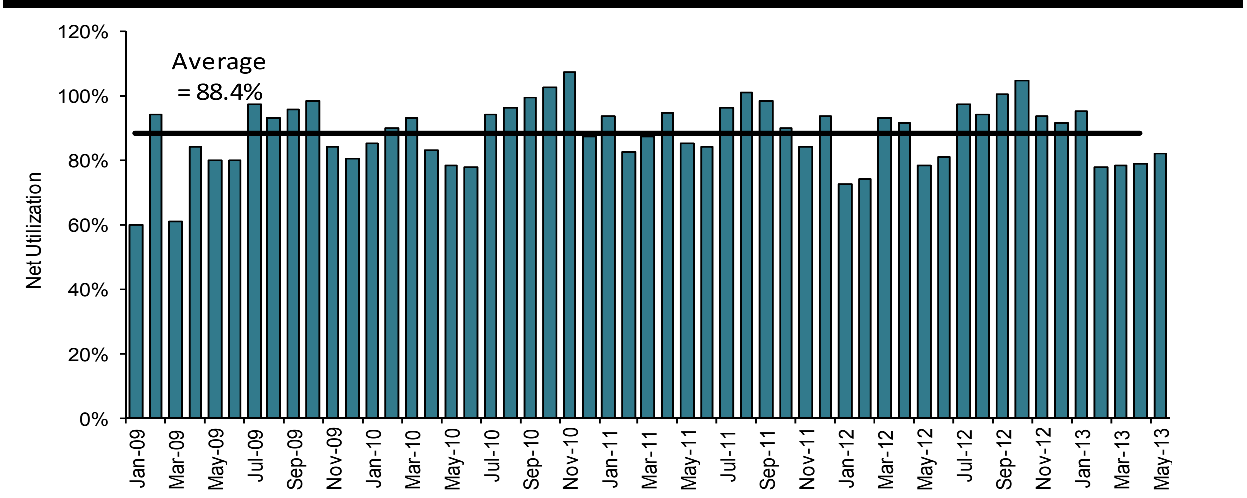
Exhibit 84 China Power Generation: 2012 vs. 2015E



Source: CEIC, NBS and Bernstein estimates and analysis.

Nuclear power utilization has been high and stable over the last several years, averaging ~88% (see Exhibit 85). February to May in 2013 saw a decrease in utilization, reflecting new capacity being added (according to media reports, Ningde 1 and Hongyanhe 1 have come on line in the first half of 2013).

Exhibit 85 China: Nuclear Power Utilization (2009-May 2013)



Source: CEIC, NBS and Bernstein estimates and analysis.

We believe nuclear and other non-fossil fuel generation will take share from thermal generation. We expect thermal power production to remain at low single digits over the next several years (see Exhibit 86).

Exhibit 86 **China Power Demand Model (2011-20E)**

China Power Demand Model	2011	2012	2013E	2014E	2015E	2016E	2017E	2018E	2019E	2020E
GDP Growth	9.3%	7.8%	7.5%	7.0%	6.5%	6.0%	5.0%	5.0%	4.0%	4.0%
Power Multiplier	1.17x	0.54x	0.80x	0.80x	0.80x	0.70x	0.60x	0.50x	0.40x	0.40x
Power Consumption per Capita (KWh	3,521	3,670	3,890	4,108	4,322	4,503	4,639	4,755	4,831	4,908
Installed Capacity (MW)										
Coal	735,643	776,520	807,479	831,884	839,774	814,581	781,998	742,898	698,324	650,000
Gas	32,650	42,650	47,650	57,650	67,650	82,650	97,650	112,650	132,650	150,000
Hydro	229,917	248,900	253,900	268,900	290,000	302,000	314,000	326,000	338,000	350,000
Nuclear	11,915	12,570	20,048	30,416	40,770	40,770	40,770	49,770	61,770	75,000
Wind	47,001	60,830	78,830	98,830	120,000	150,000	180,000	205,000	230,000	250,000
Solar	4,943	8,300	18,300	30,300	45,300	70,300	100,300	135,300	170,300	204,860
Total Installed Capacity	**1,062,069**	**1,149,770**	**1,226,207**	**1,317,980**	**1,403,494**	**1,460,301**	**1,514,718**	**1,571,618**	**1,631,044**	**1,679,860**
Installed Capacity Growth (%)										
Coal	9.2%	5.6%	4.0%	3.0%	0.9%	-3.0%	-4.0%	-5.0%	-6.0%	-6.9%
Gas	-8.7%	30.6%	11.7%	21.0%	17.3%	22.2%	18.1%	15.4%	17.8%	13.1%
Hydro	6.4%	8.3%	2.0%	5.9%	7.8%	4.1%	4.0%	3.8%	3.7%	3.6%
Nuclear	10.0%	5.5%	59.5%	51.7%	34.0%	0.0%	0.0%	22.1%	24.1%	21.4%
Wind	58.9%	29.4%	29.6%	25.4%	21.4%	25.0%	20.0%	13.9%	12.2%	8.7%
Solar	1639.1%	67.9%	120.5%	65.6%	49.5%	55.2%	42.7%	34.9%	25.9%	20.3%
Total	**9.9%**	**8.3%**	**6.6%**	**7.5%**	**6.5%**	**4.0%**	**3.7%**	**3.8%**	**3.8%**	**3.0%**
Utilization Rates (%)										
Coal	59.9%	55.4%	55.8%	55.4%	54.8%	54.8%	56.6%	58.9%	60.0%	61.2%
Gas	25.0%	25.0%	24.0%	24.0%	24.0%	24.0%	24.0%	24.0%	24.0%	24.0%
Hydro	31.2%	35.6%	35.6%	35.6%	35.6%	35.6%	35.6%	35.6%	35.6%	35.6%
Nuclear	91.1%	89.8%	60.0%	80.0%	80.0%	90.0%	95.0%	95.0%	95.0%	95.0%
Wind	21.4%	19.3%	20.0%	24.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%
Solar	n/a	n/a	10.0%	13.0%	13.0%	13.0%	13.0%	13.0%	13.0%	13.0%
Power Generation (TWh)										
Coal	3,698	3,667	3,872	3,975	4,014	3,974	3,958	3,935	3,786	3,617
Gas	75	82	95	111	132	158	190	221	258	297
Hydro	609	747	785	816	872	924	961	999	1,036	1,074
Nuclear	86	94	86	140	213	321	339	339	414	514
Wind	72	91	122	187	259	319	390	455	514	568
Solar/Other	37	90	98	112	129	158	192	232	272	311
Total Power Generation	**4,577**	**4,771**	**5,058**	**5,341**	**5,619**	**5,855**	**6,030**	**6,181**	**6,280**	**6,380**
Memo: *Y/Y Growth*	*10.9%*	*4.2%*	*6.0%*	*5.6%*	*5.2%*	*4.2%*	*3.0%*	*2.5%*	*1.6%*	*1.6%*
Power Generation Growth										
Coal	14.7%	-0.8%	5.6%	2.7%	1.0%	-1.0%	-0.4%	-0.6%	-3.8%	-4.5%
Gas	5.8%	10.1%	15.1%	16.6%	19.0%	20.0%	20.0%	16.6%	16.6%	15.2%
Hydro	-7.6%	22.7%	5.0%	4.0%	6.9%	5.9%	4.1%	3.9%	3.8%	3.6%
Nuclear	17.1%	8.5%	-8.5%	63.9%	51.7%	50.8%	5.6%	0.0%	22.1%	24.1%
Wind	69.7%	26.5%	34.5%	52.7%	38.6%	23.4%	22.2%	16.7%	13.0%	10.3%
Solar/Other	-33.7%	141.9%	9.8%	13.9%	15.2%	22.0%	21.7%	20.8%	17.2%	14.5%
Total Power Generation Growth	**10.9%**	**4.2%**	**6.0%**	**5.6%**	**5.2%**	**4.2%**	**3.0%**	**2.5%**	**1.6%**	**1.6%**

Source: CEIC, NBS and Bernstein estimates and analysis.

Roughly 1GW of nuclear generation capacity (operating at standard utilization) displaces ~4 million tons of coal. With 7.5GW of nuclear capacity coming on line in 2013, ~30 million tons of coal will be displaced. In the context of an overall market of almost 4 billion tons of coal consumption, 30 million tons is nothing. But in the context of a market that is expanding coal consumption at ~100 million tons per year, displacing 30 million tons is significant…in an already oversupplied market (see Exhibit 87).

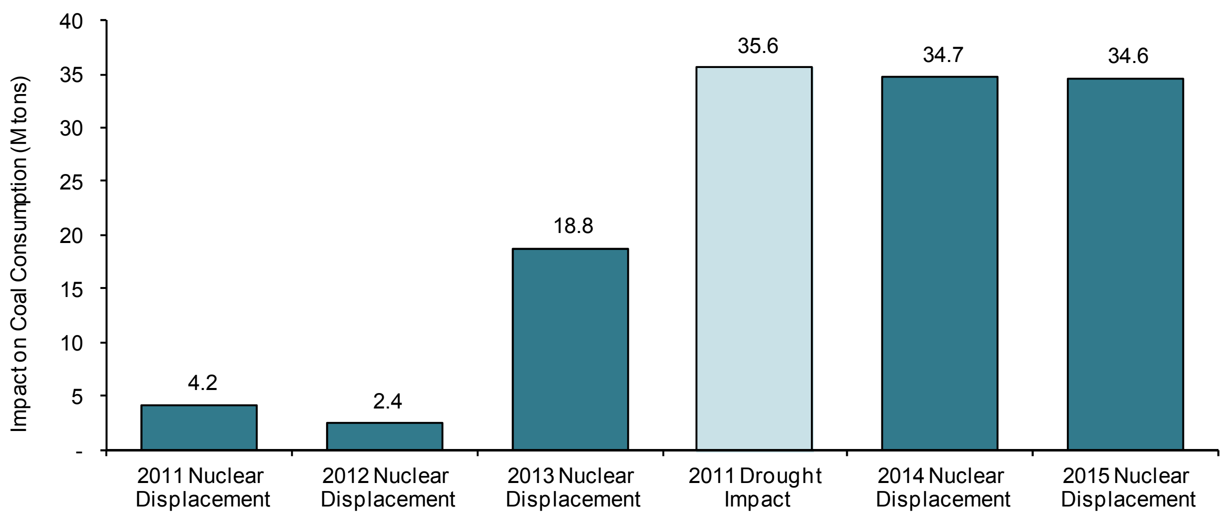
Exhibit 87 **Tons of Coal Consumption Displaced by Nuclear Power (2011-15E)**

	2011	2012	2013E	2014E	2015E
Nuclear Expansion					
Incremental Nuclear Capacity (GW)	1.1	0.7	7.5	10.4	10.4
Utilization	91%	90%	60%	80%	80%
Incremental Power Generation (TWh)	8.8	5.1	39.4	72.7	72.6
Coal Displacement					
Grams per KWh — Standard Coal	375	375	375	375	375
Tons per TWh — Standard Coal	375,000	375,000	375,000	375,000	375,000
Adjusted to Benchmark (5,500KCal vs. 7,000KCal)	477,273	477,273	477,273	477,273	477,273
Tons of Coal Displaced (M)	4.2	2.4	18.8	34.7	34.6
Cumulative Annual Coal Displacement (M tons)	**4.2**	**6.6**	**25.4**	**60.1**	**94.7**
Displaced Coal as % of Incremental Consumption	*1.0%*	*1.0%*	*129.6%*	*66.6%*	*693.0%*

Source: CEIC, NBS and Bernstein estimates and analysis.

To place 30 million tons in some kind of context, the 2011 drought in southwestern China lowered hydro utilization for the year by roughly 500 bp. This loss equated to ~36 million tons of incremental coal that was consumed to operate coal-fired power stations that would, in a normal year, have instead come from hydro generation (see Exhibit 88). In short, in coming years, we expect that the Chinese power sector will effectively experience the opposite of the 2011 drought each year cumulatively — additional power generation from nuclear that serves to displace coal demand and put further pressure on coal prices.

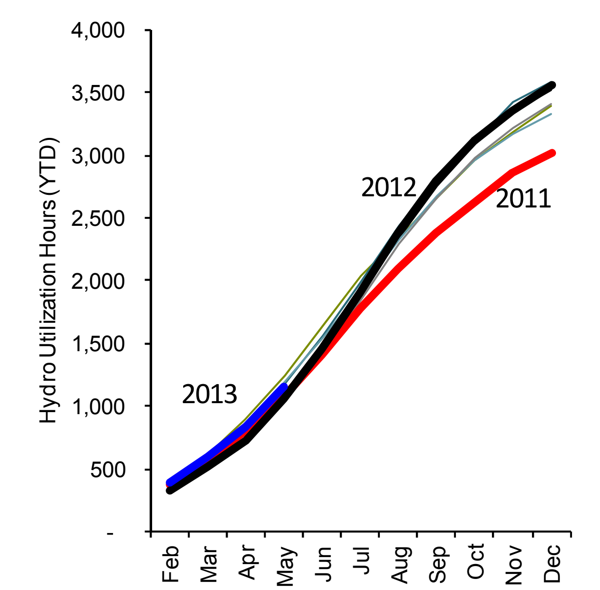
Exhibit 88 **China Coal Incremental Displacement by Nuclear vs. 2011 Drought**



Source: CEIC, NBS and Bernstein estimates and analysis.

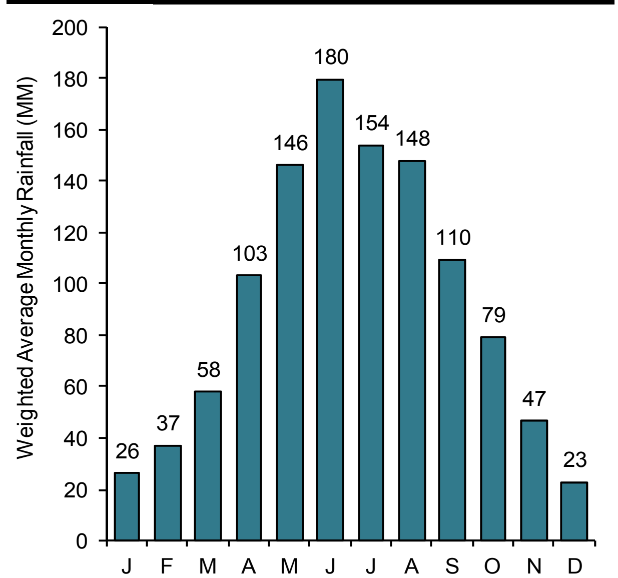
Of course, during 2011, the decline in hydro power generation during the peak summer monsoon season exacerbated pricing pressures given that the shortfall in supply came during a short period of time. Hydro utilization hours in 2011 were ~12% lower than historical averages (see Exhibit 89 and Exhibit 90).

Exhibit 89 **China Hydro Utilization Hours**



Source: CEIC, CEC and Bernstein analysis.

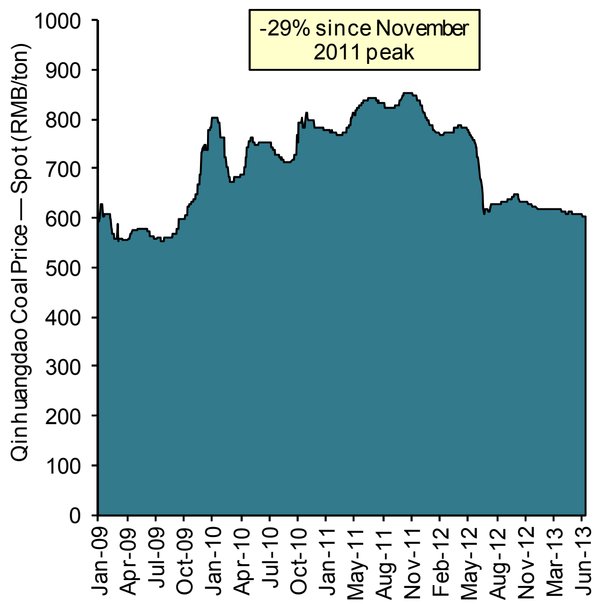
Exhibit 90 **Monthly Rainfall, Weighted Average for Hydro Generating Provinces**



Source: UN World Meteorological Organization, Bernstein analysis

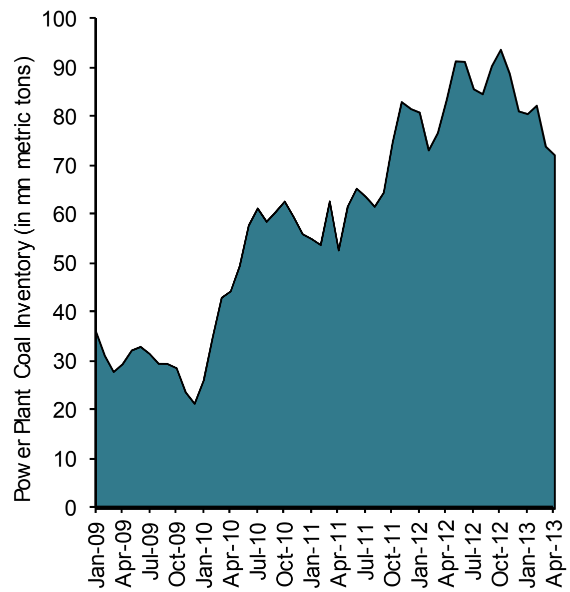
In 2011, coal prices rose significantly over the summer in part due to weak hydro generation and, in part, from lower inventories (see Exhibit 91 and Exhibit 92). The shift to nuclear power is unlikely to have the same kind of effect on coal price volatility given the nuclear power is base load and operates throughout the year. However, diversifying sources of power serves to reduce the risk of spikes in coal prices.

Exhibit 91 Qinhuangdao 5,500 Kcal Coal Spot Price (2009-June 2013)



Source: SX Coal and Bernstein analysis.

Exhibit 92 China Power Station Coal Inventories (2009-April 2013)



Source: SX Coal and Bernstein analysis.

Is There Enough Uranium?

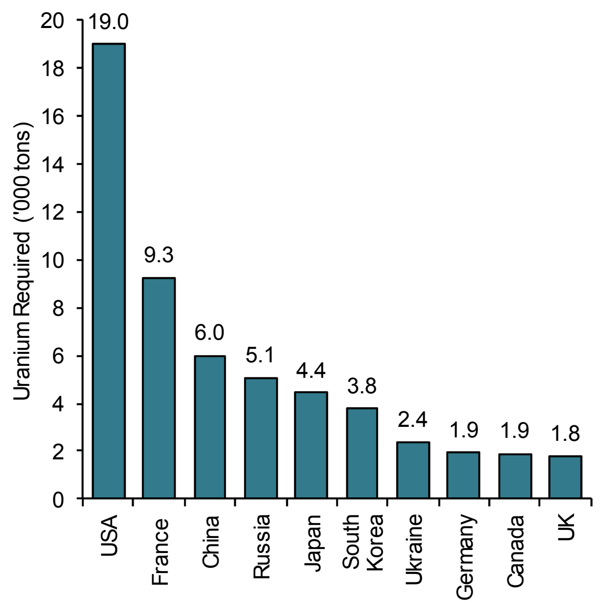
All of this begs the obvious question: what is going to happen to uranium prices as China becomes the source of the majority of nuclear power capacity expansion in coming years? We are in no way claiming expertise in the area of uranium mining. However, there are at least three reasons to believe that the pattern of spiking commodity prices as Chinese demand increases is probably misleading in this instance.

First, the growth in China's nuclear installed capacity is going to happen over a long period of time. It will become noticeable at the margin in 2013 based on the displacement of coal, as described earlier. However, China will — in the best-case scenario — have ~20GW of nuclear capacity at the end of 2013, equivalent to ~5% of total nuclear capacity globally. The ramp is, in our view, over too long a period to result in a spike in commodity prices.

Second, uranium is a common metal with proven reserves in a variety of locations. Because there is not likely to be a sudden spike in demand, the usual dynamics rewarding those who have invested in capacity well ahead of the demand boom are unlikely to play out. The locations with significant uranium reserves include Kazakhstan, Canada, Niger, Mongolia, China and Australia (see Exhibit 95). Without one location or supplier being able to tie up share over the rest of the decade, we believe a spike in prices — or a lack of supply — is unlikely as producers from all of these regions increase supply roughly simultaneously.

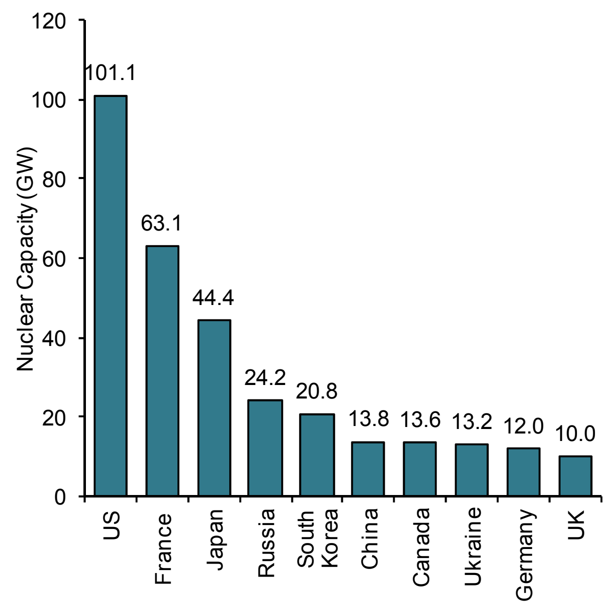
The World Nuclear Association now estimates that China will demand ~6,000 tons of uranium in 2013 (see Exhibit 93), making it the third-largest consumer of uranium in the world. Since China's nuclear capacity was only eighth in the world at the end of 2011 (see Exhibit 94), the strong demand suggests that China is already ramping up its procurement of uranium ahead of commissioning ~30GW of nuclear capacity over the next several years.

Exhibit 93 2013E Uranium Required



Source: World Nuclear Association and Bernstein analysis.

Exhibit 94 Nuclear Installed Capacity by Country, as of June 2013

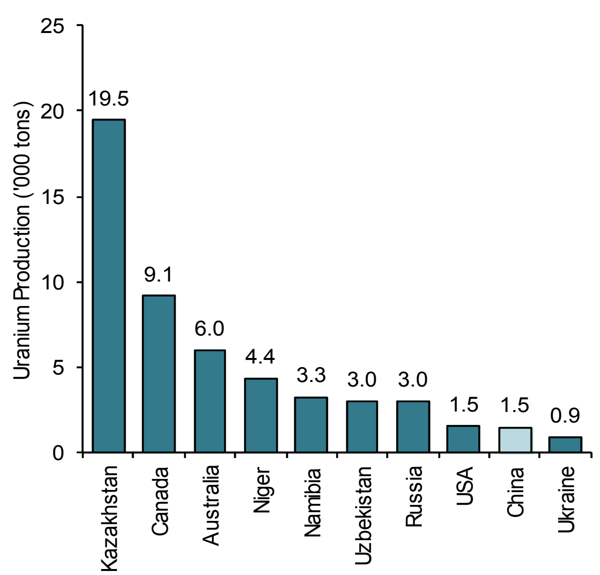


Source: World Nuclear Association and Bernstein analysis.

If China is, in fact, already buying ahead of demand, it has yet to register in terms of uranium pricing (see Exhibit 96).

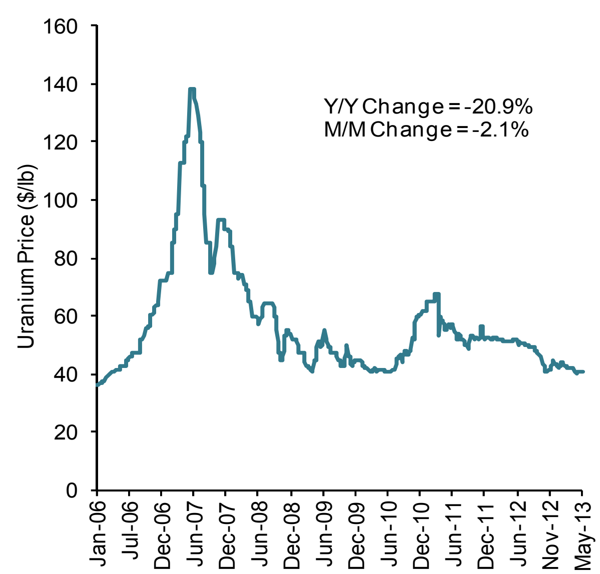
Third, China is developing its own uranium supply. In 2012, Xinhua announced that geologists have found significant uranium deposits in Inner Mongolia, and that the area could become one of the top uranium mines in the world. China produced ~1,500 tons of uranium in 2011 (see Exhibit 95), significantly less than its expected uranium requirement.

Exhibit 95 2011 Uranium Production



Source: World Nuclear Association and Bernstein analysis.

Exhibit 96 Uranium Spot Price (USD/lb)



Source: Bloomberg L.P. and Bernstein analysis.

Game Done Changed: Cost Structures and Strategies Within the Chinese Mining Sector

Why Aren't the Large Chinese Coal Miners Taking Market Share

The most surprising thing about the Chinese coal mining sector in the first half of 2013 has been the fact that the large, publicly traded miners are not taking share. Prices have fallen 30% since November 2011, and these coal miners are reporting falling earnings year-over-year. The textbook response is to ramp up production. Yet that isn't happening. In this chapter, we explore the best explanations.

We also update our estimate of marginal production cost for the large miners and the delivered cost at the coast based on recently reported 2012 production and financial data from the 21 publicly traded Chinese coal mining companies.

We believe that the two dynamics — a flattening cost curve and a falling array of options for the coal miners in the face of weak pricing and high inventories — are related.

It's Good to Be Cheap

The 60 largest coal miners in China produced, by our estimate, ~2,871 million tons of coal in 2012, representing ~73% of the industry. Yet growth, this year, from the publicly traded miners is surprisingly weak. At this point in the cycle, you might expect that large, low-cost producers would take share to bolster earnings. To the extent that a miner has positive gross margins on incremental supply, this is the economically rational next step.

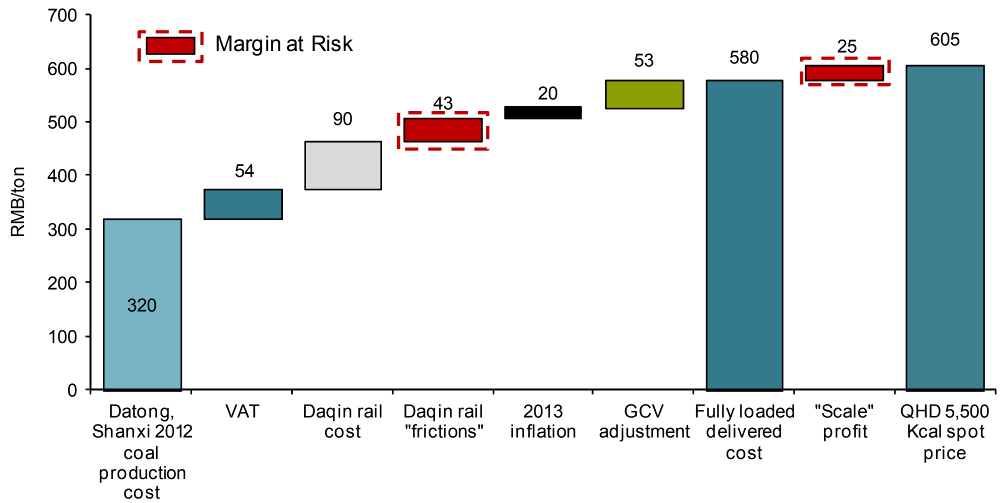
Yet Shenhua's production growth was up just 1.5% year-to-date through April 2013. The 21 publicly traded Chinese coal miners expanded production at ~11% in 2012 but the covered companies are slowing production growth year-to-date.

We believe that the best explanation for the weak production growth year-to-date is simply a combination of three factors. First, inventories remain high at all points across the supply chain (including with the miners). Second, the publicly traded coal miners' marginal production costs may be, in many cases, significantly higher than their average cost, meaning incentives to ramp up production at marginal mines are weak and the cost curve is even flatter than we have previously believed. Third, rail bottlenecks are improving but still mean that there are frictions in connecting low-cost interior coal production with coastal demand.

The spread between the incremental ton of coal being supplied by large-scale miners and the spot price is ~RMB25/ton in June 2013 (see Exhibit 97). In short, this is an oversupplied market with deteriorating long-term demand growth and a flat cost curve. Options, whether strategic or otherwise, for any miner are limited.

In any industry, it is good to be a low-cost producer. And in a fragmented industry, when everything else goes wrong — prices fall, demand is weak, customers take production in-house, and imports go up — low-cost producers can always increase volumes, take market share and thereby boost earning. Sure, the action is corrosive to the long-term economics of the industry as it pushes out higher-cost producers and places more pressure on price. But it is still the best strategy for low-cost suppliers at a certain point in the cycle. And in a fragmented industry, if you don't do it, someone else will.

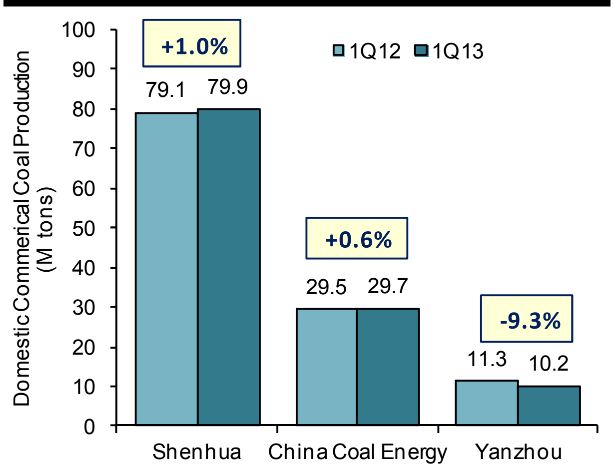
Exhibit 97 **Qinhuangdao Coal Price Composition (June 2013)**



Source: Bloomberg L.P., SX Coal and Bernstein estimates and analysis.

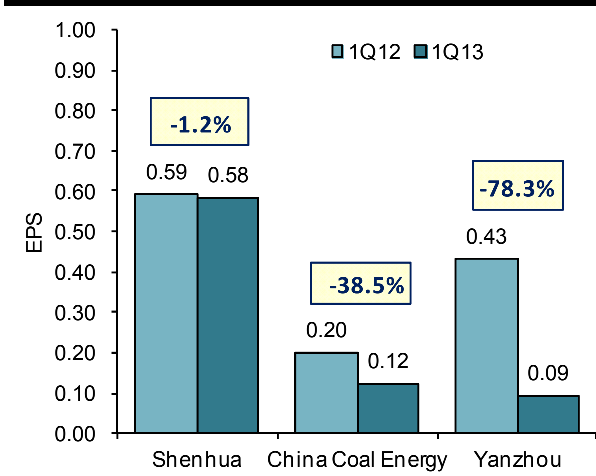
The most surprising thing about the Chinese coal mining sector so far in 2013 has been the fact that the large, publicly traded miners are not executing this strategy. Coal prices have fallen 30% over the last 18 months, and all coal miners are reporting a decline in earnings year-over-year (see Exhibit 99). Yet production growth is also weak year-over-year for large miners. Shenhua and China Coal Energy are reporting flat production year-over-year, while Yanzhou's domestic production is down sharply (see Exhibit 98). The textbook response for what happens next isn't playing out: the big miners aren't taking market share to boost earnings.

Exhibit 98 **Domestic Commercial Coal Production 1Q:12 and 1Q:13**



Source: Corporate reports and Bernstein analysis

Exhibit 99 **EPS 1Q:12 and 1Q:13**



Source: Corporate reports and Bernstein analysis

And the explanation for "*why not?*" is not immediately obvious. Shenhua's production cost averaged RMB130/ton in the first quarter of 2013 and its average selling price was over RMB400/ton. On a cash basis, it would seem to make sense to produce more coal. In our view, the industry remains too fragmented for large-scale miners to attempt to exert any price discipline. The industry is consolidated to the point where 60 miners accounted for 73% of the industry in 2012 and closer to 75% of the industry now. But the second-largest coal miner in China has a market share of less than 5%. This stresses the fact that the industry remains massively fragmented.

As we set out in this chapter, production, consumption and inventory data do not tie. We believe that the most likely reason is understated inventory data (likely in the form of inventories at the miner's coal yards and in transit). Given the fragmented nature of the industry, this is a more likely explanation than the miners imposing some form of pricing discipline on themselves.

High inventories mean that we do not believe upward pressure on coal price is likely in coming months. But at the same time, even putting together the best case in terms of incremental supply, we do not believe that there is near-term downside risk to coal price given the timing of new rail line commissioning and the "go slow" the large miners are now working to in terms of taking market share.

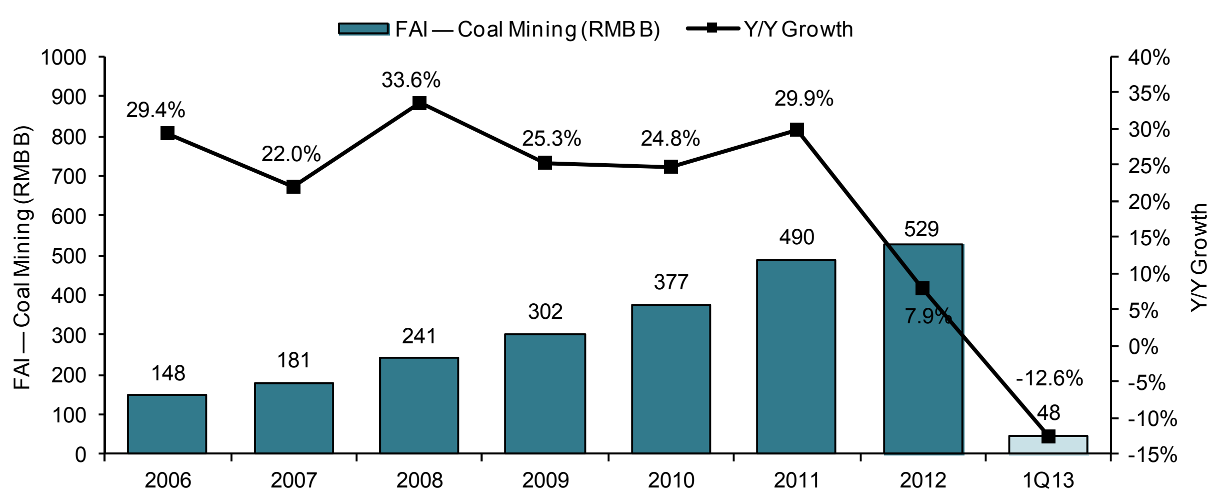
In short, the status quo looks like the most likely scenario. We expect coal prices to remain stable into 2015 (RMB630/ton this year, 2014 and 2015). Inflationary pressures will inevitably raise coal costs over time. To the extent that the top 55-60 miners push out high-cost miners, the cost curve flattens as it rises.

Coal Production Cost Analysis of the Top 21 and Top 55 Chinese Miners

The simplest way to explain the fact that coal prices fell 22% over the course of 2012 despite the fact that the overall demand for coal was essentially flat is the share shift within the Chinese coal mining sector. In short, the bigger players got bigger and, in the absence of continuing rapid demand growth, the smaller, high-cost miners got squeezed out. Production share was taken by lower-cost coal miners, who set a low spot price.

We anticipate that domestic production capacity growth in 2013 will expand at a similar rate as in 2012 and the high-cost domestic producers will continue to lose share, although this is happening slower than we would have guessed. Fixed asset investment (FAI) in coal mining in recent years reflects a slowdown in investment since mid-2012, but new capital is still entering rapidly (see Exhibit 100).

Exhibit 100 **FAI in China Coal Mining Sector (2006-1Q:13)**



Source: NBS, CEIC and Bernstein analysis.

Exhibit 101 sets out the coal production volumes of the 21 publicly traded Chinese coal miners.

Exhibit 101 — Coal Production Volumes of the 21 Publicly Traded Chinese Coal Miners (2008-12)

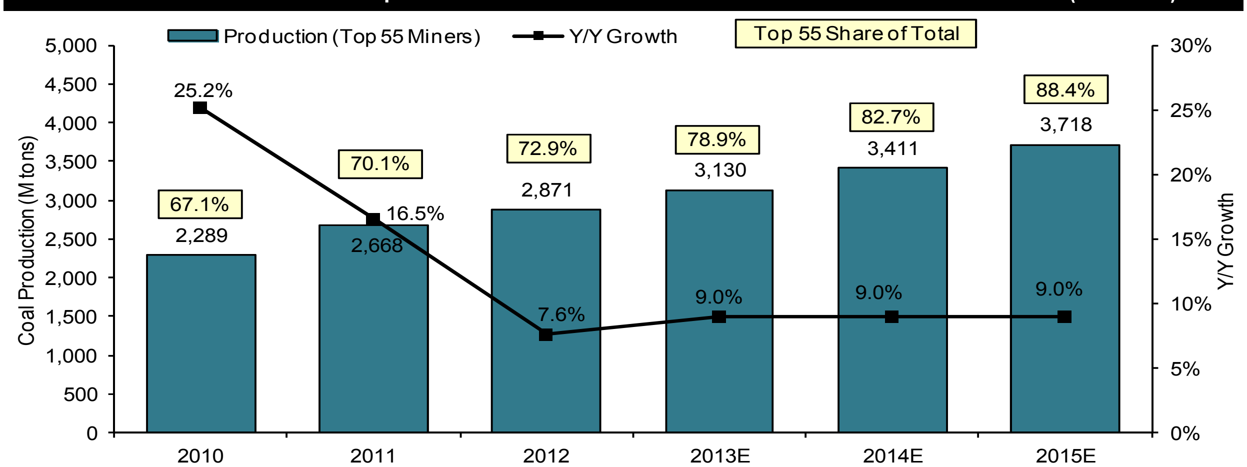
Company Name	Coal Production (000 tons) 2008	2009	2010	2011	2012	2012 CAGR%
China Shenhua	186,500	209,500	241,100	282,300	306,800	13.3%
China Coal Energy	74,100	78,970	89,750	101,720	111,120	10.7%
Huolinhe Opencut Coal Industry Corp. (China Power)	36,820	42,340	42,450	43,960	45,000	5.1%
Shanxi Guoyang New Energy Co	36,333	39,528	45,380	51,110	56,530	11.7%
Pingdingshan Tianan Coal Mining	34,506	37,405	39,810	38,613	38,394	2.7%
Yanzhou Coal Mining Company Limited	33,501	34,332	36,234	40,882	44,416	7.3%
Inner Mongolia Yitai Coal Company Limited	18,196	26,042	36,129	35,085	49,760	28.6%
Shanxi Lu'an Environmental Energy Development	23,230	26,710	33,220	34,230	28,720	5.4%
Jizhong Energy Resources Co., Ltd	11,669	25,895	31,021	34,146	36,425	32.9%
Datong Coal Industry	17,471	25,786	29,290	30,940	38,190	21.6%
Shanxi Xishan Coal and Electricity Power Co	16,172	17,796	21,111	21,321	25,437	12.0%
Anhui Hengyuan Coal Industry	4,611	9,672	10,418	11,509	12,198	27.5%
SDIC Xinji Energy	10,825	10,964	13,379	13,843	16,361	10.9%
Inner Mongolia PingZhuang Energy Limited (China Guodian)	9,212	10,053	9,622	10,698	9,866	1.7%
Guizhou Panjiang Refined Coal	2,371	9,312	11,400	12,300	13,549	54.6%
Shanxi Lanhua Sci-Tech Venture	5,427	5,816	5,697	5,307	5,776	1.6%
Zhengzhou Coal Industry and Electric Power	4,620	4,810	4,890	4,860	11,110	24.5%
Shanghai Ace Company	3,920	3,936	3,326	3,358	3,141	-5.4%
Gansu Jingyuan Coal Industry and Electricity Power Co.	1,775	1,930	2,450	2,600	10,552	56.2%
Sundiro Holding (Wujiu Coal Group)	1,864	1,864	2,410	2,679	2,471	7.3%
Inner Mongolia Tehong Coal Group Co.	264	453	820	1,081	906	36.1%
Total	**533,386**	**623,114**	**709,906**	**782,543**	**866,721**	**12.9%**
Y/Y Growth		**16.8%**	**13.9%**	**10.2%**	**10.8%**	

Source: Corporate reports and Bernstein analysis.

Generally, at this point in the cycle, you might expect that large, low-cost producers would take share to bolster their earnings. To the extent that a miner has positive gross margins on incremental supply, the economically rational next step is to increase production. We believe that the industry's reticence in expanding production is more a function of current inventory levels rather than challenging economics of marginal supply. In short, large-scale miners still have a cost advantage over the bottom quintile of the industry, although that advantage is fading.

The top 55 Chinese coal miners produced ~2.9 billion tons of coal in 2012, ~8% higher than the 2011 level at ~2.7 billion tons (see Exhibit 103). These top 55 coal producers accounted for ~73% of total coal production in 2012, compared to ~70% in 2011 (see Exhibit 102).

Exhibit 102 — Top 55 Coal Miners' Production and Their Share of Total Production (2010-15E)



Source: China National Coal Association, SX Coal, corporate reports and Bernstein estimates and analysis.

Exhibit 103 **Top 55 Coal Miners' Production (2008-12)**

Company	Coal Production (mmt) 2008	2009	2010	2011	2012	Y/Y Growth
Shenhua Group	281.3	327.8	357.0	407.1	440.0	8.1%
China National Coal Group	114.1	125.1	146.8	163.6	176.0	7.6%
Shanxi Datong Coal Mining Group	68.9	74.5	101.2	115.4	132.1	14.5%
Shanxi Coking Coal Group	80.3	80.8	102.1	110.1	105.4	-4.2%
Shaanxi Coal & Chemical Industry Group	60.4	71.0	100.4	101.9	114.0	11.9%
Shandong Energy Group	n/a	n/a	79.1	108.2	123.0	13.7%
Hebei Jizhong Energy Group	35.8	42.4	73.3	102.2	115.0	12.6%
Henan Coal & Chemical Industry Group	44.7	57.0	74.0	84.8	75.2	-11.4%
Shanxi Lu'an Mining Industry Group	42.1	55.1	71.0	77.2	80.1	3.8%
Yankuang Mining Group	39.7	49.7	60.1	70.8	75.3	6.4%
Hebei Kailuan Group	32.9	40.5	60.9	70.6	83.5	18.3%
Anhui Huainan Mining Group	56.7	67.2	66.2	67.5	70.1	3.8%
Shanxi Yangquan Coal Industry Group	37.3	44.1	51.6	58.5	68.8	17.6%
China Guodian	n/a	n/a	47.0	65.1	68.5	5.3%
China Huaneng	n/a	n/a	46.3	64.1	68.6	7.1%
China Power Investment Corporation	n/a	n/a	54.1	60.7	60.5	-0.4%
Inner Mongolia Yitai Group	25.7	36.7	51.1	63.3	68.2	7.7%
Heilongjiang Longmei Mining Group	55.0	54.9	50.1	51.7	54.0	4.4%
Shanxi Jincheng Anthracite Mining Group	37.4	42.6	46.0	52.5	54.7	4.1%
Inner Mongolia Yidong Group	16.2	21.2	39.5	49.3	50.0	1.4%
China Pingmei Shenma Group	41.2	45.8	49.7	47.6	50.0	5.1%
Shanxi Coal Transportation & Marketing Group	15.6	21.8	28.0	28.0	50.4	80.0%
Henan Yima Coal Industry Group	21.9	22.6	31.2	33.6	30.0	-10.8%
Anhui Huaibei Mining Group	26.5	27.3	30.6	33.7	36.3	7.7%
Jilin Coal Industry Group	20.6	26.1	28.1	32.2	34.7	7.7%
Inner Mongolia Huineng Coal & Power Group	18.8	23.0	27.5	30.6	33.0	7.7%
Inner Mongolia Mengtai Coal Group	10.9	28.8	30.6	36.3	39.1	7.7%
Liaoning Tiefa Coal Group	21.8	24.1	23.1	25.7	27.7	7.7%
Inner Mongolia Yongli Coal Company	n/a	n/a	n/a	24.6	26.5	7.7%
China Huadian	n/a	n/a	9.3	22.6	25.1	11.2%
Henan Zhengzhou Coal Industry Group	16.7	18.4	22.0	22.5	24.3	7.7%
Jiangsu Xuzhou Mining Group	19.4	19.4	18.8	21.2	20.9	-1.1%
Inner Mongolia Manshi Coal Group	4.1	8.9	15.0	21.0	22.6	7.7%
Inner Mongolia Erdos Wulan Coal Group	n/a	n/a	12.0	17.6	18.9	7.7%
Anhui Wanbei Coal Group	12.8	14.0	16.2	17.4	18.8	7.7%
Guizhou Panjiang Coal & Power Group	11.9	13.4	12.9	17.2	18.6	7.7%
China Resources Power	n/a	n/a	11.4	16.4	16.8	2.8%
Liaoning Shenyang Coal Industry Group	17.0	15.4	11.1	15.8	17.0	7.7%
SDIC Xinji Energy	11.8	12.5	15.1	15.3	16.5	7.9%
Inner Mongolia Tehong Coal Group	n/a	n/a	10.1	14.0	15.1	7.7%
Inner Mongolia Ruide Coal Chemical Co.	n/a	n/a	n/a	13.8	14.9	7.7%
Inner Mongolia Zhalainuoer Coal Co.	n/a	n/a	n/a	13.7	14.7	7.7%
Chongqing Energy Investment Corporation	12.4	12.9	13.1	13.7	13.9	1.9%
China Datang	n/a	n/a	11.3	13.8	13.0	-5.8%
Sichuan Coal Industry Group	13.0	14.1	13.1	13.1	14.1	7.7%
Shanxi Lanhua Coal Industry Group	10.2	12.6	13.5	13.0	14.0	7.7%
Liaoning Fuxin Mining Group	12.1	13.5	12.0	12.1	13.0	7.7%
Guizhou Shuicheng Mining Group	8.1	10.2	10.7	11.6	16.0	37.8%
Shendong Tianlong Group	14.4	13.5	13.5	11.1	11.9	7.7%
Yunnan Xiaolongtian Mining Bureau	10.1	9.8	9.8	11.7	12.6	7.7%
Shanxi Liansheng Energy Company	n/a	n/a	n/a	10.9	11.8	7.7%
Inner Mongolia Kaiyuan Shiye Group Co.	n/a	n/a	n/a	10.7	11.5	7.7%
Shanxi Hunyuan Baichuan Coal Industry Company Ltd.	n/a	n/a	n/a	10.6	11.4	7.7%
Gansu Jingyuan Coal Industry Group	9.8	9.4	10.0	10.5	11.3	7.7%
Shanxi Kexing Energy Development Group Co.	n/a	n/a	n/a	10.5	11.3	7.7%
Inner Mongolia Ximeng Group	12.3	13.4	15.8	n/a	n/a	n/a
Jilin Liaoyuan Mining Group	8.6	11.0	12.5	n/a	n/a	n/a
Jiangxi Coal Group	8.0	8.6	9.6	n/a	n/a	n/a
Yunnan Dongyuan Coal Industry Group	9.6	8.4	8.4	n/a	n/a	n/a
Hunan Coal Industry Group	7.3	7.7	7.7	n/a	n/a	n/a
Shanghai Ace Company	4.0	3.9	3.3	3.4	3.1	-6.5%
Sundiro Holding Company	1.6	1.9	2.4	2.6	2.5	-4.3%
Huolinhe Opencut Coal Industry Corporation	37.1	42.2	42.5	44.0	45.0	2.4%
Inner Mongolia Pingzhuang Coal Industry Group	22.8	25.3	n/a	n/a	n/a	n/a
Huaneng Hulunbeier Energy Development	20.7	23.0	n/a	n/a	n/a	n/a
Shandong Xinwen Mining Group	13.6	18.3	n/a	n/a	n/a	n/a
Shandong Zaozhuang Mining Group	16.9	17.5	n/a	n/a	n/a	n/a
Gansu Huating Coal Industry Group (Huaneng)	17.5	17.0	n/a	n/a	n/a	n/a
Shandong Zibo Mining Group	13.8	13.2	n/a	n/a	n/a	n/a
Shandong Longkou Mining Group	8.0	8.3	n/a	n/a	n/a	n/a
China Energy Corporation	1.6	1.9	n/a	n/a	n/a	n/a
Total	**1,592**	**1,829**	**2,289**	**2,668**	**2,871**	**7.6%**

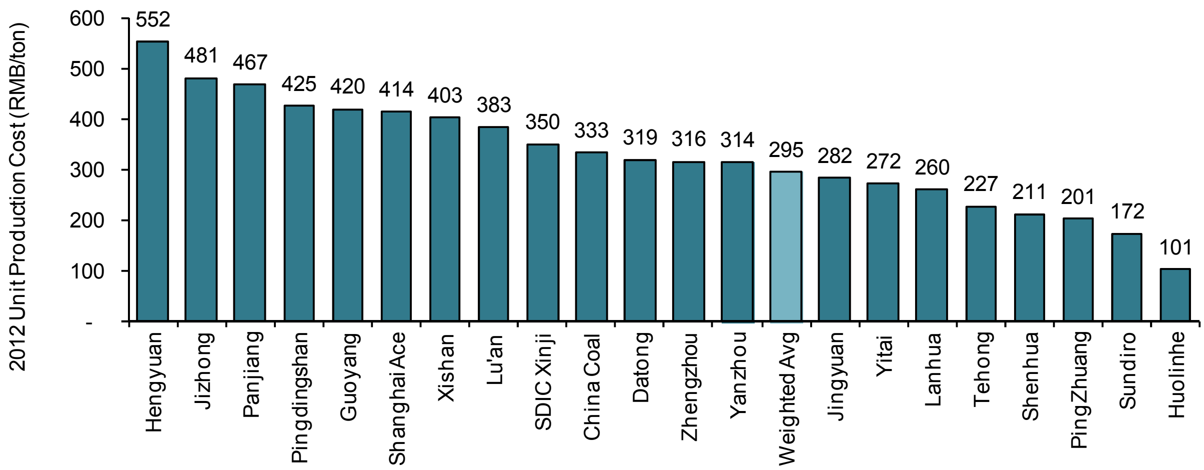
Source: China National Coal Association, SX Coal, corporate reports and Bernstein estimates and analysis.

With further consolidation and technical improvements in the industry, we believe the sector will continue to shift towards larger-scale, lower-cost miners. This will squeeze the high-cost coal miners on the right hand side of the cost curve out of the market. Based on our demand forecast, we believe demand for domestically produced coal will remain at ~4.1 billion tons in 2013, up ~60 million tons from 2012.

We project a 9% growth rate for the top 55 miners between now and 2015. By 2015, we believe these companies will account for ~88% of the total domestic market (see Exhibit 102). Today, there is another roughly 1 billion tons of Chinese production capacity in the market. Given that the 50th largest coal miner in China today produces ~10 million tons of coal, this implies at least another 100 coal miners still in operation, and in all likelihood, the real number is several thousand. In short, even after all this, the industry is highly fragmented.

Weighted average unit production cost (delivered) has pretty much stayed flat at RMB295/ton in 2012, compared to RMB296/ton in 2011. Hengyuan was the highest-cost coal producer among the 21 publicly traded Chinese coal miners (see Exhibit 104).

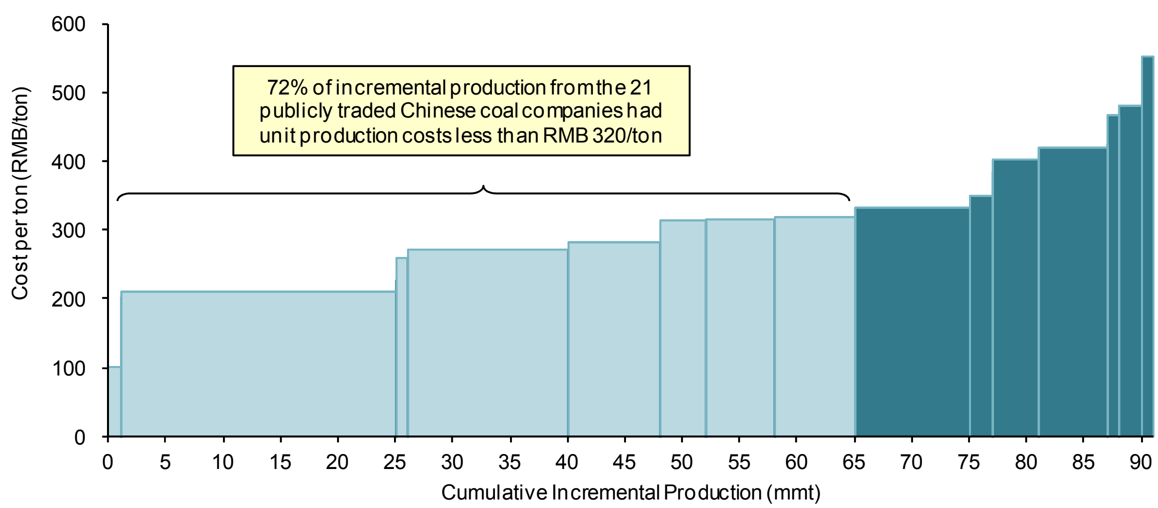
Exhibit 104 **Unit Production Cost for 21 Publicly Traded Chinese Coal Miners (2012)**



Source: Corporate reports and Bernstein estimates and analysis.

Based on 2012 data, we estimate that the 75th percentile of new supply costs at ~RMB320/ton (see Exhibit 105).

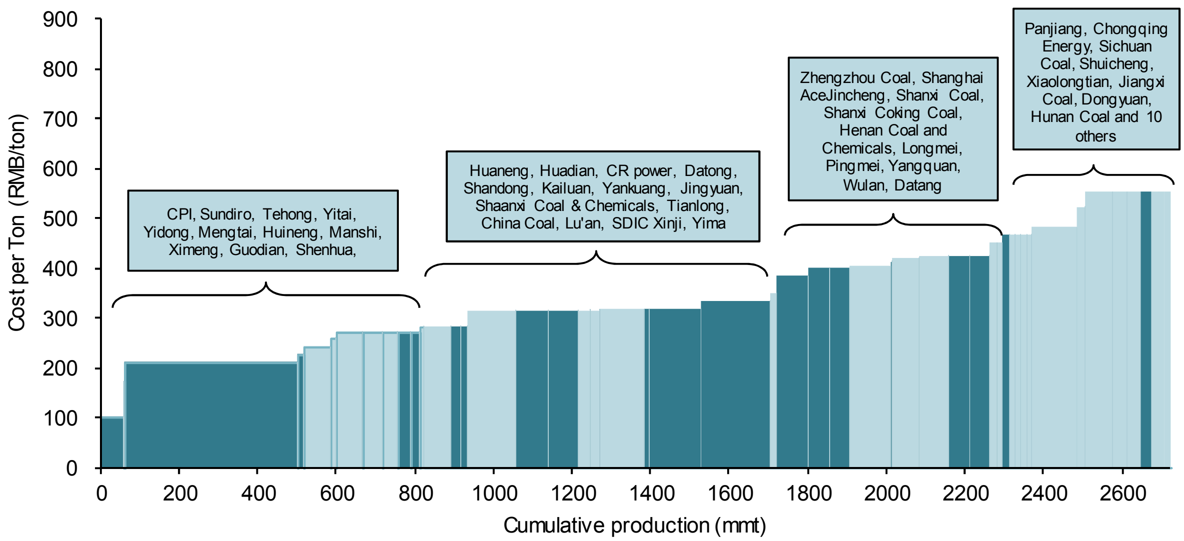
Exhibit 105 **Cost Curve of Incremental Coal Production from 21 Publicly Traded Miners (2012)**



Source: Corporate reports and Bernstein estimates and analysis.

Adding VAT at 17% implies a price (at short-run variable cost) of RMB374/ton. Add on RMB90/ton to rail that coal to the coast and this implies a delivered cost for the top 55 producers of RMB580/ton, after adjusting for transport frictions, a GCV adjustment and inflation in 2013. Combining the known cost structures of the publicly traded coal miners with the production level of the rest of the top 55, we have pieced together our view of the coal cost curve in 2012 (see Exhibit 106).

Exhibit 106 **Cost Curve for Top 55 Chinese Coal Miners (2012)**



Note: Bars in dark blue represent costs based on corporate reports; bars in light blue represent estimates based on production volume and region; see online version for colors.

Source: Corporate reports and Bernstein analysis.

Looking at the 21 publicly traded Chinese coal miners, production cost for the ~75th percentile in 2012 was RMB320/ton at or near the mine mouth. These costs represent the average, rather than the incremental, cost from these 21 coal miners. Given that incremental cost is likely to be higher, the incentives to push additional production into the marketplace may simply not be there for even large miners.

Why Are the Big Getting Bigger?

There is no satisfying answer to this question of why Shenhua is not increasing production volume right now. Presumably, the fact that its customers don't want any more coal, are happy with current supply relationships and will only switch to greater volumes at further discounts is playing a part. The textbook answer says Shenhua should be producing more coal. But if the customers won't read the textbook and won't buy the coal, and Shenhua won't cut pricing because of the concern over ripple effects, then more production just means higher inventories.

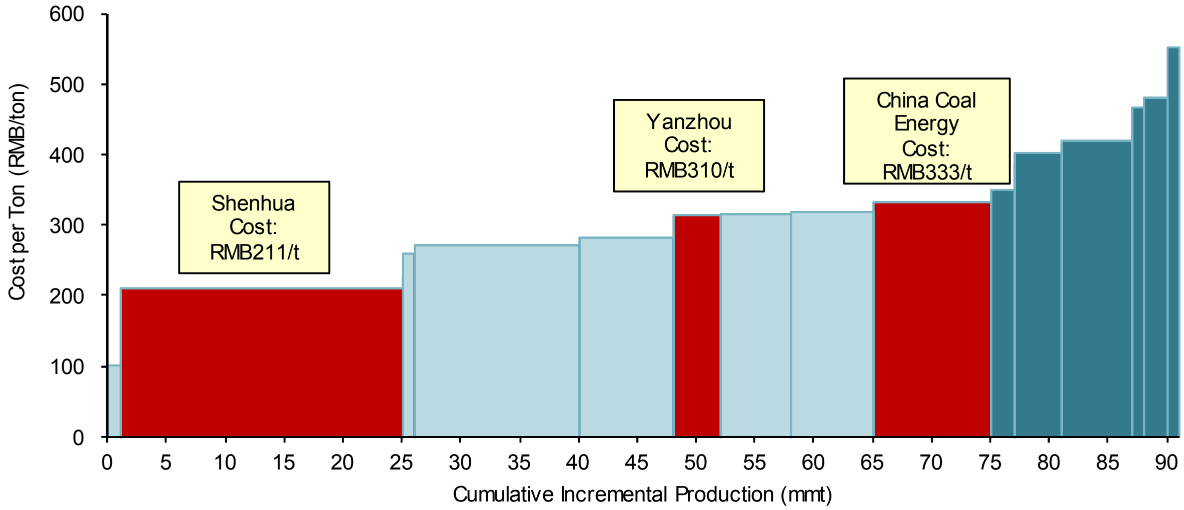
The answer to the same question for China Coal Energy is much simpler, as we outline later in the chapter. We believe that a combination of the flat cost curve, high inventories and rail bottlenecks are slowing production volume growth from the large-scale miners currently. In short, the cost curve may be even flatter than we think.

Flat Cost Curves Have Consequences

China Coal Energy's 2012 unit production cost sits in the higher end of the cost curve of the 21 publicly traded Chinese coal miners (see Exhibit 107). We estimate that at a unit production of RMB333/ton near the mine (with some local transportation), China Coal Energy's fully loaded delivery cost to Qinhuangdao is RMB610/ton currently.

In other words, China Coal Energy is out-of-the-money on a fully loaded basis if it sells incremental production into the spot market (see Exhibit 108). Yes, we should take out depreciation (may be RMB30/ton) but we should also adjust cost up for marginal rather than average cost.

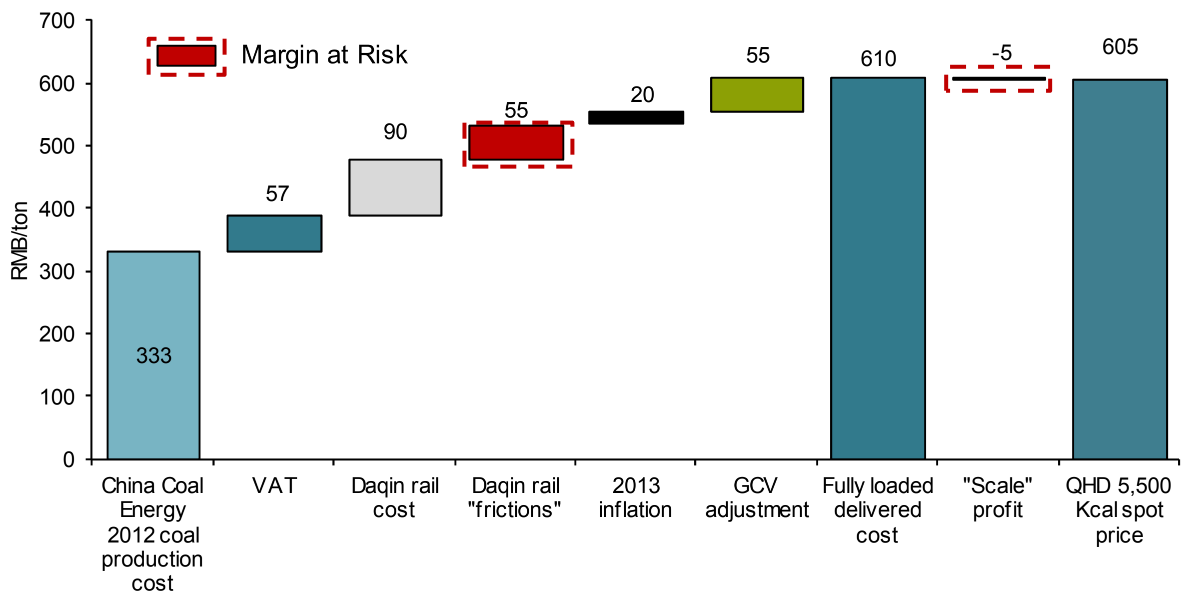
Exhibit 107 **Cost Curve of Incremental Coal Production from 21 Publicly Traded Miners (2012)**



Source: Corporate reports and Bernstein estimates and analysis.

In short, China Coal Energy cannot expand production for the simple reason that doing so would just come at a small cash loss. We believe that a large number of scaled Chinese coal miners are likely to be in a similar position.

Exhibit 108 **China Coal Energy's Cost and Margin at the Coastal Region**

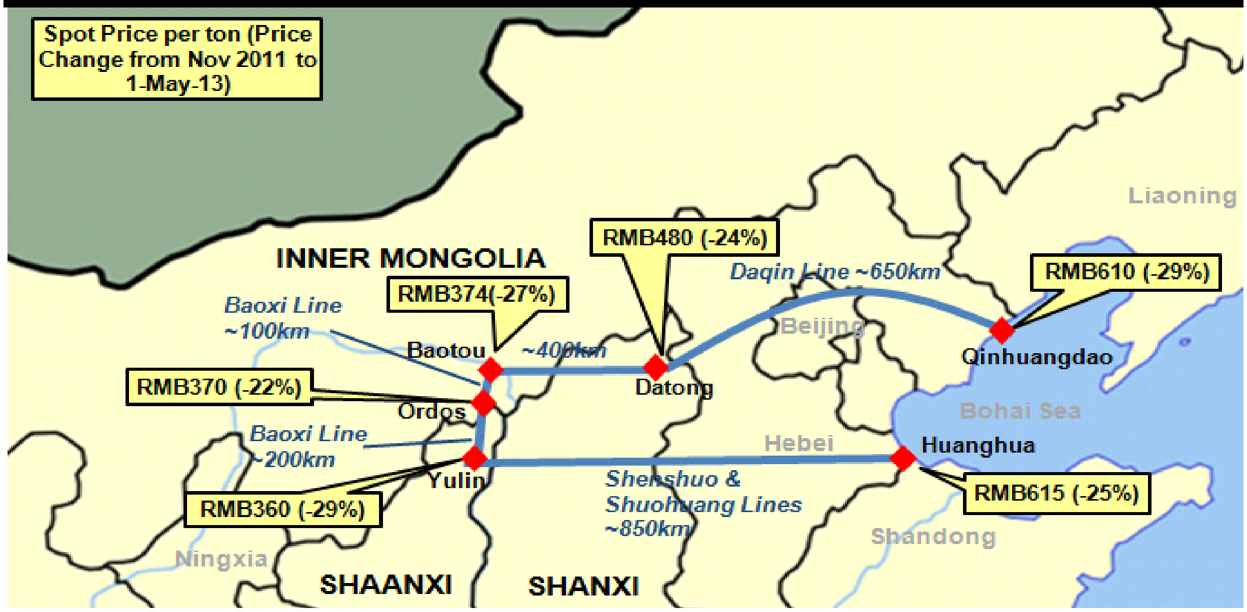


Source: Bloomberg L.P., SX Coal and Bernstein estimates and analysis.

Further, given the recent changes in coal prices in Baotou, Huanghua, Qinhuangdao and Ordos, it is not clear that the Qinhuangdao coal price will hold up if further supply starts coming on right now.

Over the last month and a half, coal prices were down 12% in Baotou but almost flat in Qinhuangdao (see Exhibit 109 and Exhibit 110) after prices moving across these regions in sympathy for 17 of the last 18 months. Efforts by the coal miners to push more coal to the coast risks a further drop in benchmark coal prices.

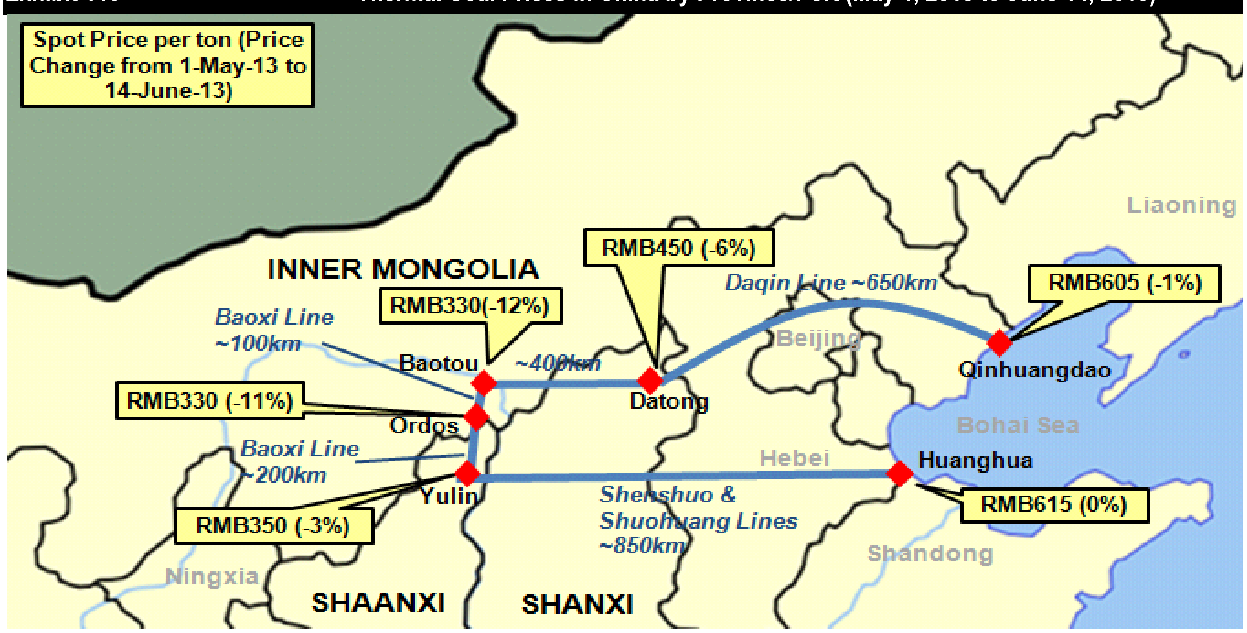
Exhibit 109 **Thermal Coal Prices in China by Province/Port (Nov 2011 to May 1, 2013)**



Source: Wikimedia commons, SX Coal and Bernstein analysis.

The textbook suggests that coal prices cannot fall from here given that such a move would cut into the muscle of the coal mining industry (companies such as China Coal Energy). However, if inventories are as high as we suspect (discussed in later sections), there is clearly some downside risk, especially given the sudden disparity in coal prices over the last one month and a half.

Exhibit 110 **Thermal Coal Prices in China by Province/Port (May 1, 2013 to June 14, 2013)**



Source: Wikimedia commons, SX Coal and Bernstein analysis.

Inventories in the Chinese Coal Supply Chain

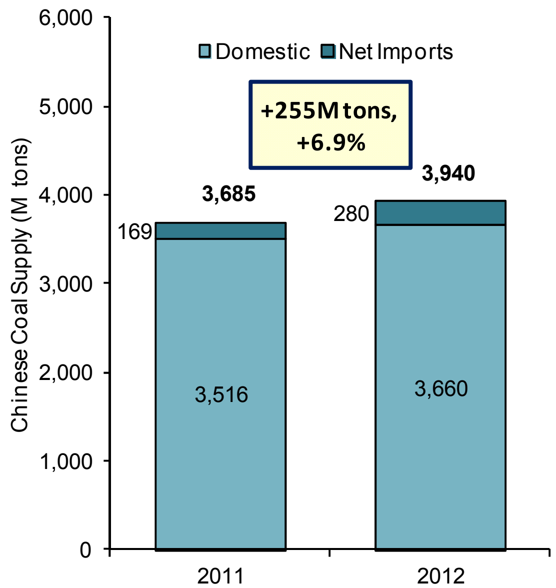
Hindsight is 20:20…except when it comes to the Chinese coal mining sector. The data produced by the mining sector for 2012 remains opaque. Even the simplest data — 2012 production — is inconsistent between the two most credible providers, and doesn't reconcile with consumption and the movement in inventory over the year either.

Based on both SX Coal data and the NBS data, domestic coal supply in 2012 increased 6-7% last year. According to NBS, Chinese domestic coal production increased 4.1% to 3.66 billion tons in 2012. With net imports of 280 million tons, Chinese coal supply was therefore 3.94 billion tons in 2012, up 7% (see Exhibit 111).

According to SX Coal, Chinese raw coal production was 3.63 billion tons through November 2012. Assuming something like 300 million tons of production in December 2012 would mean 3.94 billion tons of domestic supply and 280 million tons in net imports, meaning total supply was 4.2 billion tons last year, up 6% (see Exhibit 112).

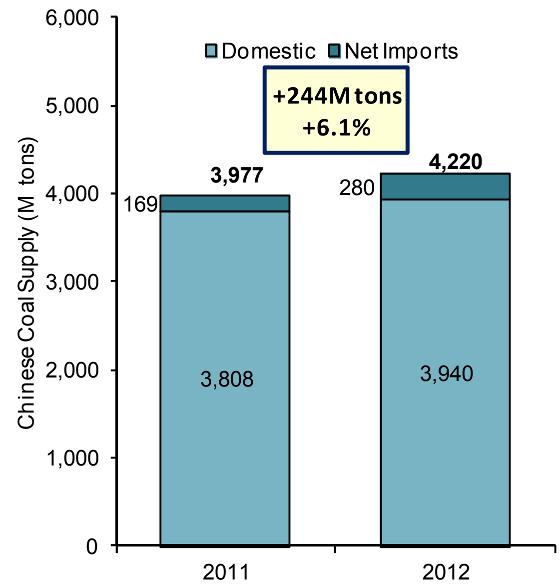
Yet none of these numbers make great sense to us. Coal demand growth in 2012 (and in every year in China) was dominated by power demand growth. Thermal power generation growth in 2012 in China fell 0.6%.

Exhibit 111 Chinese Coal Supply Based on NBS Data (2011-12)



Source: NBS, CEIC and Bernstein analysis.

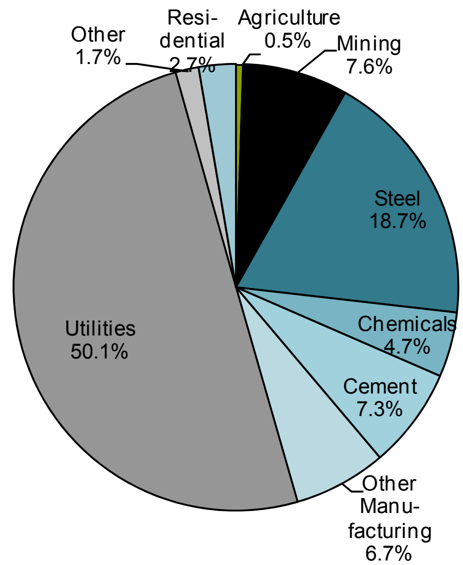
Exhibit 112 Chinese Coal Supply Based on SX Coal Data (2011-12)



Source: SX Coal and Bernstein analysis.

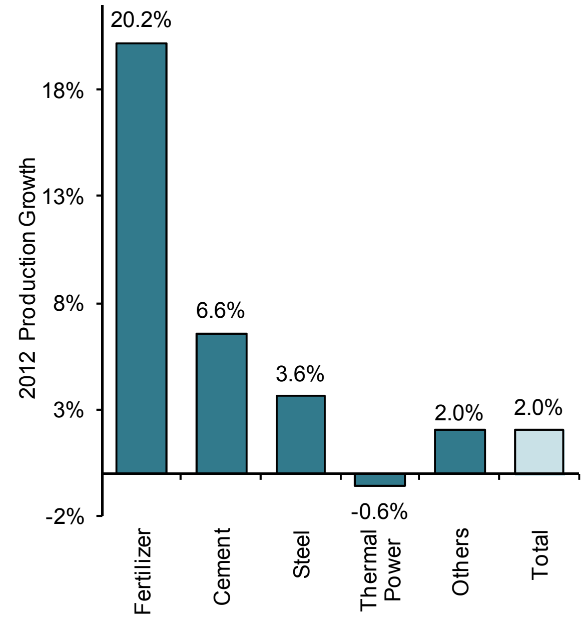
Steel and cement (which account for another 25% of Chinese coal consumption) saw production increases of 3.6% and 6.6%, respectively (see Exhibit 114). Fertilizer was the only "growth" story among Chinese coal end markets in 2012 (up 20.2% year-over-year); chemicals were only 5% of Chinese coal consumption (see Exhibit 113).

Exhibit 113 Chinese Coal Consumption by Segment (2011)



Source: NBS, CEIC and Bernstein analysis.

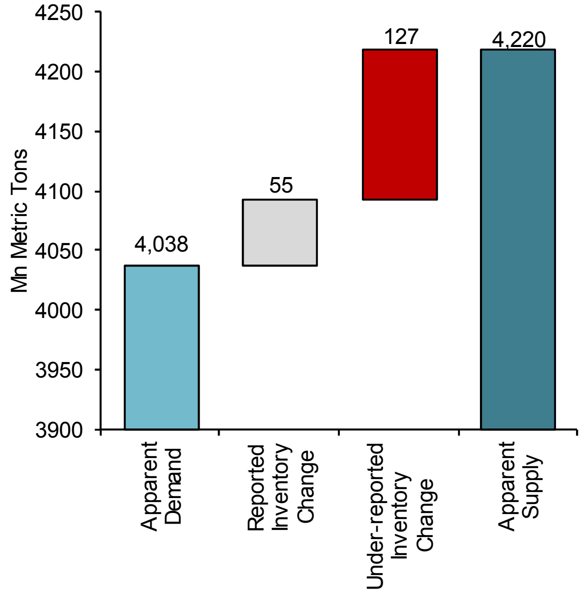
Exhibit 114 Coal Consuming Sectors Production Growth (2012)



Source: NBS, CEIC, media reports and Bernstein analysis.

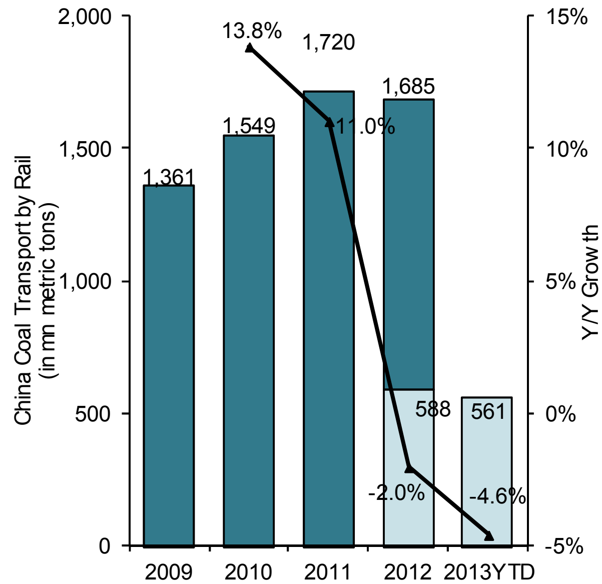
Transport and inventory data reflect rising inventories and falling transport volume (see Exhibit 116 through Exhibit 118).

Exhibit 115 Reported vs. Under-Reported Coal Inventories (2012)



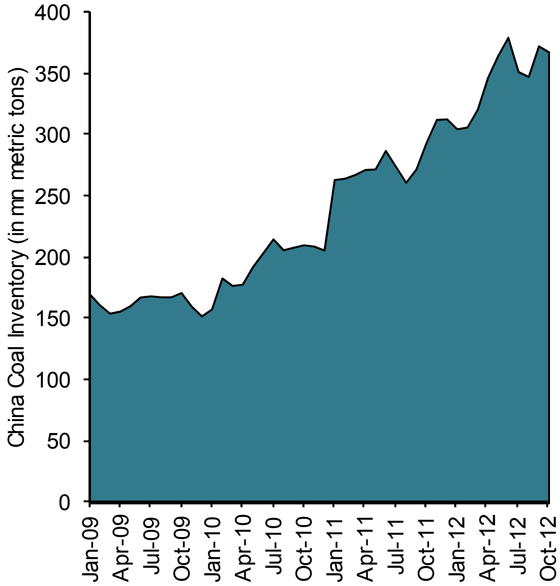
Source: SX Coal and Bernstein estimates and analysis.

Exhibit 116 China Coal Transport Volumes by Rail (2009-April 2013)



Source: SX Coal, State Administration of Coal Mine Safety and Bernstein analysis.

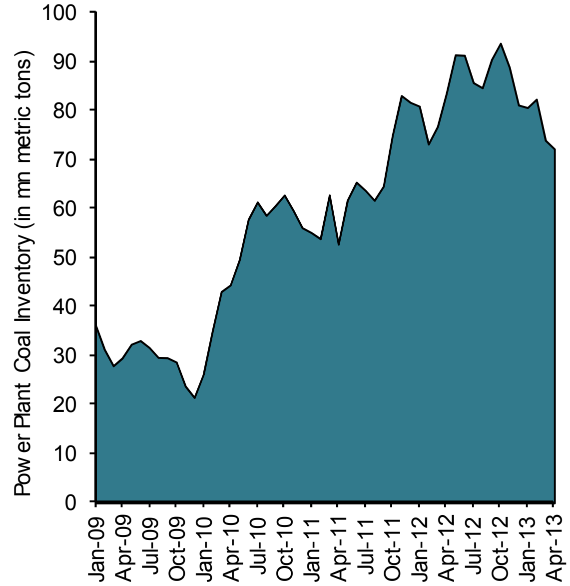
Exhibit 117 China National Coal Inventories (2009-October 2012)



Note: No recent data is available.

Source: SX Coal and Bernstein analysis.

Exhibit 118 China Power Plant Coal Inventories (2009-April 2013)

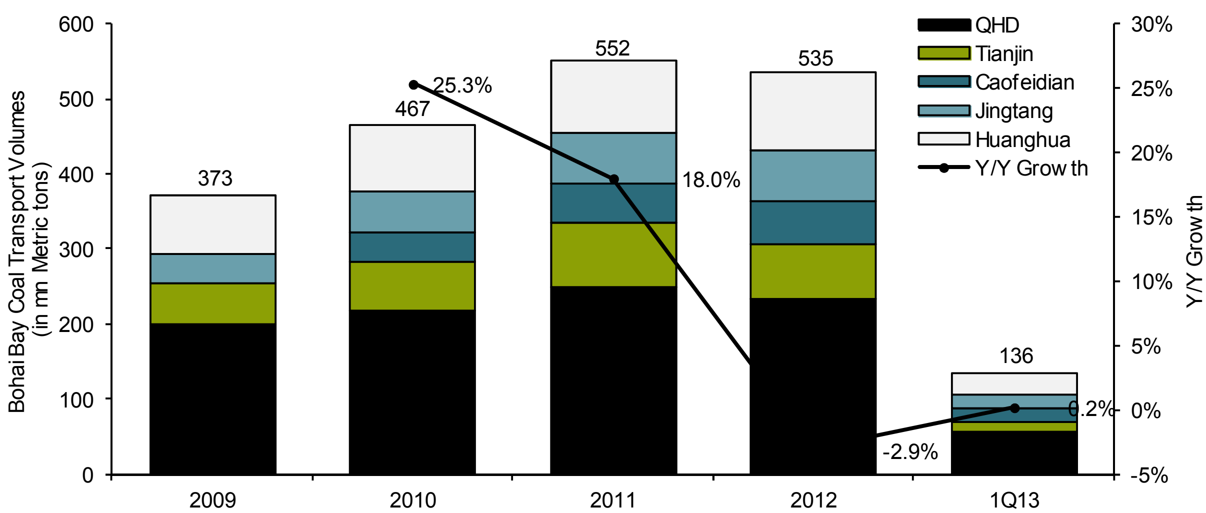


Source: SX Coal and Bernstein analysis.

The shortfall between incremental demand and incremental supply is ~160-180 million tons (see Exhibit 115). Yet reported national inventories increased only 55 million tons between December 2011 and October 2012 (see Exhibit 117).

Bohai Bay coal transport volumes and Chinese coal rail transport volumes were also down in 2012 year-over-year and continued to fall this year (see Exhibit 119). In short, either the inventory data was understated by ~125 million tons (the most likely explanation) or the production data in 2012 was overstated. Either way, we believe that low utilization among marginal mining facilities and/or high coal inventories throughout Chinese coal end markets are the best explanation for the stable pricing year-to-date.

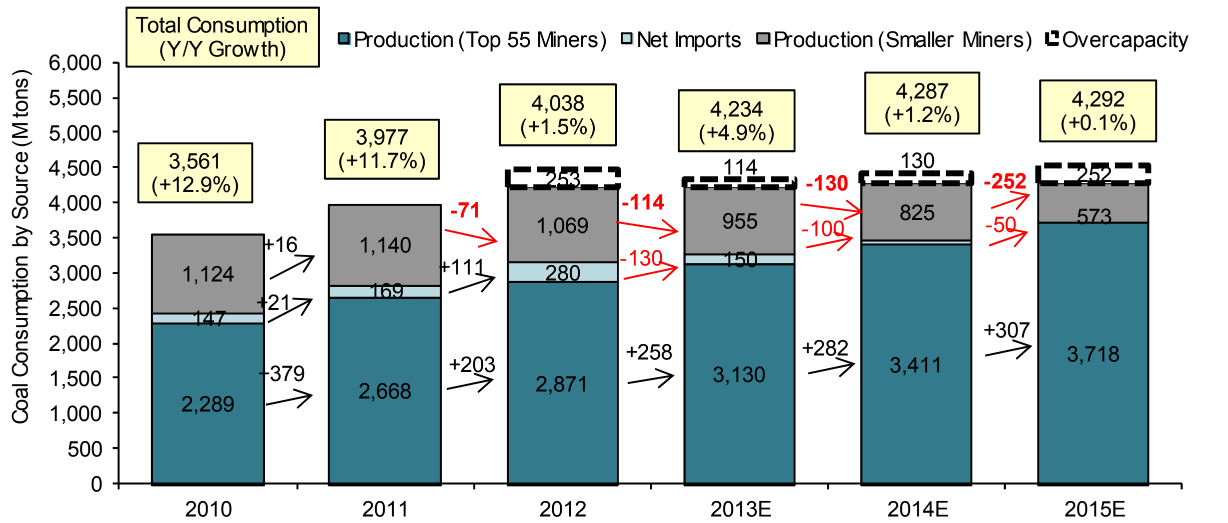
Exhibit 119 Bohai Bay Coal Transport Volumes (2009-Mar 2013)



Source: SX Coal, State Administration of Coal Mine Safety and Bernstein analysis.

And given weak production growth, we expect this stable pricing to continue (see Exhibit 120). In short, the miners (even the large ones) are reluctant to expand production, in our view, because the entire system is full of coal.

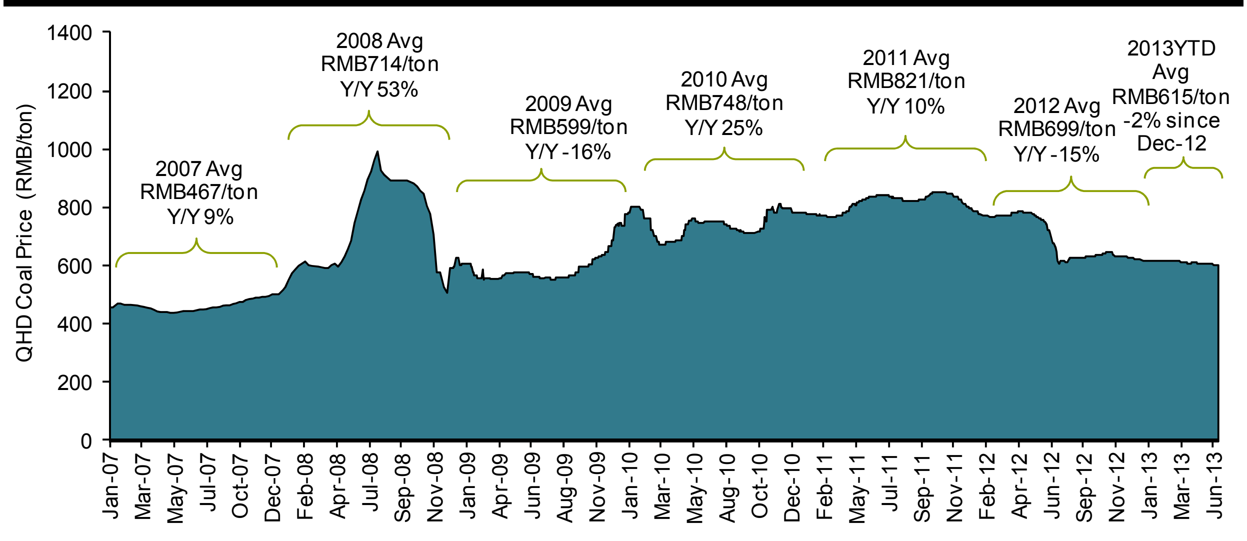
Exhibit 120 **Chinese Coal Supply by Source (2010-15E)**



Source: SX Coal, CEIC, NBS, China General Administration of Customs and Bernstein estimates and analysis.

Coal prices have fallen 2% since the beginning of the year from RMB620/ton to RMB605/ton in June 2013 (see Exhibit 121). Coal prices have fallen ~29% since November 2011 when the price touched RMB855/ton. We are in the longest sustained period of stable pricing since at least 2006, at Qinhuangdao.

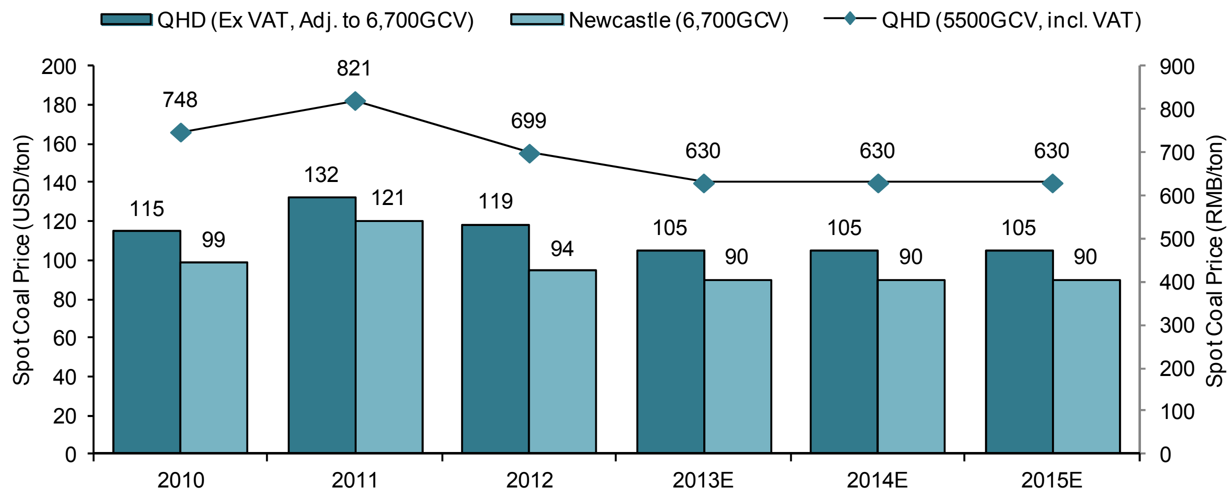
Exhibit 121 **Qinhuangdao 5,500 Kcal Spot Coal Price (2007-June 2013)**



Source: SX Coal and Bernstein estimates and analysis.

Exhibit 122 shows our coal price forecasts from 2013E to 2015E.

Exhibit 122 **Bernstein Coal Price Forecasts: Qinhuangdao and Newcastle**



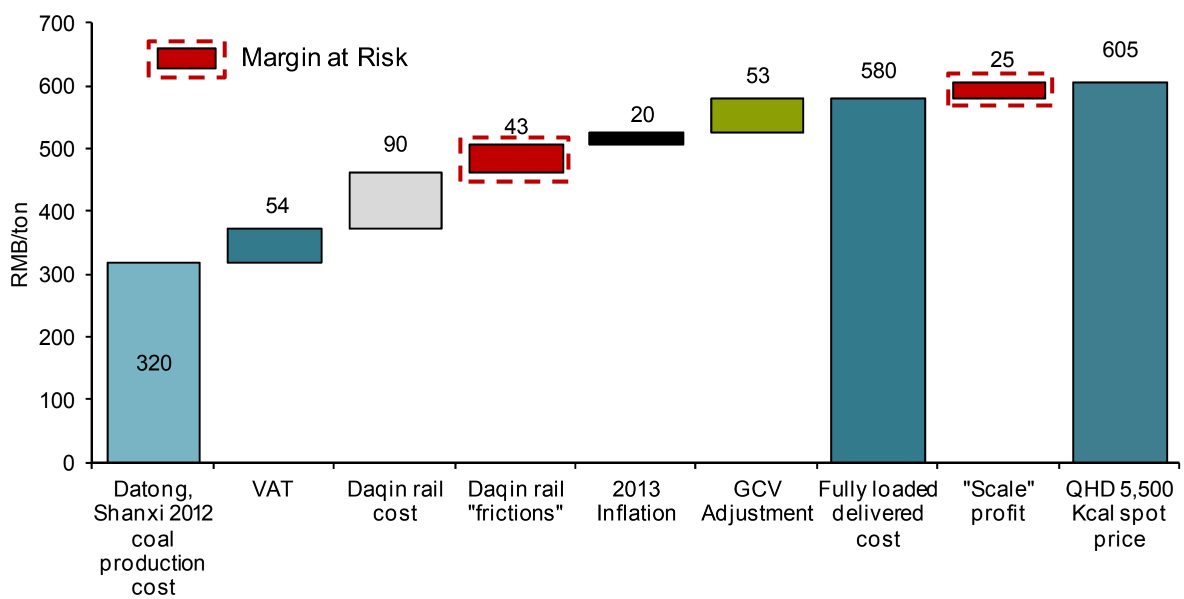
Note: Figures for 2010-15E are yearly average prices.

Source: Bloomberg L.P., SX Coal and Bernstein estimates and analysis.

Impact of Rail Bottlenecks and the Effect of New Rail Line Commissioning

Coal prices have fallen 30% since November 2011. Over that time, there hasn't been a single "golden spike" moment where the commissioning of a new rail line resulted in a sudden decrease in coal prices as supply of coal from a low-cost region flooded into either a demand center or high-cost coal producing region, displacing higher-cost coal. We don't think this is likely to change. The "network effect" within the already complex Chinese rail system means that additions to existing rail capacity and the commissioning of new links simply eases the path of coal to market, creates optionality for moving coal around the country, and results in long-term deflationary pressure on coal price.

Exhibit 123 **Qinhuangdao Coal Price Composition (June 2013)**



Source: Bloomberg L.P., SX Coal and Bernstein estimates and analysis.

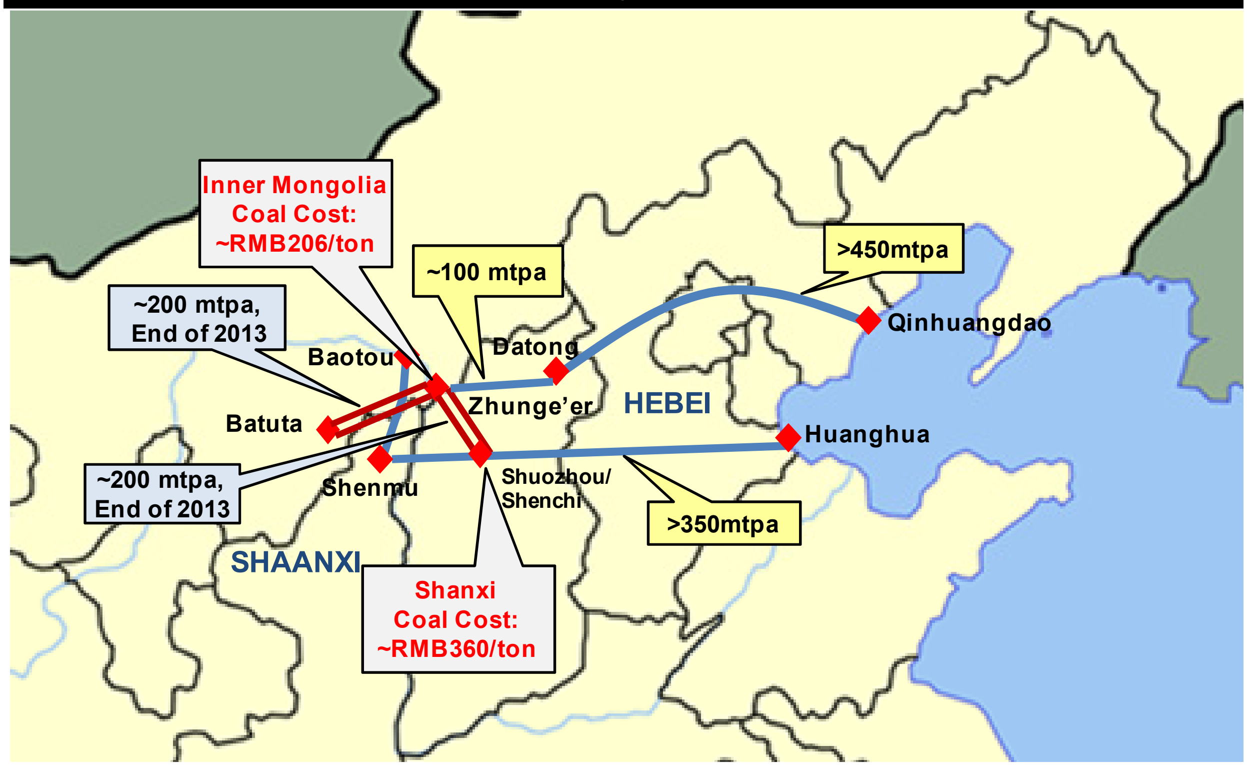
But the frequency of those deflationary shocks should pick up over the next 18 months as new lines are commissioned. Currently, lack of new rail capacity may be contributing to weak production growth among the publicly traded miners.

The earlier-mentioned analysis (where we estimate that the incremental ton of coal has a cost of ~RMB580/ton currently) assumes that the marginal ton of coal today is coming from Datong in Shanxi (see Exhibit 123).

With improving rail capacity into Inner Mongolia, the math changes at the margin if the source of the incremental ton of coal is Inner Mongolia. That sourcing could change as new rail lines are commissioned (see Exhibit 124).

Transporting coal from Zhunge'er in Inner Mongolia to Qinhuangdao currently requires railing that coal to Datong and then on to Qinhuangdao. The capacity of the line from Zhunge'er to Datong is ~100 million tons. The Daqin line has a capacity of 450 million tons per annum (although not all of that coal makes it to Qinhuangdao).

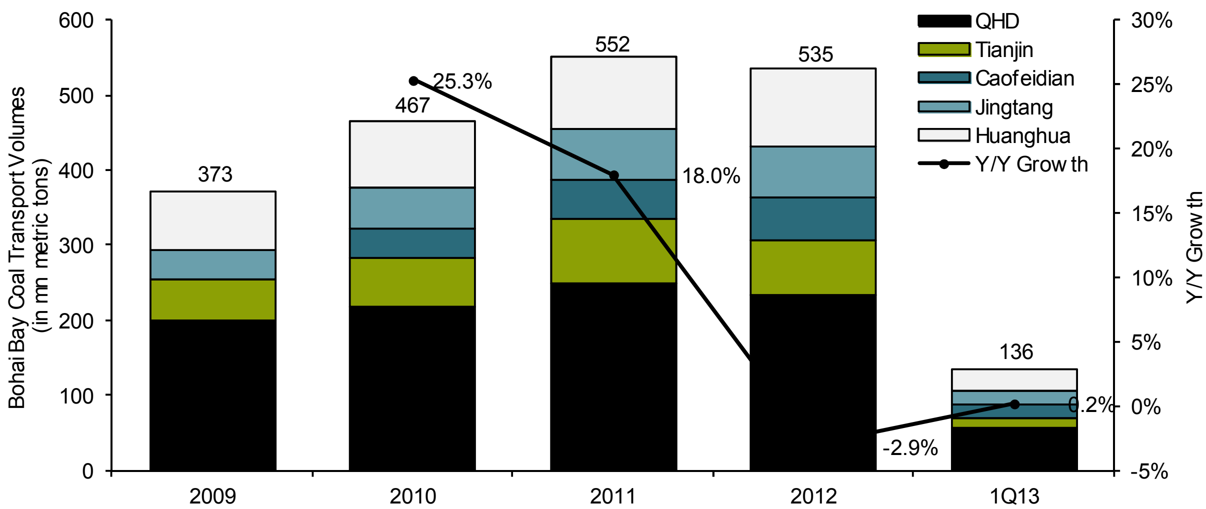
Exhibit 124 Batuta to Zhunge'er Line, Zhunge'er to Shenchi Line, Daqin Railway and Shenmu/Shuozhou/Huanghua Line



Source: Shenhua Group, Chinese Ministry of Railways and Bernstein analysis.

With the commissioning of the new (Shenhua) line between Zhunge'er and Shenchi at the end of 2013, a new pathway to market opens up. The new route takes Inner Mongolian coal south into Shanxi and then east on the Shenmu-to-Huanghua line. The new line has a capacity of 200 million tons per annum and so will represent a significant increase in the amount of coal heading for Bohai Bay (see Exhibit 125).

Exhibit 125 **Bohai Bay Coal Transport Volumes (2009-Mar 2013)**



Source: SX Coal, State Administration of Coal Mine Safety and Bernstein analysis.

China transports ~1.7 billion tons of coal via its railway system each year and about 530 million tons of coal was shipped from the northern Chinese ports to various domestic locations in 2012 (see Exhibit 126). Exports were negligible.

Exhibit 126 **Coal Transport Volumes (Domestic) via Bohai Ports (2011-12)**

Port (in M metric tons)	2011 Domestic	2012 Domestic	Y/Y Growth
QHD	251	234	-6.6%
Tianjin	80	71	-10.7%
Caofeidian	52	55	5.0%
Jingtang	66	68	2.1%
Huanghua	93	100	7.6%
Total	**542**	**527**	**-2.6%**

Source: SX Coal, State Administration of Coal Mine Safety and Bernstein analysis.

Another line that Shenhua is working on is the Batuta to Zhunge'er line (Bazhun line) — see Exhibit 124. The capacity of that line should also reach 200mtpa. Shenhua is expecting to complete this line around the same time as the Zhunchi line. The Bazhun line is designed to connect either to the Shuozhou/Huanghua line (with over 350mtpa of capacity) via the Zhunchi line or to the Daqin line (with over 450mtpa of capacity) via the Datong/Zhunge'er line. Both the Zhunchi and Bazhun lines will be serving Shenhua's mines in Inner Mongolia. Shenhua expects the capacity at Huanghua Port could ramp up to ~200mtpa of capacity by the end of 2013, which should match up with the rail capacity. New rail capacity (and this is by far not the full extent of all new rail capacity coming on this year; see the chapter, "Coal Train's Slow Blues: Why Weak Rail Capacity Additions in 2012 Won't Re-Bottleneck Chinese Coal") may be another gating factor behind weak production growth from the large Chinese coal miners.

But perhaps the most important aspect of the new rail lines is that it will bring low-cost Inner Mongolian coal south into Shanxi, potentially displacing high-cost Shanxi coal. Inner Mongolian coal production cost — based on the 21 publicly traded miners with Inner Mongolia — has a weighted average unit cost of ~RMB206/ton (see Exhibit 127).

Exhibit 127 **Production Cost of the Publicly Traded Chinese Miners With Assets in Inner Mongolia (2012)**

Company	Production (M metric tons)	Unit Production Cost (RMB/ton)
China Shenhua	306.8	210.8
Huolinhe Opencut Coal Industry Corp. (China Power)	45.0	101.3
Inner Mongolia Yitai Coal Company Limited	49.8	271.7
Inner Mongolia PingZhuang Energy Limited (China Guodian)	9.9	201.4
Sundiro Holding (Wujiu Coal Group)	2.5	172.5
Inner Mongolia Tehong Coal Group Co.	0.9	226.7
Total	**414.8**	**205.8**

Source: Corporate reports and Bernstein estimates and analysis.

This compares to a Shanxi coal cost that averaged RMB360/ton in 2012 (see Exhibit 128). Thus, we believe the higher cost Shanxi coal could potentially be displaced.

Exhibit 128 **Production Cost of the Publicly Traded Chinese Miners With Assets in Shanxi (2012)**

Company	Production (M metric tons)	Unit Production Cost (RMB/ton)
China Coal Energy	111.1	332.8
Shanxi Guoyang New Energy Co	56.5	420.0
Shanxi Lu'an Environmental Energy Development	28.7	383.3
Datong Coal Industry	38.2	319.0
Shanxi Xishan Coal and Electricity Power Co	25.4	402.7
Shanxi Lanhua Sci-Tech Venture	5.8	259.8
Total	**265.8**	**359.9**

Source: Corporate reports and Bernstein estimates and analysis.

Of course, there are other differences in the coal (primarily heat content) that make the Shanxi coal more valuable than the Inner Mongolian coal. Further, these new lines are likely to ramp up over time rather than all at once. In addition, there is a cost associated with transporting coal on the Zhunge'er to Shuozhou line. All of this means that the commissioning of these lines is unlikely to result in a steep, sudden drop in coal prices at the start of 2013. However, it does reflect the fact that coal price deflation from improving transportation is likely to counter coal production cost inflation in coming years.

The winners from this are the consumers of coal, just about anywhere. The losers are the Chinese coal miners, which are unable to pass on cost increases in an oversupplied market.

In short, prospects for the coal miners look miserable both in the short term and the long term.

Appendix

This section briefly describes the listed Chinese coal producers outside of our coverage that we have used in the previous analysis.

- Huolinhe Opencut Coal Industry Corp (SZSE: 002128): The company is located in Inner Mongolia and operates one of the largest open-pit mines in China. However, the coal the company produces is lignite that has low calorific value, which is very costly if transported over long distances. Most of the company's revenue therefore comes from Inner Mongolia, Jilin and Liaoning. The company is 70% owned by China Power Investment Corporation. It produced 45 million tons of coal in 2012.
- Shanxi Guoyang New Energy Co (SHSE: 600348): Founded in 2003, the company has mine resources around Shanxi's Yangquan city, which is close to the Shitai Railroad that transports coal to Shijiazhuang in Hebei. The company is 58.34% owned by Yangquan Coal Industry Group. It produced 56.5 million tons of coal in 2012.
- Pingdingshan Tianan Coal Mining (SHSE: 601666): The company was founded in 1997 after a merger between several coal companies in Henan. It is 57% owned

by Zhong Ping Energy, which in turn is 65% owned by the provincial SASAC. The company produced 38.4 million tons of coal in 2012.

- Inner Mongolia Yitai Coal Company Limited (SHSE: 900948): The company was established in 1997, and is now one of the largest coal enterprises in Inner Mongolia. It is 54.64% owned by Inner Mongolia Yitai Group. The company also owns railroads and highways in Inner Mongolia. The company received approval from the CSRC in June 2010 to list its shares in the Hong Kong Stock Exchange. The company produced 49.8 million tons of coal in 2012.
- Shanxi Lu'an Environmental Energy Development (SHSE: 601699): Established in 2001, the company's coal resources are located in southeastern Shanxi. The company was co-founded by five companies, including Lu'an Group, Zhengzhou Ministry of Railways and the Rizhao Port Company Ltd. Lu'an Group still owns 64% of the company. The company's largest customers are located in Shanxi, Shandong, Henan and Hubei. Shanxi Lu'an produced 28.7 million tons of coal in 2012.
- Jizhong Energy Resources Co., Ltd (SHSE: 000937): The company was founded in 1999 in Hebei and has coal resources in Hebei and Shanxi. As a part of a restructuring, the company was merged with Fengfeng Group, Handan Coal Group and Zhangkang Group in 2008. The company is 39% owned by Jizhong Energy Group, and produced 36.4 million tons of coal in 2012.
- Datong Coal Industry (SHSE: 601001): The company was incorporated in 2001 in Datong, Shanxi, which is close to some of the main coal-dedicated railroads in China, including the Daqin Line. The company's largest customer is Beijing Datang Fuel Company, which accounts for 57% of its revenue. The company is 60% owned by Datong Coal Mining Group, and produced 38.2 million tons of coal in 2012.
- Shanxi Xishan Coal and Electricity Power Co (SHSE: 000983). The company is based in Taiyuan, Shanxi, and was formerly part of the Shanxi Coal Administration, which was established in 1956. Shanxi Xishan's coal mines are located in Shanxi and Inner Mongolia, and the company's products are sold across 20 provinces. The company is 54% owned by Shanxi Coking Coal Group, and produced 25.4 million tons of coal in 2012.
- Anhui Hengyuan Coal Industry (SHSE: 600971): The company was founded in 2000 and was listed on the A-share market in 2004. The company's coal resources are located in the eastern provinces of China, and are accessible by the major railroads. The company's main customers are located in Anhui, Shandong and Zhejiang. The company is 60% owned by Anhui Wanbei Coal and Power Group. The company produced 12.2 million tons of coal in 2012.
- SDIC Xinji Energy (SHSE: 601918): The company first began its coal mine development in 1989 in Anhui, and was listed on the A-share market in 2007. It is also engaged in other businesses, such as property development and food and beverage; however, coal mining still accounts for 99% of its revenue. The company is 42% owned by the State Development and Investment Corporation (SDIC), and produced 16.4 million tons of coal in 2012.
- Inner Mongolia PingZhuang Energy Limited (SHSE: 000780): The company was established in 1993 in Chifeng, Inner Mongolia, and is 61% owned by Inner Mongolia PingZhuang Coal Industry, which is in turn 51% owned by a China Guodian subsidiary. The company was listed in mainland China in 1997, and in 2008, China Guodian acquired a controlling stake in the company. Although the company's coal production is based in Inner Mongolia, only 24% of the company's revenue is generated in the province, with the rest generated elsewhere in China. The company produced 9.9 million tons of coal in 2012.
- Guizhou Panjiang Refined Coal (SHSE: 600395): The company was founded in 1999 in Liupanshui in Guizhou and is 41% owned by Panjiang Coal and Power Group. It produced 13.5 million tons of coal in 2012.
- Shanxi Lanhua Sci-Tech Venture (SHSE: 600123): The company was established in 1998 and is currently 45% owned by Shanxi Lanhua Coal Industry Group. It is

located close to Jincheng, Shanxi, and is also engaged in fertilizer production. The company produced 5.8 million tons of coal in 2012.

- Zhengzhou Coal Industry and Electric Power (SHSE: 600121): The company was established in 1997 and engages in both coal production and electricity generation businesses. The company is 53% owned by Zhengzhou Coal Industry Group. It produced 11.1 million tons of coal in 2012.
- Shanghai Ace Company (SHSE: 600652): The company was incorporated in 1996 and has coal mines in Shandong, Inner Mongolia and Shanxi. The company produced 3.1 million tons of coal in 2012.
- Gansu Jingyuan Coal Industry and Electricity Power Co. (SZSE: 000552): The company was founded in 1993 in Gansu and is currently 47% owned by Gansu Jingyuan Coal Industry Group. The company produced 10.6 million tons of coal in 2012.
- Sundiro Holding (Wujiu Coal Group) (SZSE: 000571): The company was founded in 2001 and engages in two very different businesses: coal mining and motorcycle manufacturing, although 70% of the company's revenue is still from the coal mining segment, which operates under its subsidiary, Wujiu Coal Group. The company's coal mines are located in Inner Mongolia, and they produced 2.5 million tons of coal in 2012.
- Inner Mongolia Tehong Coal Group Co. (OTCBB: CHGY): The company's coal mine is located in the Dongsheng district of Ordos. The company produced 0.9 million tons of coal in 2012.

Dark and Full of Terrors: Valuing Miners in Terminal Decline

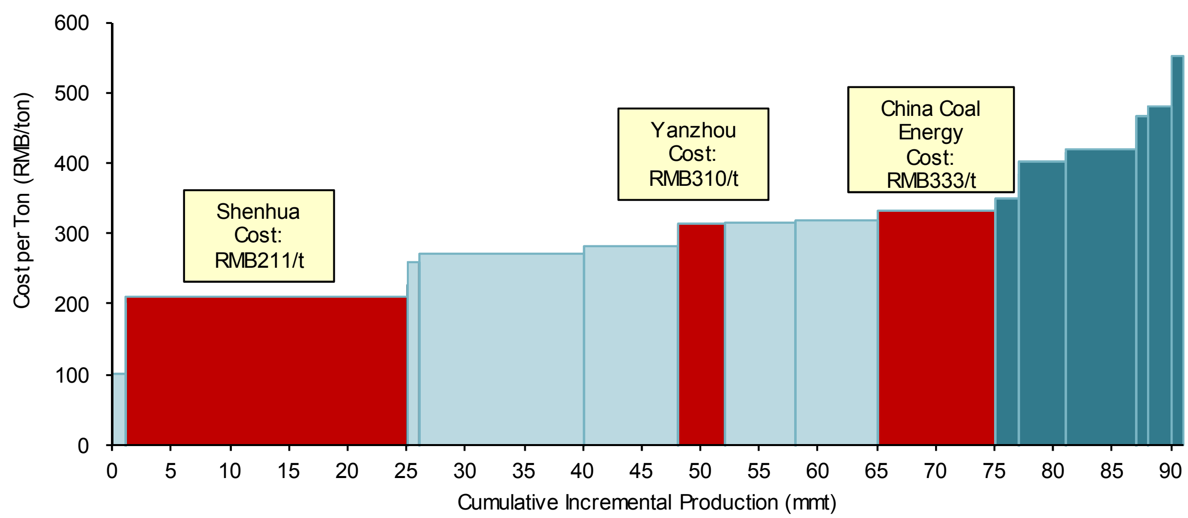
No Cash, No Replacement Value, No Reserve Value, But Aside from That…

The Chinese coal miners have fallen in value by at least 25% since the start of 2013 and have all underperformed the MSCI Asia-ex Japan by ~32%. We have argued for the last 18 months that — given the structural shift in the industry — historical P/B and P/E multiples are meaningless for valuing these stocks. Now that Shenhua, even on our numbers, is pushing the lower end of these historical trading ranges, we are expanding our approach to valuation and look at EV/EBITDA, DCF, free cash flow, dividend yield and comparisons to global peers. All three stocks under our coverage still look expensive to us. We reiterate our underperform rating.

The structure of the industry has changed. Today, there is more coal production capacity than demand; transport bottlenecks are being resolved; the government is putting policies in place not just to reduce coal imports but to reduce coal consumption overall. And coal prices have come down 30% since November 2011. We view this change as permanent. Putting a *zero-growth-Chinese-energy-SOE* earnings multiple (~8x) on our forward earnings estimates continues to provide plenty of downside.

For Yanzhou and China Coal Energy, it is possible to argue that the stocks are worth zero. The companies are not producing any free cash flow currently. If the companies do not reduce capital spending in coming years, production costs continue to rise and coal prices remain flat, they will slowly spend themselves into insolvency. We assume that eventually capital spending will moderate to maintenance capital levels. However, we expect that as the industry continues to consolidate, the cost curve will become flatter and flatter. Coal will eventually be priced at short-run variable cost plus maintenance capital spending for scaled miners like Yanzhou and China Coal Energy (see Exhibit 129). The value of these businesses, once they reach this juncture, is close to zero.

Exhibit 129 Cost Curve of Incremental Coal Production from 21 Publicly Traded Miners (2012)

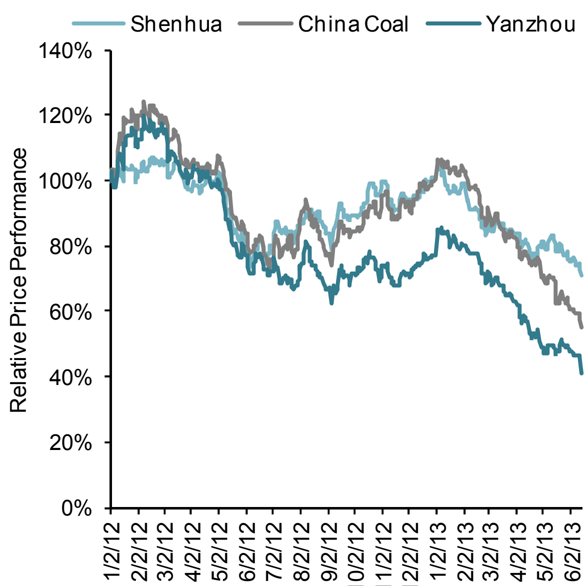


Source: Corporate reports and Bernstein estimates and analysis.

The outlook for Shenhua is more positive than for China Coal Energy and Yanzhou…which isn't saying much. We still believe that — based on cash-based valuation metrics — Shenhua looks expensive too but we estimate that it will remain cash flow positive through 2018 at least. Assuming that the company maintains its current dividend payout ratio of ~40% and that investors will demand a 5% dividend yield given the absence of growth, we believe that the stock is worth ~$20.

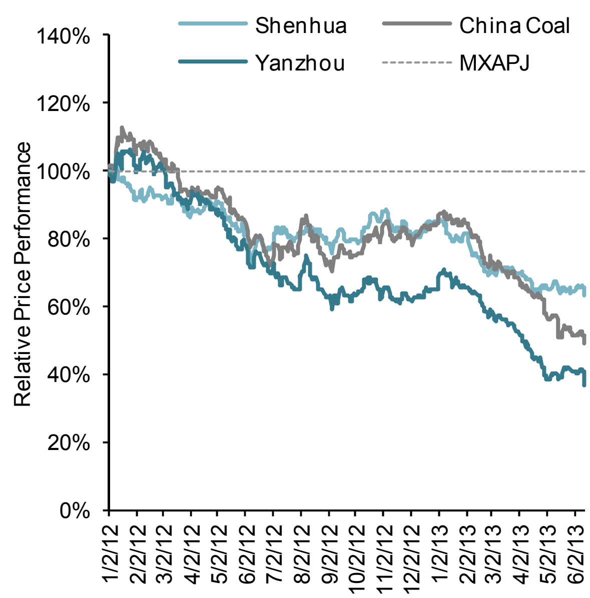
For a group exposed to the kind of pricing pressure that China Coal Energy and Yanzhou face, earnings and return profiles in coming years are miserable (see Exhibit 130 and Exhibit 131). With a return on equity significantly below the cost of equity, there is no reason to believe that 1x book is a floor, especially if you take the view that the industry is in overcapacity currently and will eventually start to contract. In that case, there is no replacement value for high-cost miners for the simple reason that no one would invest to build excess out-of-the-money capacity…except perhaps Chinese SOEs.

Exhibit 130 Chinese Coal Miners — Stock Performance Since January 2012 (Absolute)



Source: Bloomberg L.P. and Bernstein analysis.

Exhibit 131 Chinese Coal Miners — Stock Performance Since January 2012 (Relative to MSCI Asia-ex Japan)



Source: Bloomberg L.P. and Bernstein analysis.

That gives rise to the question of whether the selloff is now done. The main pushback that we hear currently to our sell recommendations is that the forward earnings multiple is well below historical trading ranges, and China Coal Energy and Yanzhou are trading at well under 1x on a price/book basis. But in our view, consensus earnings estimates still reflect inflated coal prices and sales volumes. Historical multiples were set at a time when demand and price were going up. Given the industry has gone through a structural change in the last 18 months, we believe that historical multiples no longer make sense.

But if the old trading ranges are no longer relevant, P/E and P/B are tremendously imprecise valuation tools. The historical ranges were set during a period that does not resemble the current coal market at all. It is easy to argue that the stocks should trade below their historical ranges while they are above those ranges. Now that Shenhua is pushing the bottom of those ranges, more precision in valuation is required.

In this chapter, we cast the net a little wider in terms of valuation. And that is where the trouble really starts…because on cash valuation metrics, the stocks look even worse than on P/E.

The End Game for the Chinese Coal Miners

In the end of May 2013, Beijing's municipal environmental agency announced that the city will reduce coal consumption from 23 million tons annually currently to 15 million tons in 2015 and 10 million tons in 2020. Four new gas-fired heating and power stations will be commissioned in 2014 to supply the energy lost with declining coal use.

All industrial societies reach a point where they determine that the long-term economic cost (in terms of health outcomes and the environment) of burning coal in inefficient facilities in large cities outweighs the short-term economic benefits. China has reached that moment. Following Beijing's lead, coal consumption in large east coast cities is going to decline in coming years due to falling energy demand growth, substitution from gas and renewables, and the transition of economic activity to the interior of the country. In short, the long term doesn't look very good for the coal industry.

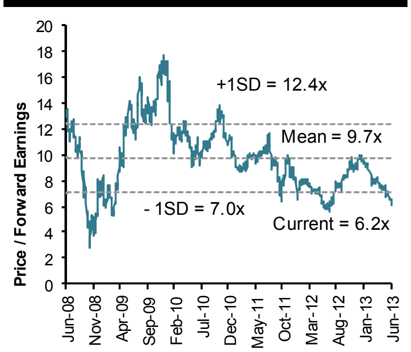
We agree that P/E and P/B are imprecise tools to try to value these businesses when the industry is in this kind of flux. In this chapter, we look for other valuation tools.

Valuing the Stocks Hong Kong-Style: P/E and P/B

On a P/FE or P/B basis, the Chinese coal miners are now trading below historical average multiples, based on consensus.

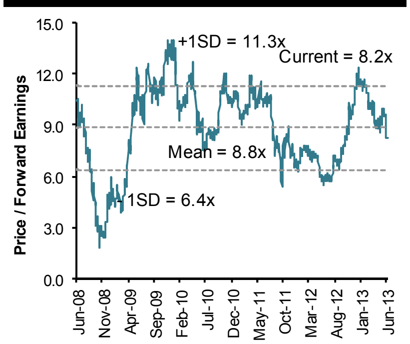
Shenhua, over the last five years, has traded on average at 11.6x forward consensus EPS and 2.75x on a P/B basis. Currently, it is trading at 7.4x and 1.43x, respectively. Yanzhou and China Coal Energy are currently trading at 8.2x and 6.2x, respectively, below their historical P/FE averages and 0.57x and 0.56x, respectively, below their historical P/B averages (see Exhibit 132 through Exhibit 134).

Exhibit 132 China Coal Energy — P/FE Multiple



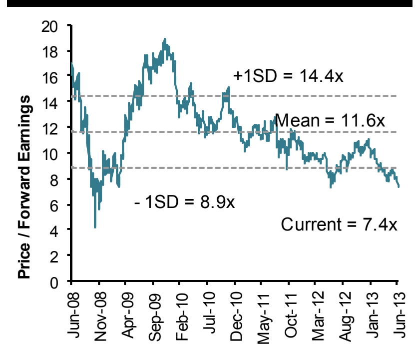
Source: Bloomberg L.P. and Bernstein analysis.

Exhibit 133 Yanzhou — P/FE Multiple



Source: Bloomberg L.P. and Bernstein analysis.

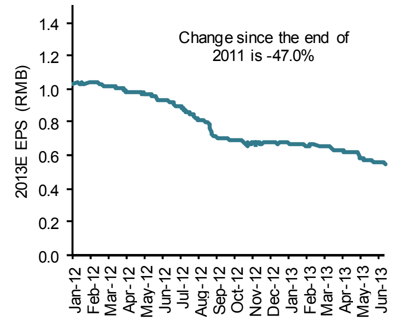
Exhibit 134 Shenhua — P/FE Multiple



Source: Bloomberg L.P. and Bernstein analysis.

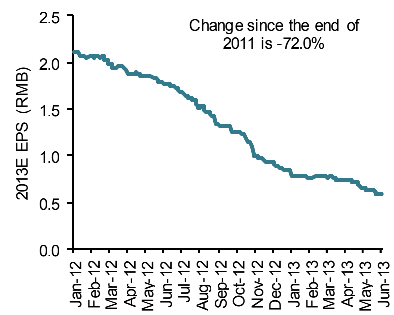
Consensus earnings estimates have all trended down since the end of 2011. Shenhua's 2013 consensus EPS estimate at the end of 2011 was RMB2.90. Today, consensus 2013 EPS estimate is RMB2.35 (representing an 18.9% decline). For Yanzhou and China Coal Energy, the decline in consensus earnings estimates for 2013 since the end of 2011 has been 72.3% and 47.0%, respectively (see Exhibit 135 through Exhibit 137).

Exhibit 135 China Coal Energy — Consensus 2013E EPS



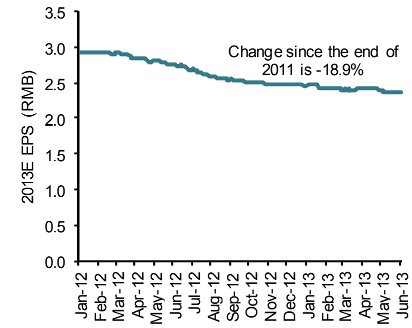
Source: Bloomberg L.P. and Bernstein analysis.

Exhibit 136 Yanzhou — Consensus 2013E EPS



Source: Bloomberg L.P. and Bernstein analysis.

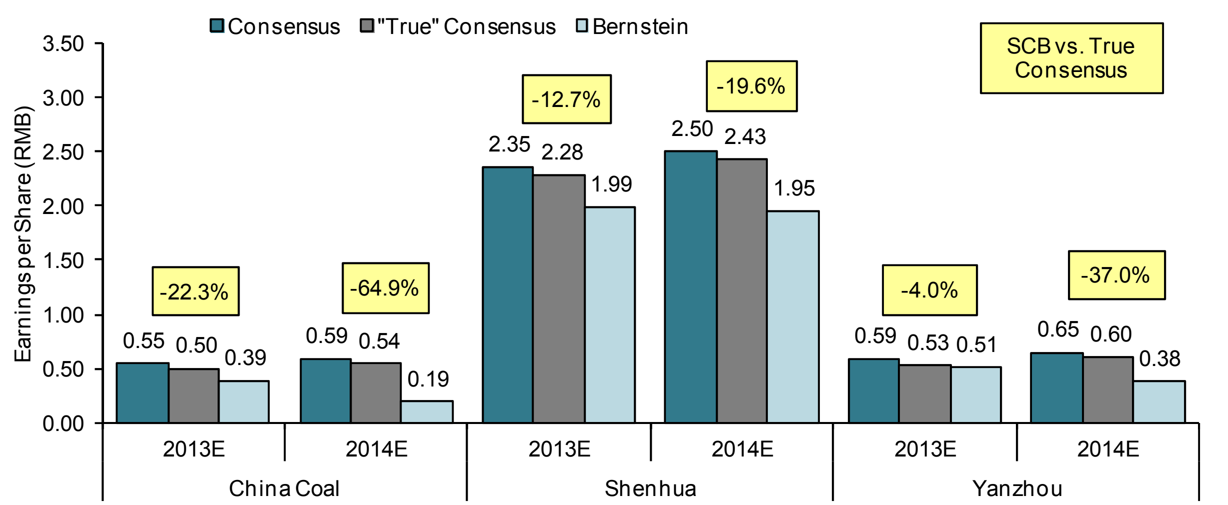
Exhibit 137 Shenhua — Consensus 2013E EPS



Source: Bloomberg L.P. and Bernstein analysis.

All that said, we believe that consensus estimates remain too high (see Exhibit 138).

Exhibit 138 Chinese Coal Miners Consensus and SCB EPS (2013 and 2014)



Note: "True" consensus contains the 12 most recent estimates posted on Bloomberg L.P.

Source: Bloomberg L.P., corporate reports and Bernstein estimates and analysis.

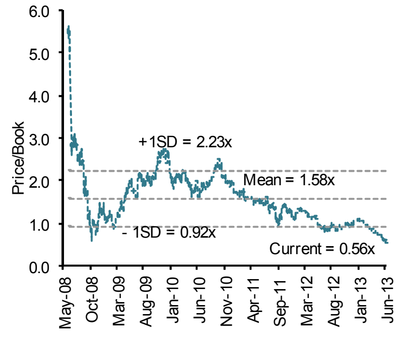
We extract "stale" consensus estimates in Exhibit 138 to get to a truer sense of consensus thinking from the 12 most recently published analyst estimates. The earnings revision trend and the "true" consensus trend tell the same story — earnings expectations are declining.

We believe that the stocks are now trading at multiples (on our earnings estimates) near or above historical averages. Shenhua is trading at 9.4x 2014 our earnings estimates (historical average is 11.6x). Yanzhou and China Coal Energy are trading at 13.9x and 19.5x, respectively (historically, they have traded at ~9x and ~10x, respectively).

We believe that slow growing Chinese SOEs in the energy sector, with no pricing power, should trade at roughly 8x. Accordingly, there is plenty of downside on our numbers for all three stocks. In our view, Yanzhou and China Coal Energy have not even started to de-rate.

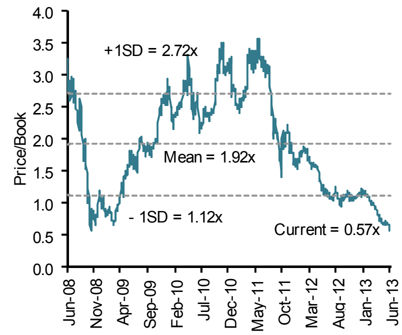
The defense about these stocks that we hear from investors is that our price targets cannot be right as they imply P/B multiples less than 1x…a level these stocks have rarely seen (see Exhibit 139 through Exhibit 141). All three stocks are trading below their historical average P/B multiples.

Exhibit 139 China Coal Energy — P/B multiple



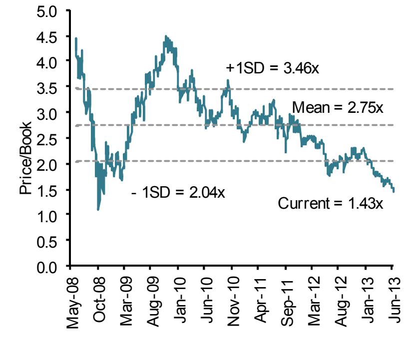
Source: Bloomberg L.P. and Bernstein analysis.

Exhibit 140 Yanzhou — P/B multiple



Source: Bloomberg L.P. and Bernstein analysis.

Exhibit 141 Shenhua — P/B multiple



Source: Bloomberg L.P. and Bernstein analysis.

However, for a group facing the kind of pricing pressure that China Coal Energy faces, earnings and return profiles in coming years are miserable. With a return on equity significantly below the cost of equity, there is no reason to believe that 1x book is a floor, especially if you take the view that the industry is in overcapacity currently and will eventually start to contract. In that case, there is no replacement value for high-cost miners for the simple reason that no one would invest to build excess out-of-the-money capacity…except perhaps Chinese SOEs.

Looking for Cash...DCF, Free Cash Flow Yield, Dividend Yield, EV/EBITDA

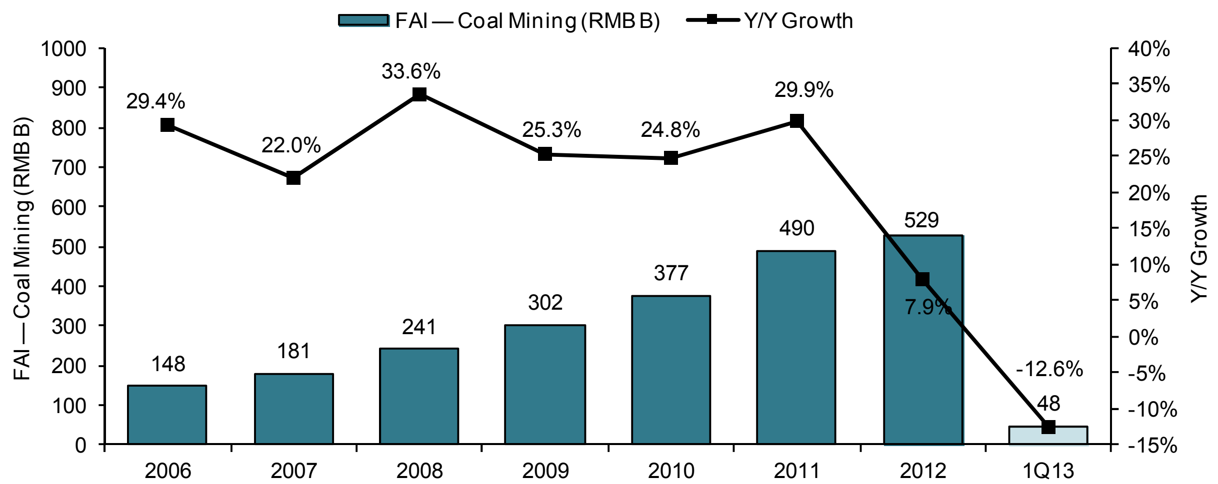
All of the Chinese SOEs that we cover follow the simple maxim that there is no such thing as free cash flow in China.

For the utilities, there is always the hope that — given slowing power consumption growth — capital spending will moderate eventually and the companies will turn into "real" utilities. Power consumption growth will continue to go up and the utilities may eventually be run for cash. In theory, you can build a DCF with positive free cash flow in the terminal year and a positive terminal growth rate beyond.

That is unlikely to be true for most of China's coal miners. Demand ultimately will fall. The terminal growth rate in any DCF is therefore a debate between 2%, zero and something worse. Terminal-year free cash flow is (for most coal miners) negative. And so is current-year free cash flow. China will still consume lots of coal in 2020, 2030 and 2040…but consumption in absolute terms will fall. The industry will slowly move down the cost curve, with the least-efficient mines slowly shutting down. Pricing pressure will be contained by this deflationary effect.

We expect capital spending for both the industry and the three companies that we cover to moderate. This has already started at the national level, although fixed asset investment in coal mining in China is likely to match 2010 levels this year, in the RMB300-400 billion range (see Exhibit 142). Investment in the coal mining fixed assets in 2011 was up 29.9% year-over-year, compared to a 7.9% increase in 2012. In the first quarter of 2013, it declined 12.6% year-over-year.

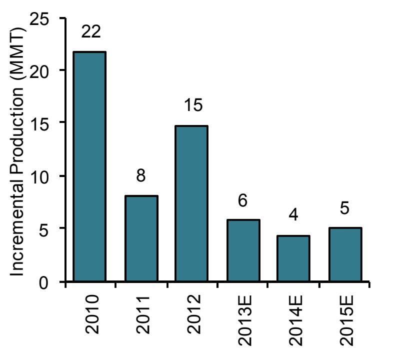
Exhibit 142 Chinese Coal Mining Fixed Asset Investment (2006-1Q:13)



Source: CEIC, NBS and Bernstein analysis.

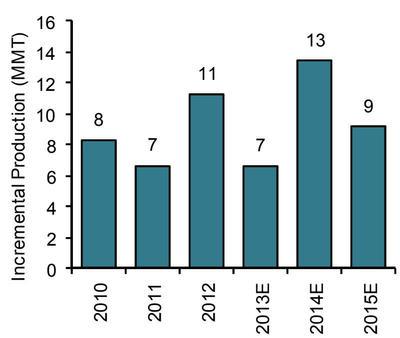
Incremental production from the miners should slow as a function of the slowing of the market (see Exhibit 143 through Exhibit 145).

Exhibit 143 China Coal Energy — Incremental Production



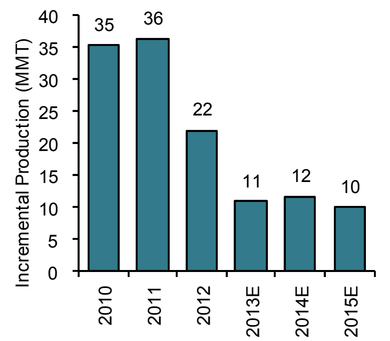
Source: Corporate reports and Bernstein estimates and analysis.

Exhibit 144 Yanzhou — Incremental Production



Source: Corporate reports and Bernstein estimates and analysis.

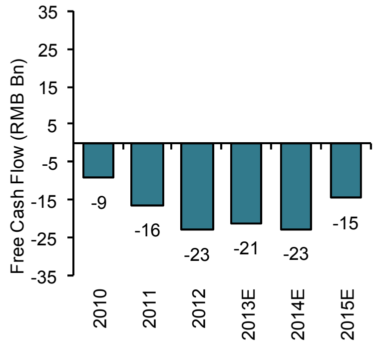
Exhibit 145 Shenhua — Incremental Production



Source: Corporate reports and Bernstein estimates and analysis.

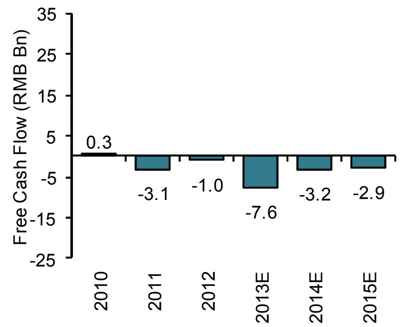
For Yanzhou and China Coal Energy, it is possible to argue that the stocks are worth zero. The companies are not producing any free cash flow currently (see the DCFs in Exhibit 164 through Exhibit 166). If the companies do not reduce capital spending in coming years, production costs continue to rise and coal prices remain flat (our view on all three counts), they will spend themselves into insolvency. We assume that eventually capital spending will moderate to maintenance capital levels (see Exhibit 146 through Exhibit 148).

Exhibit 146 China Coal Energy — Free Cash Flow (RMB Bn)



Source: Corporate reports and Bernstein estimates and analysis.

Exhibit 147 Yanzhou — Free Cash Flow (RMB Bn)



Source: Corporate reports and Bernstein estimates and analysis.

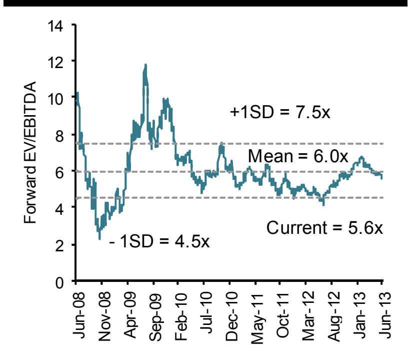
Exhibit 148 Shenhua — Free Cash Flow (RMB Bn)

Source: Corporate reports and Bernstein estimates and analysis.

However, as we expect that the industry continues to consolidate, the cost curve will become flatter and flatter. Coal will eventually be priced at short-run variable cost plus maintenance capital spending. The value in these businesses is accordingly close to zero. On a DCF basis, the outlook for Shenhua is more positive than for China Coal Energy and Yanzhou. In our modeling, we believe that Shenhua will remain a cash flow positive company through 2018 at least. Assuming that the company maintains its current dividend payout ratio, we believe the stock is worth ~$20, assuming a 5% dividend yield.

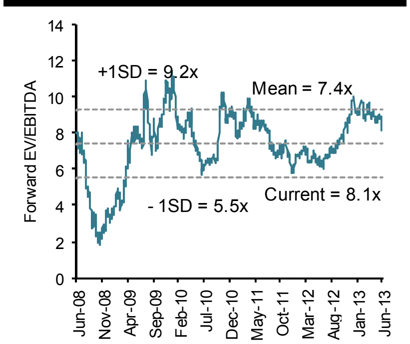
Yanzhou has the highest EV/EBITDA of 8.1x. Shenhua has the lowest EV/EBITDA of 4.8x (see Exhibit 149 through Exhibit 151). We tend not to focus on these companies on an EV/EBITDA basis given that they have positive earnings and limited debt levels currently, although both characteristics are subject to pressure going forward.

Exhibit 149 China Coal Energy — EV/EBITDA Multiple



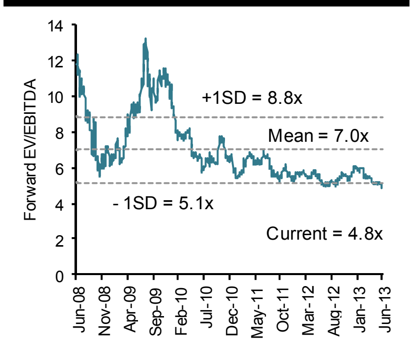
Source: Bloomberg L.P. and Bernstein analysis.

Exhibit 150 Yanzhou — EV/EBITDA Multiple



Source: Bloomberg L.P. and Bernstein analysis.

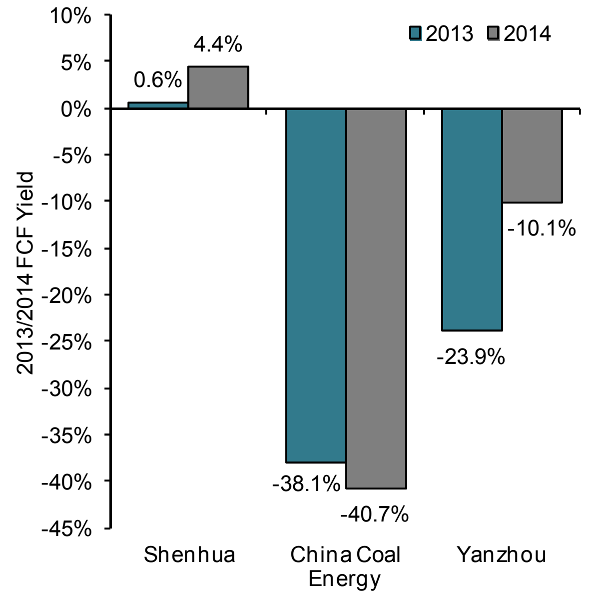
Exhibit 151 Shenhua — EV/EBITDA Multiple



Source: Bloomberg L.P. and Bernstein analysis.

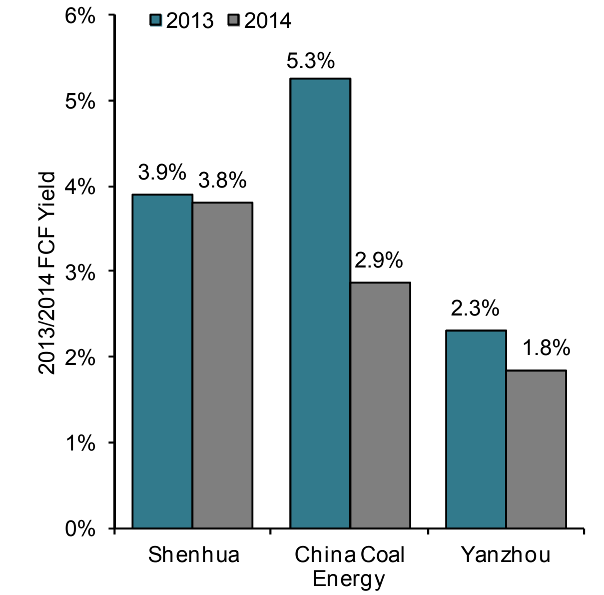
On a free cash flow basis (see Exhibit 152), all three companies are paying dividends but China Coal Energy and Yanzhou will — if they maintain dividends at current payout ratios — be funding those dividends out of debt. Shenhua has a ~40% dividend payout ratio (see Exhibit 153).

Exhibit 152 2013-14E Free Cash Flow Yield



Source: Bloomberg L.P., corporate reports and Bernstein estimates and analysis.

Exhibit 153 2013-14E Dividend Yield

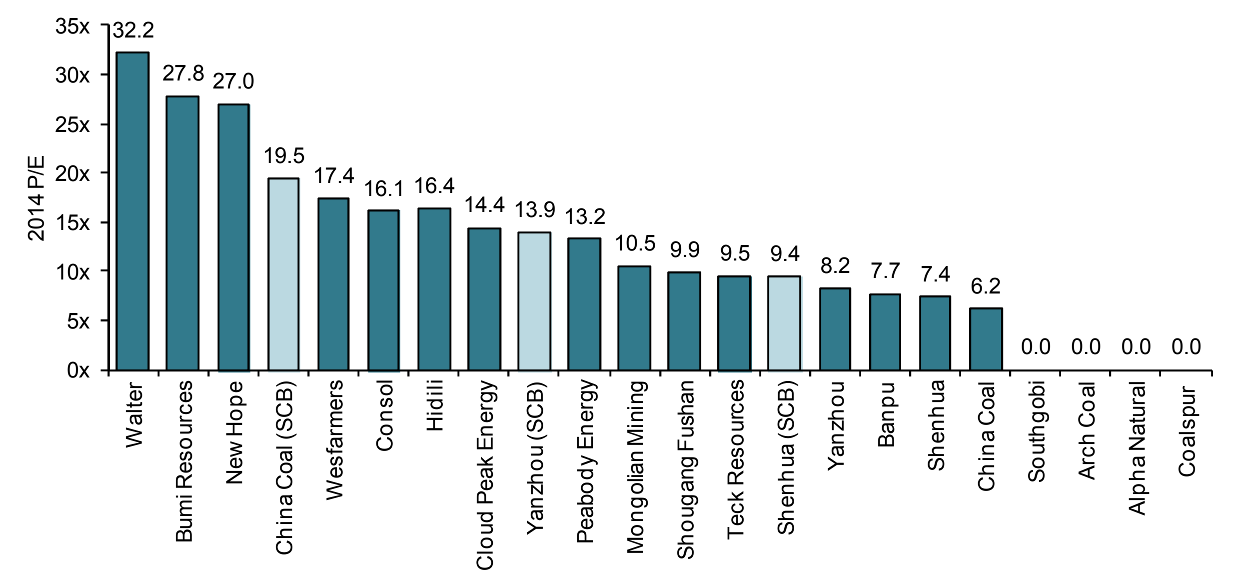


Source: Bloomberg L.P., corporate reports and Bernstein estimates and analysis.

Global Comparisons

On a P/E basis, the three stocks are in the middle of the pack compared to global peers, using our earnings estimates (see Exhibit 154). We are below true consensus on 2013 and 2014 earnings per share estimates for all three coal miners — ~22% below for China Coal, ~13% below for Shenhua and ~4% below for Yanzhou on 2013 earnings (see Exhibit 138). Our P/E multiples are therefore higher than consensus.

Exhibit 154 Global Coal Miners' 2014 P/E Multiples on Consensus and SCB Estimates

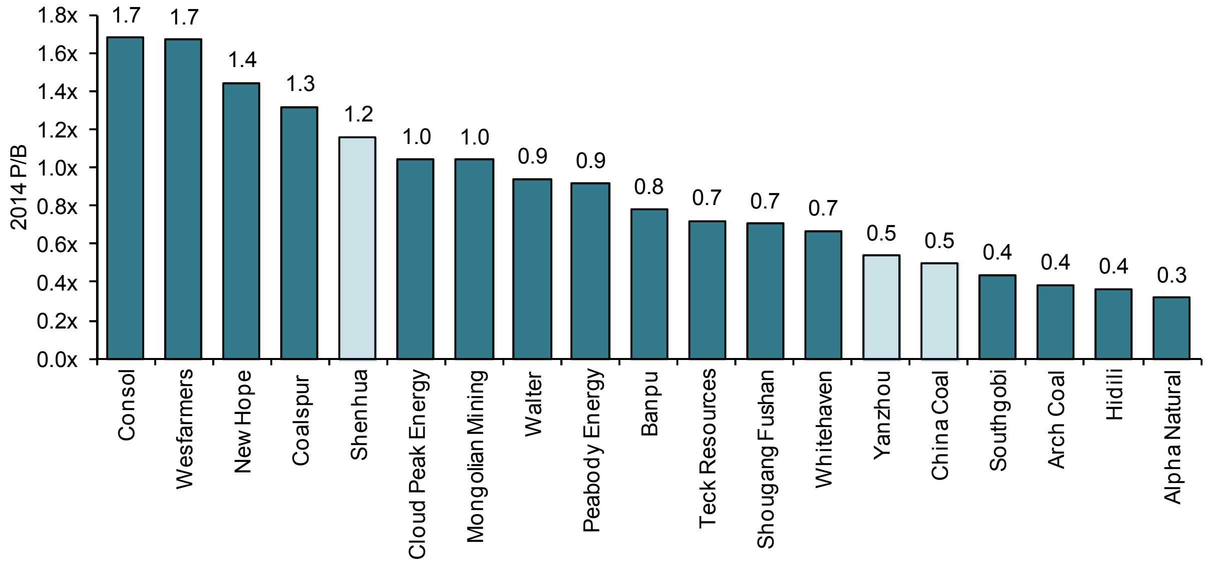


Note: Whitehaven is removed as its 2014 P/E is not meaningful.

Source: Bloomberg L.P., corporate reports and Bernstein estimates and analysis.

Similarly, on a price-to-book basis, at current valuations, the Chinese coal miners do not stand out as being over or undervalued versus peers (see Exhibit 155).

Exhibit 155 **Global Coal Miners' 2014 P/B Multiples on Consensus and SCB Estimates**

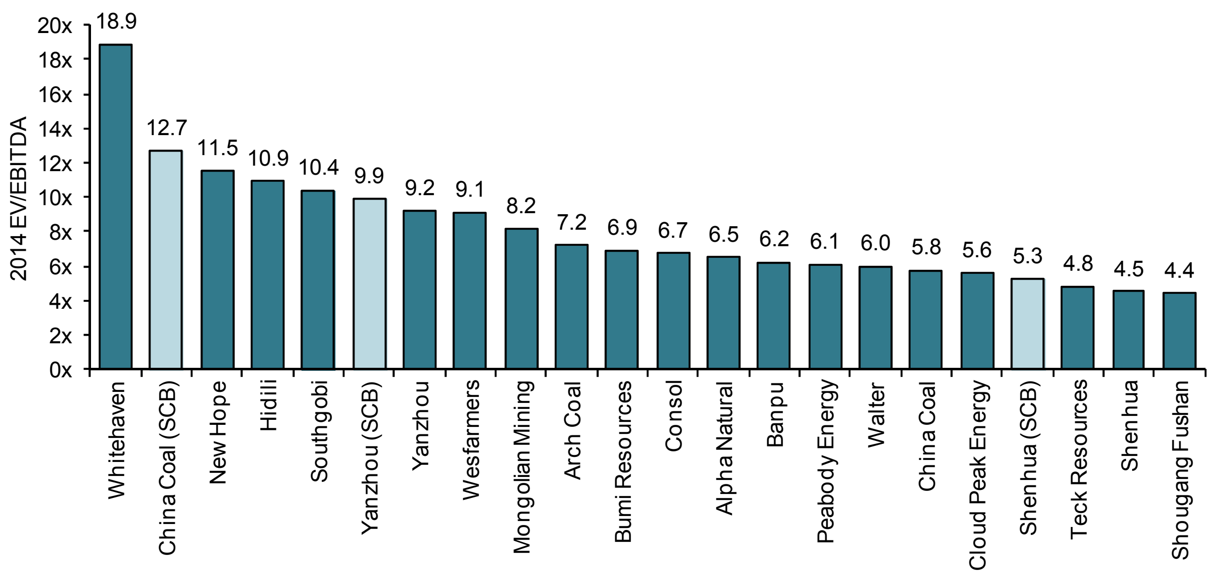


Note: Bumi is removed as its 2014 P/B is not meaningful.

Source: Bloomberg L.P., corporate reports and Bernstein estimates and analysis.

Finally, on an EV/EBITDA basis, Shenhua — even on our numbers — looks cheaper than the global coal companies (see Exhibit 156).

Exhibit 156 **Global Coal Miners' 2014 EV/EBITDA Multiples on Consensus and SCB Estimates**



Note: Whitehaven is removed as its 2014 EV/EBITDA is not meaningful.

Source: Bloomberg L.P., corporate reports and Bernstein estimates and analysis.

Exhibit 157 gives details of the companies within this global coal miners' screen.

Exhibit 157 Comps Table of the Global Coal Miners

Company	Local Currency	Share price (local)	Shares (M)	52-W High	52-W Low	EV (US$M)	EV (Local M)	P/E 2013E	P/E 2014E	P/B Current	P/B Forward	EV/EBITDA 2013E	EV/EBITDA 2014E	Avg. Daily Trading Volume (6 mo) M Shares	Avg. Daily Trading Volume (6 mo) USD M	Market cap (US$M)	Dividend Yield 2013E
HK-Listed Thermal Coal Miners																	
China Shenhua (H)	HKD	23.35	3,399	35.5	23.3	70,270	545,452	7.8x	7.4x	1.28x	1.16x	4.9x	4.5x	18.1	68.2	61,674	5.2%
China Coal Energy (H)	HKD	4.61	4,107	9.0	4.6	18,617	144,515	6.7x	6.2x	0.53x	0.50x	6.6x	5.8x	29.9	26.4	11,559	5.8%
Yanzhou Coal (H)	HKD	6.78	1,958	14.5	6.6	14,657	113,777	9.0x	8.2x	0.56x	0.54x	10.3x	9.2x	27.2	37.9	7,779	6.7%
HK-Listed Coking Coal Miners																	
Mongolian Mining	HKD	1.80	3,705	5.6	1.7	1,689	13,101	25.8x	10.5x	1.12x	1.04x	12.5x	8.2x	3.7	1.5	859	0.0%
Southgobi	HKD	11.52	182	41.4	11.0	351	2,728	nm	nm	0.45x	0.44x	nm	10.4x	0.1	0.3	270	-
Hidili	HKD	1.70	2,064	2.6	1.5	1,631	12,644	74.6x	16.4x	0.37x	0.36x	14.8x	10.9x	8.3	2.4	452	0.0%
Shougang Fushan	HKD	2.77	5,302	3.7	1.9	1,639	12,724	10.5x	9.9x	0.74x	0.70x	4.6x	4.4x	23.6	9.7	1,892	5.4%
U.S.-Listed Coal Miners																	
Arch Coal	USD	4.38	212	8.9	4.3	5,062	5,062	nm	nm	0.37x	0.38x	11.7x	7.2x	10.9	63.2	930	4.6%
Alpha Natural Resources	USD	6.23	221	10.7	5.3	4,147	4,147	nm	nm	0.30x	0.32x	9.9x	6.5x	12.9	106.8	1,376	0.0%
Consol	USD	32.44	229	37.4	26.4	10,577	10,577	38.1x	16.1x	1.83x	1.68x	9.3x	6.7x	2.5	81.9	7,417	1.9%
Walter	USD	14.69	63	49.0	13.9	3,294	3,294	nm	32.2x	0.99x	0.94x	10.8x	6.0x	4.4	108.8	919	3.4%
Teck Resources	USD	24.34	571	38.6	23.4	18,635	18,635	11.3x	9.5x	0.77x	0.72x	5.5x	4.8x	2.5	74.4	14,128	3.4%
Peabody Energy	USD	17.37	270	29.8	16.8	10,236	10,236	nm	13.2x	0.96x	0.92x	8.4x	6.1x	7.4	163.5	4,683	2.0%
Cloud Peak Energy	USD	18.16	61	22.3	14.1	1,588	1,588	19.2x	14.4x	1.13x	1.04x	6.5x	5.6x	0.9	16.0	1,105	0.0%
Australian/UK Coal Miners																	
New Hope	AUD	3.73	831	4.6	3.3	1,628	1,810	26.6x	27.0x	1.43x	1.44x	11.5x	11.5x	0.2	0.7	2,972	2.9%
Wesfarmers	AUD	38.35	1,007	44.3	28.8	45,627	47,332	19.5x	17.4x	1.69x	1.67x	10.0x	9.1x	2.6	106.7	42,689	4.3%
Whitehaven	AUD	2.15	1,026	4.6	1.8	2,535	2,609	nm	143.3x	0.67x	0.67x	nm	18.9x	5.8	15.3	2,116	1.4%
Coalspur	AUD	0.27	640	1.1	0.2	152	159	nm	nm	1.15x	1.32x	nm	nm	1.2	0.7	166	0.0%
SEA Coal Miners																	
Bumi Resources	IDR	550.00	20,773	1,260.0	490.0	5,972	58,267,258	nm	27.8x	2.93x	2.42x	8.6x	6.9x	95.9	7.5	1,157	-
Banpu	THB	252.00	263	478.0	245.0	5,020	149,690	9.4x	7.7x	0.81x	0.78x	7.2x	6.2x	1.2	13.8	2,171	7.1%

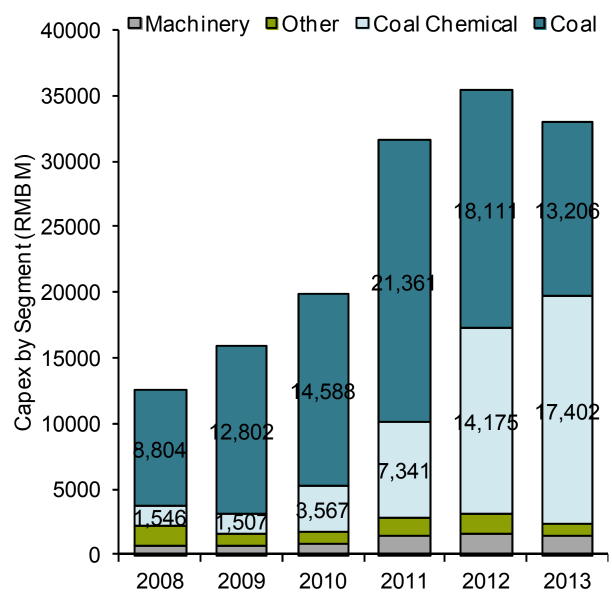
Source: Bloomberg L.P., corporate reports and Bernstein analysis.

The Step Back — Are There Other Businesses to Consider Within These Companies?

There are no other businesses operated by China Coal Energy or Yanzhou that we believe represent an upside risk to valuation.

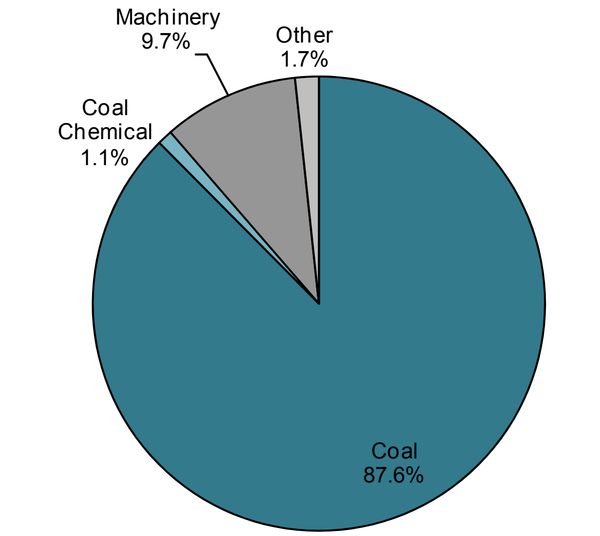
For China Coal Energy, the machinery business is clearly tied to the demand for coal in China overall, and so we see it as a weak performer going forward. The coal-to-chemicals business is an entirely new operation for China Coal Energy. We do not believe that prospects for significant earnings contribution from newly commissioned facilities in 2014 are high. In fact, this unit is likely to be a drain on China Coal Energy's capital budget for some time (see Exhibit 158 and Exhibit 159).

Exhibit 158 China Coal Energy: Capital Expenditure (2008-2013E)



Source: Corporate reports and Bernstein estimates and analysis.

Exhibit 159 China Coal Energy: 2012 Gross Profit by Segment

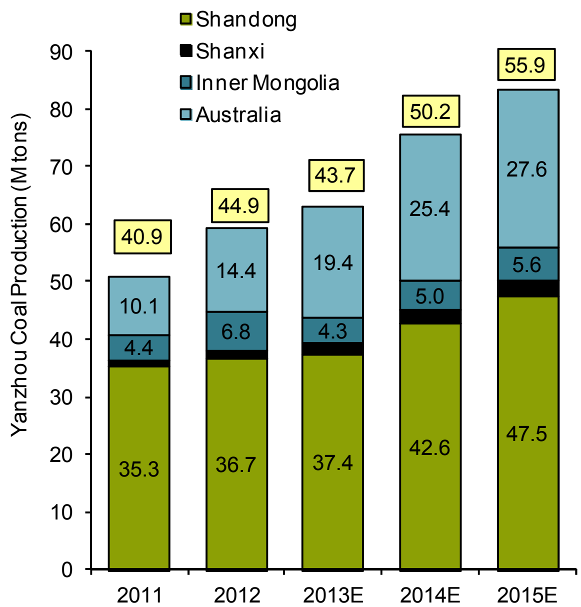


Source: Corporate reports and Bernstein estimates and analysis.

Yanzhou's Australian business is levered to exactly the same demand trends that Yanzhou faces. In fact, given that the business is located in a high-cost jurisdiction with an inflexible labor market and is a great distance from any end market, the business is in worse shape than Yanzhou's domestic operations.

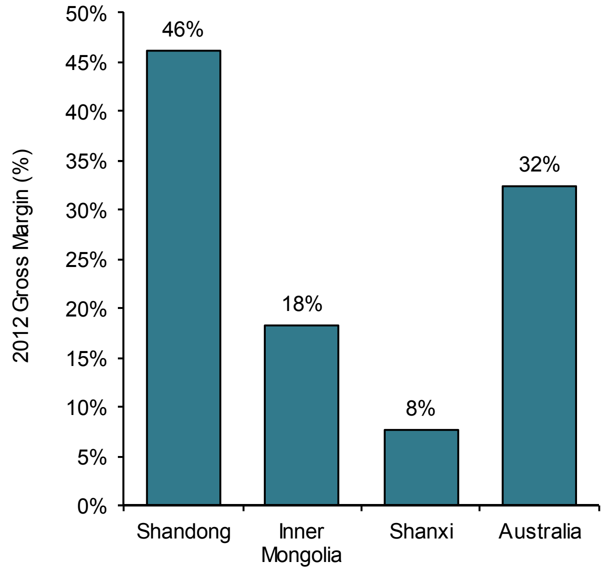
The hope that a devaluation of the dollar will aid Yanzhou's Australian business is half right: the profitability of the unit (with costs in Australian dollars and revenues in U.S. dollar) will go up. The value of the Australian asset would presumably fall if potential buyers value the assets on a replacement-cost basis in Australian dollars (see Exhibit 160 and Exhibit 161).

Exhibit 160 Yanzhou: Coal Production by Geography (2011-2016E)



Source: Corporate reports and Bernstein estimates and analysis.

Exhibit 161 Yanzhou: 2012 Gross Profit by Segment



Source: Corporate reports and Bernstein estimates and analysis.

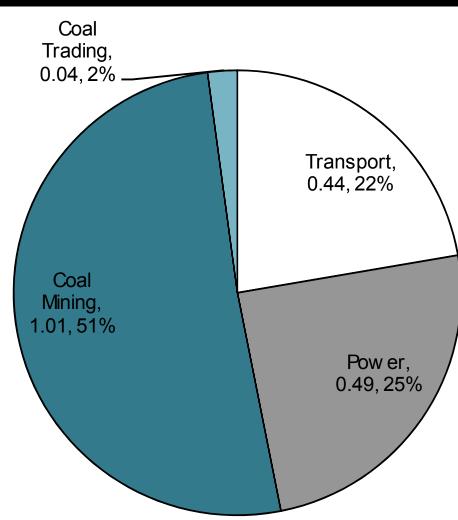
Shenhua is often referred to as a diversified business because of its rail, mining, power and port assets. All are, to state the obvious, levered to coal demand. All of these markets in China are entering an extended period of overcapacity (see Exhibit 162 and Exhibit 163).

Exhibit 162 Shenhua: Sum-of-the-Parts Analysis

Segment	2012 EPS	2013E EPS	Warranted Multiple	Implied Valuation	FX RMB/ HKD	Implied Valuation
	RMB	RMB		RMB		HKD
Coal	1.58	1.06				
Mining	1.51	1.01	8.0	8.11	1.25	10.10
Trading	0.06	0.04	2.0	0.09	1.25	0.11
Power	0.38	0.49	8.0	3.91	1.25	4.86
Transport	0.37	0.44	8.0	3.55	1.25	4.42
Total Segment Value	**2.33**	**1.99**	**7.9**	**15.65**	**1.25**	**19.48**
Excess cash per share						1.81
SOTP valuation per share						**21.29**

Source: Corporate reports and Bernstein estimates and analysis.

Exhibit 163 Shenhua: 2013E EPS Contribution by Segment



Source: Corporate reports and Bernstein estimates and analysis.

Exhibit 164 China Coal Energy — Discounted Cash Flow Valuation

Discounted Cash Flow Analysis (RMB M)	2013E	2014E	2015E	2016E	2017E	2018E	Terminal
Revenue	83,579	86,558	88,724	91,262	94,153	95,209	
Gross Profit	14,091	10,466	7,334	4,461	2,343	404	
EBIT	8,189	4,353	1,069	(1,562)	(3,871)	(5,880)	
Tax Rate	25%	25%	25%	25%	25%	25%	
EBIT*(1-t)	6,142	3,265	801	(1,172)	(2,903)	(4,410)	
Add:							
Depreciation	3,772	4,624	5,285	5,722	6,145	6,556	
Less:							
Capital Expenditure	(32,889)	(30,000)	(20,000)	(20,000)	(20,000)	(20,000)	
Chg in NWC	63	39	47	60	69	51	
Free Cash Flow to Firm	(22,913)	(22,073)	(13,867)	(15,390)	(16,689)	(17,803)	(243,141)
Discount Factor	1.00	0.91	0.83	0.76	0.70	0.64	0.58
Discounted FCF	(22,913)	(20,163)	(11,572)	(11,732)	(11,622)	(11,325)	(141,292)

Weighted Average Cost of Capital	9.5%		
Cost of Equity	12.4%	**Cost of Debt**	6.6%
Risk Free Rate	3.4%	Book Value of Debt	39.4%
Beta	1.50	Market Value of Equity	60.6%
Market Risk Premium	6.0%	Corporate Tax Rate	25.0%
Terminal Growth Rate	2.0%		

Valuation			
Aggregate, Discounted FCF	(230,619)	Implied DCF Valuation (HKD)	(25.00)
Less: Book Value of Debt	(50,466)	Target Share Price	$ 3.00
Less: Minority Interest	(14,911)	Current Share Price	4.61
Add: Cash	23,035	Delta from Current Share Price	-34.9%
Add: Associates and JVs	10,704		
Total	**(262,256)**		
Shares Outstanding	13,259		

Source: Bloomberg L.P., corporate reports and Bernstein estimates and analysis.

Exhibit 165 Shenhua — Discounted Cash Flow Valuation

Discounted Cash Flow Analysis (RMB M)	2013E	2014E	2015E	2016E	2017E	2018E	Terminal
Revenue	248,276	253,275	258,936	269,782	278,633	284,588	
Gross Profit	72,427	71,280	70,979	71,398	68,723	64,086	
EBIT	60,710	59,952	58,326	58,203	55,085	50,150	
Tax Rate	20%	20%	20%	20%	20%	20%	
EBIT*(1-t)	48,568	47,962	46,661	46,562	44,068	40,120	
Add:							
Depreciation	19,150	21,729	23,171	24,160	25,090	25,966	
Less:							
Capital Expenditure	(63,442)	(50,021)	(40,017)	(40,017)	(40,017)	(40,017)	
Chg in NWC	63	57	60	56	66	74	
Free Cash Flow to Firm	4,340	19,726	29,875	30,761	29,206	26,143	358,998
Discount Factor	1.00	0.91	0.84	0.76	0.70	0.64	0.58
Discounted FCF	4,340	18,026	24,949	23,476	20,369	16,661	209,088

Weighted Average Cost of Capital	9.4%		
Cost of Equity	10.3%	**Cost of Debt**	5.3%
Risk Free Rate	3.4%	Book Value of Debt	14.0%
Beta	1.15	Market Value of Equity	86.0%
Market Risk Premium	6.0%	Corporate Tax Rate	25.0%
Terminal Growth Rate	2.0%		
Valuation			
Aggregate, Discounted FCF	316,908	Implied DCF Valuation (HKD)	16.65
Less: Book Value of Debt	(66,914)	Target Share Price	$ 20.00
Less: Minority Interest	(52,798)	Current Share Price	23.35
Add: Cash	57,746	Delta from Current Share Price	-14.3%
Add: Term deposits	2,373		
Add: Associates and JVs	4,691		
Total	**262,006**		
Shares Outstanding	19,890		

Source: Bloomberg L.P., corporate reports and Bernstein estimates and analysis.

Exhibit 166 Yanzhou — Discounted Cash Flow Valuation

Discounted Cash Flow Analysis (RMB M)	2013E	2014E	2015E	2016E	2017E	2018E	Terminal
Revenue	53,310	56,228	62,038	63,849	67,435	70,710	
Gross Profit	11,541	11,394	10,965	11,116	9,844	8,978	
EBIT	3,935	3,406	2,152	2,631	1,022	(319)	
Tax Rate	25%	25%	25%	25%	25%	25%	
EBIT*(1-t)	2,951	2,554	1,614	1,973	766	(239)	
Add:							
Depreciation	3,773	5,647	6,417	6,646	6,851	7,040	
Less:							
Capital Expenditure	(12,005)	(10,800)	(10,100)	(9,900)	(9,850)	(9,800)	
Chg in NWC	49	34	61	9	12	33	
Free Cash Flow to Firm	(5,230)	(2,565)	(2,009)	(1,272)	(2,221)	(2,965)	(47,432)
Discount Factor	1.00	0.92	0.85	0.79	0.72	0.67	0.62
Discounted FCF	(5,230)	(2,367)	(1,710)	(999)	(1,610)	(1,983)	(29,272)

Weighted Average Cost of Capital	8.4%		
Cost of Equity	11.4%	**Cost of Debt**	3.6%
Risk Free Rate	3.4%	Book Value of Debt	34.6%
Beta	1.33	Market Value of Equity	65.4%
Market Risk Premium	6.0%	Corporate Tax Rate	25.0%
Terminal Growth Rate	2.0%		

Valuation			
Aggregate, Discounted FCF	(43,172)	Implied DCF Valuation (HKD)	(19.20)
Less: Book Value of Debt	(41,100)	Target Share Price	$ 5.00
Less: Minority Interest	(5,822)	Current Share Price	6.78
Add: Cash	11,899	Delta from Current Share Price	-26.3%
Add: Associates and JVs	3,487		
Total	**(74,707)**		
Shares Outstanding	4,918		

Source: Bloomberg L.P., corporate reports and Bernstein estimates and analysis.

Coal Train's Slow Blues: Why Weak Rail Capacity Additions in 2012 Won't Re-Bottleneck Chinese Coal

Mining It and Moving It Proved Less Difficult Than Was Initially Assumed…Now China Is Building for the Next 30 Years

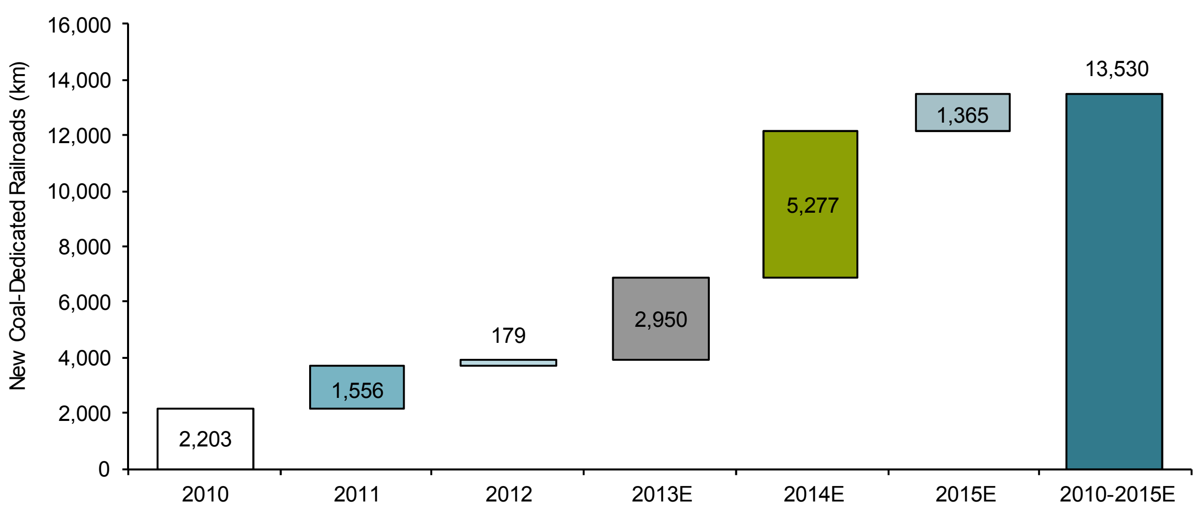
The old bull case for Chinese coal held that China could mine all of the additional coal it wanted; if it couldn't also move the coal, there would be no impact on coal price from all the new coal production capacity.

Things haven't worked out that way. We track or have tracked 46 different coal-dedicated rail projects in China that were commissioned in 2010-12 or will be commissioned between 2013 and 2015. In total, this is roughly 12,000 km of new rail lines. To date, 4,000 km have been commissioned and yet rail bottlenecks have dropped dramatically since 2011. We expect that the downward pressure on coal prices from improving rail logistics will continue through 2015 as new capacity comes on line.

Why Weak Rail Capacity Additions in 2012 Won't Re-Bottleneck Chinese Coal

Rail capacity growth is a core aspect of our bearishness on the Chinese coal sector (see Exhibit 167). The year 2012 was a disappointment on this score. Yet the drop in the coal price — despite the near-total lack of new coal-dedicated rail capacity additions — highlights, in part, the progress made in 2010 and 2011 in adding new transport lines. Given the restoration of funding to the projects we track (see Exhibit 169), by the end of 2014, we expect ~8,000 km of new capacity to be added, with new lines coming on every two to three months. In short, the old bull case on Chinese coal (most of the new rail capacity isn't coming on until 2013-14) is now a core part of the bear case (most of the new rail capacity is coming on in 2013-14).

Exhibit 167 **2010-15E Chinese Coal-Dedicated Railroads — Completed and Under Construction**

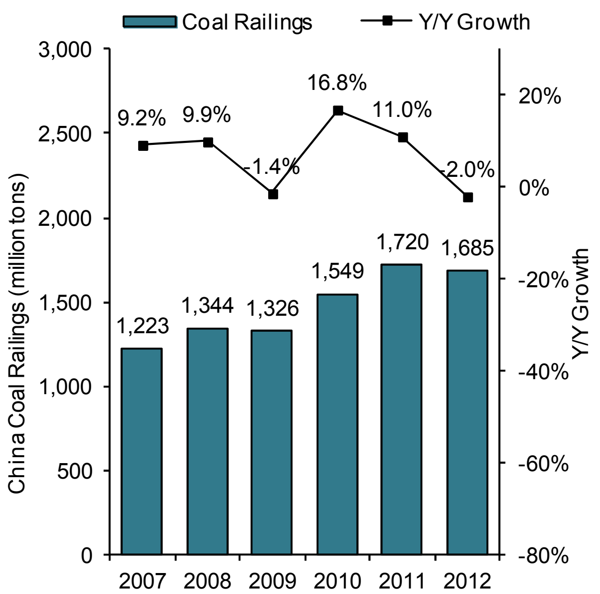


Source: Government announcements, CRCC, media reports and Bernstein estimates and analysis.

Total coal-dedicated rail line additions in 2012 were dismal: just 179 km, down 88% from 2011 and a fraction of what we expected in early 2012 (~3,000 km). Yet coal prices fell over the course of 2012 anyway. Delays were caused mainly by the temporary loss of funding after the Zhejiang rail accident in 2011 and the subsequent fallout at the Ministry of Rail. As delayed projects are commissioned in 2013, paths to market will expand and pressure on coal price will persist, in our view.

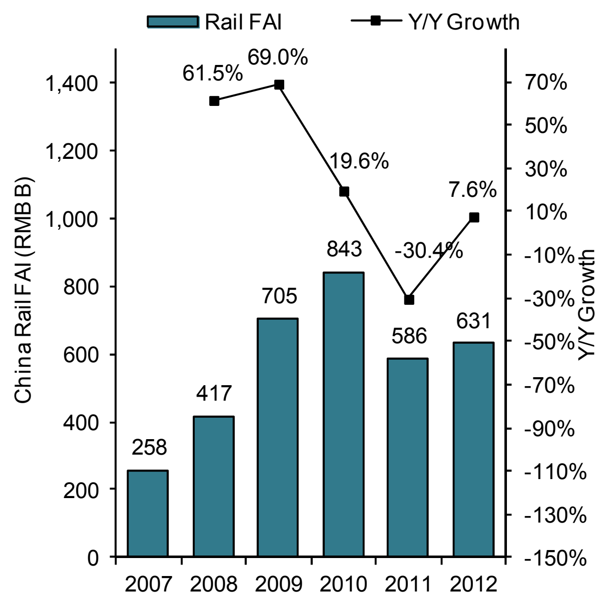
Total coal-dedicated rail lines commissioned in China in 2012 totaled 179 km. Only one of the 11 new lines we were monitoring for commissioning was actually completed. The rest have been delayed and most are now due for commissioning in 2013. Yet 2012 proved the right year to miss a deadline: coal transported by rail in China in 2012 decreased 2.0% year-over-year to 1.69 billion tons, while total coal transported on the Datong to Qinhuangdao line (the Daqin line) fell 3.2% for the full year. Coal prices fell by roughly one quarter over the course of 2012. There is an excess of transport capacity in China today and, based on our analysis, things only get worse (or better) from here (see Exhibit 168).

Exhibit 168 China Coal Transported by Railway



Source: SX Coal and Bernstein analysis.

Exhibit 169 China Rail Fixed Asset Investment



Source: CEIC and Bernstein analysis.

Transport Constraints in China's Coal Sector Are Falling...and It Isn't Just More Railway Lines

Since we first attempted to calculate coal-dedicated rail lines under construction in China in September 2010, roughly 4,000 km of new coal-dedicated lines have been commissioned. The pace has been slower over the last two years than we had anticipated. However, it is noteworthy that none of the projects that we have identified in the four times that we have now carried out this exercise have been abandoned.

In 2013, the pressure on Chinese coal prices from improving logistics continues to mount.

First, we anticipate ~3,000 km and ~5,000 km of new lines in 2013 and 2014, respectively. Total coal transportation capacity from the eight high-profile projects into Bohai Bay totals 690 million tons. Given that more than half of all the coal in China is consumed in the provinces in which it is produced, 690 million tons of inter-provincial rail capacity heading to Bohai Bay equates to ~1.4 billion tons of new coal consumption over the next three years. There is no scenario in which that is likely. Instead, this new transport capacity is going to speed the path to market for existing supply, putting pressure on pricing all the while.

Second, industrial activity is heading west…*towards* the sources of coal supply and simplifying transportation logistics. The air pollution problems in Beijing earlier this year were just the latest in a series of particularly visceral messages over the last year that industrial activity is likely to migrate in coming years away from the east coast. In many ways, that makes the logistics for domestic coal supply easier and the logistics for seaborne coal supply more difficult. The implication is that the demand growth for coal dedicated rail lines we are reviewing will slow in coming years, even as these projects are being commissioned.

Finally, coal by wire — or power transmission — removes the need for coal transportation altogether. Go back just five years and coastal provinces had a preference for the fixed asset investment and economic activity associated with coal-fired power stations. Accordingly, power generation was built at the load center rather than at the source of coal supply. As emissions and coal consumption considerations become an increasingly important part of provincial government performance metrics, those preferences may well invert. Again, inter-provincial transmission removes the need for coal transportation entirely.

Our expectation of flat coal prices and easing supply constraints in China in coming years is premised on a structural slowdown in Chinese power consumption growth at the same time as improvements in coal production capacity and transport capacity ease the path to market. We expect this to be an ongoing process that started at the end of 2011 and is likely to continue broadly through 2015. However, that does require that the weak performance by the Chinese rail sector in adding new capacity in 2012 is not repeated in 2013.

In short, our bearish view on the Chinese coal sector once again is reliant on the premise that China is good at building infrastructure.

4,000 km Down, 8,000 km to Go

Of the seven major projects into Bohai Bay, the Handan-Huanghua line should be completed in September this year. The remaining six projects are on track for completion through 2014 and 2015, bringing an incremental 690 million tons of transport capacity. These projects, and their long-dated completion targets, used to be part of the bull case on Chinese coal prices because of the high trucking and handling costs rail bottlenecks created. Today, for the coal stocks, these projects are the heart of the bear case, in particular for Shenhua. Completion of more and more rail transport capacity puts further pressure on coastal coal prices and destroys the value of any synergies in Shenhua's "integrated" model.

We often hear that coal prices fell so sharply in 2012 (down 23% over the course of the year) because everything that could go wrong for the Chinese coal mining sector did go wrong. We disagree. Yes, U.S. natural gas prices fell, meaning more U.S. coal was exported to Europe, displacing South African coal into Asia-Pacific. The Australian summer was dry, meaning that the disruptions in coal supply in the first quarter of 2011 were not repeated in the first quarter of 2012. Indonesian coal supply to China increased, and the weakening rupee meant that the Indian power sector was unable to benefit to any great extent from falling seaborne coal prices. It all meant that a lot more coal was available from the seaborne market for China. We have set out previously our view of why the impact of the seaborne thermal coal market on Chinese coal prices is often overstated (see "The Appalachian Butterfly Effect: A Eulogy for the Global Thermal Coal Market" chapter). In short, the volume of additions in the seaborne market fails to explain the extent of the coal price move in China last year).

In our view, if you are looking for a part of the Chinese economy where little went right in 2012, it's not the Chinese coal mining sector but the Chinese rail sector. As a consequence, most of the projects that we expected to be completed in 2012 are now scheduled for completion during 2013.

Exhibit 170 Chinese Coal-Dedicated Railroads — Completed in 2010

Start Date	Project Location	Distance (km)	Completion Year	Completion Year Source
Aug-06	Yimin to Arxan, Inner Mongolia	185	2010	People's Rail
Jul-07	Sanbeiyang to Xinshanghaimiao, Inner Mongolia	136	2010	China Railway
Feb-08	Baotou to Xi'an, Inner Mongolia to Shaanxi	801	2010	People's Rail
May-08	Taiyuan, Shanxi to Zhongwei, Ningxia	944	2010	Xinhua
Oct-08	Baotou to Mandoula, Inner Mongolia	91	2010	People's Rail
Nov-08	Guoyang to Linhuan, Anhui	45	2010	Anhui Coal
	2010 - Subtotal	**2,203**		

Source: Government announcements, media reports and Bernstein analysis.

To put 179 km in context, China has over 90,000 km of rail infrastructure in operation today and added ~2,200 km of coal-dedicated rail lines in 2010 (see Exhibit 170) and over 1,500 km in 2011 (see Exhibit 171).

Exhibit 171 Chinese Coal-Dedicated Railroads — Completed in 2011

Start Date	Project Location	Distance (km)	Completion Year	Completion Year Source
Mar-06	Huangtong to Zhijin, Guizhou	63	2011	Media Reports
Jul-05	Xinghe, Ulanqab, Inner Mongolia	9	2011	Media Reports
May-06	Zhangjiakou, Hebei to Jining, Inner Mongolia	178	2011	Government
May-08	Huoerxinhe Coal Industry Line, Shanxi	8	2011	Media Reports
Nov-08	Western Kuqa to Ehuobulake, Xinjiang	86	2011	Government
Jan-09	Ganqimao to Jinquan, Inner Mongolia	175	2011	Government
Jun-09	Gulian to Yueyahu, Heilongjiang	34	2011	Government
Aug-09	Zhunge'er to Hushi, Inner Mongolia (Expansion)	59	2011	Media Reports
Sep-09	Renjiazhuang, Ningxia	10	2011	Media Reports
Dec-09	Tongliao to Huolinhe, Inner Mongolia (Expansion)	402	2011	Government
Dec-09	Weilong to Yinchuan, Ningxia (Expansion)	97	2011	CRCC
Dec-09	Qingting to Baishan District, Anhui (Expansion)	152	2011	CRCC
Mar-10	Ganqika to Kulun, Inner Mongolia	70	2011	CRCC
May-10	Xintai to Linyi, Shandong	60	2011	Media Reports
Aug-10	Xilinhaote to Sanggedalai, Inner Mongolia (Expansion)	153	2011	Media Reports
	2011 - Subtotal	**1,556**		

Source: Government announcements, CRCC, media reports and Bernstein analysis.

In 2012, only one rail line — between Jinquan and Wanquan in Inner Mongolia — was commissioned (see Exhibit 172).

Exhibit 172 Chinese Coal Dedicated Railroads — Completed in 2012

Start Date	Project Location	Distance (km)	Completion Year	Completion Year Source
Jan-09	Jinquan to Wanquan, Inner Mongolia	179	2012	Media Reports
	2012 - Subtotal	**179**		

Source: Government announcements, media reports and Bernstein analysis.

Delays were caused mainly by the temporary loss of funding after the Zhejiang rail accident in 2011 and the subsequent fallout at the Ministry of Rail. Press reports explain the delays as being a function of weather, problems in some instances with land clearance and resettlement and temporary lack of funding. In short, the resetting of rail fixed asset investment in 2011 has had an effect on commissioning in 2012 (see Exhibit 169).

Yet this slowdown has not resulted in re-bottlenecking for the simple reason that Chinese coal consumption from domestic sources fell in 2012 (and so did coal transported by rail) — see Exhibit 168. We expect the various "stimulus" announcements last autumn that focused on rail investment — together with the eventual completion of the projects we track — will spike new capacity commissioning in 2013 and 2014.

We expect 13 rail lines that we are tracking to be commissioned with a total distance of 2,950 km in 2013 (see Exhibit 173). We anticipate another ~8,000 km of rail lines to be commissioned over the following 18 months, with new lines opening roughly every two to three months.

Exhibit 173 **Chinese Coal Dedicated Railroads — To Be Completed in 2013E**

Start Date	Project Location	Distance (km)	Completion Year	Completion Year Source
Nov-07	Bayanwula, Inner Mongolia to Fuxin, Liaoning (Baxin Line)	496	2013E	Railway-China
Nov-08	Xilinhaote to Wulanhaote, Inner Mongolia	651	2013E	Media Reports
Apr-09	Batuta to zhungeer, Inner Mongolia (Bazhu Line Expansion)	135	2013E	Media Reports
Jun-09	Zalantun to Arun, Inner Mongolia (Aza Line)	60	2013E	Government
Jul-09	Suzhou, Anhui to Huai'an, Jiangsu	211	Nov 13E	Media Reports
Sep-09	Yuhuai Railway (North Chongqing to Fuling Section)	98	Sept 13E	Government
Nov-09	Handan, Hebei to Jinan, Shandong (Expansion)	232	2013E	Media Reports
Mar-10	Handan, Hebei to Changzhi, Shanxi (Expansion)	223	2013E	Media Reports
Mar-10	Zhunge'er, Inner Mongolia, to Shenchi, Shanxi	180	2013E	Media Reports
Apr-10	Handan to Huanghuagang, Hebei	433	Sept 13E	Government
Aug-10	Sanggedalai to Duolun, Inner Mongolia (Expansion)	103	Aug 13E	Government
Sep-11	Daigou to Erdaohe, Inner Mongolia (Expansion)	59	2013E	Government
Sep-11	Songgenshan to Dongwuqi, Inner Mongolia	71	2013E	Government
	2013E - Subtotal	**2,950**		

Source: Government announcements, media reports and Bernstein estimates and analysis.

We expect a further 5,277 km of coal-dedicated rail lines to be commissioned in 2014, with large projects from Urumqi in Xinjiang to Gansu (connecting Xinjiang to China's coal-dedicated rail network for the first time) and Lvliang to Rizhao (see Exhibit 174).

Exhibit 174 **Chinese Coal Dedicated Railroads — To Be Completed in 2014E**

Start Date	Project Location	Distance (km)	Completion Year	Completion Year Source
Nov-09	Lanzhou, Gansu to Urumqi, Xinjiang (Expansion)	1,776	2014E	CRCC
Dec-09	Lvliang, Shanxi to Rizhao, Shandong	1,260	2014E	Government
Mar-10	Zhangjiakou to Tangshan (Caofeidian), Hebei	528	2014E	Media Reports
Jun-10	Xulun Hoh Qi, Inner Mongolia to Zhangjiakou, Hebei	247	2014E	Government
Jul-10	Dezhou to Dajiawa, Shandong	256	2014E	Railway-China
Aug-10	Jining to Tongliao, Inner Mongolia (Expansion)	923	2014E	Media Reports
Nov-09	Longkou to Yantai, Shandong	113	2014E	Railway-China
Feb-11	Hohhot to Shengli (via Zhunge'er)	174	2014E	Media Reports
	2014E - Subtotal	**5,277**		

Source: Government announcements, CRCC, media reports and Bernstein estimates and analysis.

We now expect 1,365 km to be commissioned over three projects in 2015 (see Exhibit 175).

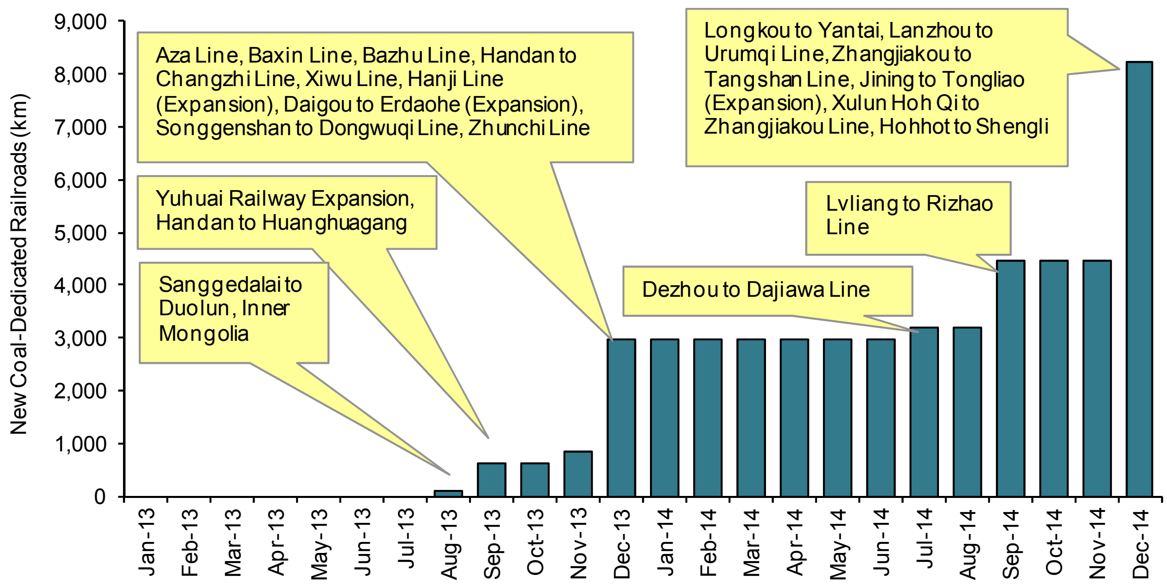
Exhibit 175 **Chinese Coal Dedicated Railroads — To Be Completed in 2015E**

Start Date	Project Location	Distance (km)	Completion Year	Completion Year Source
Jun-08	Chifeng, Inner Mongolia to Jinzhou, Liaoning	282	2015E	Media Reports
Sep-08	Lanzhou, Gansu to Chongqing	820	2015E	Media Reports
Jul-09	Shimen to Changsha, Hunan (Expansion)	263	2015E	Media Reports
	2015E - Subtotal	**1,365**		

Source: Government announcements, media reports and Bernstein estimates and analysis.

Of the eight major projects into Bohai Bay, the Handan-Huanghua line and Handan-Changzhi expansion should be completed by the end of 2013 (see Exhibit 176 through Exhibit 178). The remaining six projects are on track for completion through 2014 and 2015. These eight projects will bring an incremental 690 million tons of transport capacity.

Exhibit 176 New Coal-Dedicated Rail Lines (2013E-2014E)



Source: Government announcements, media reports and Bernstein estimates and analysis.

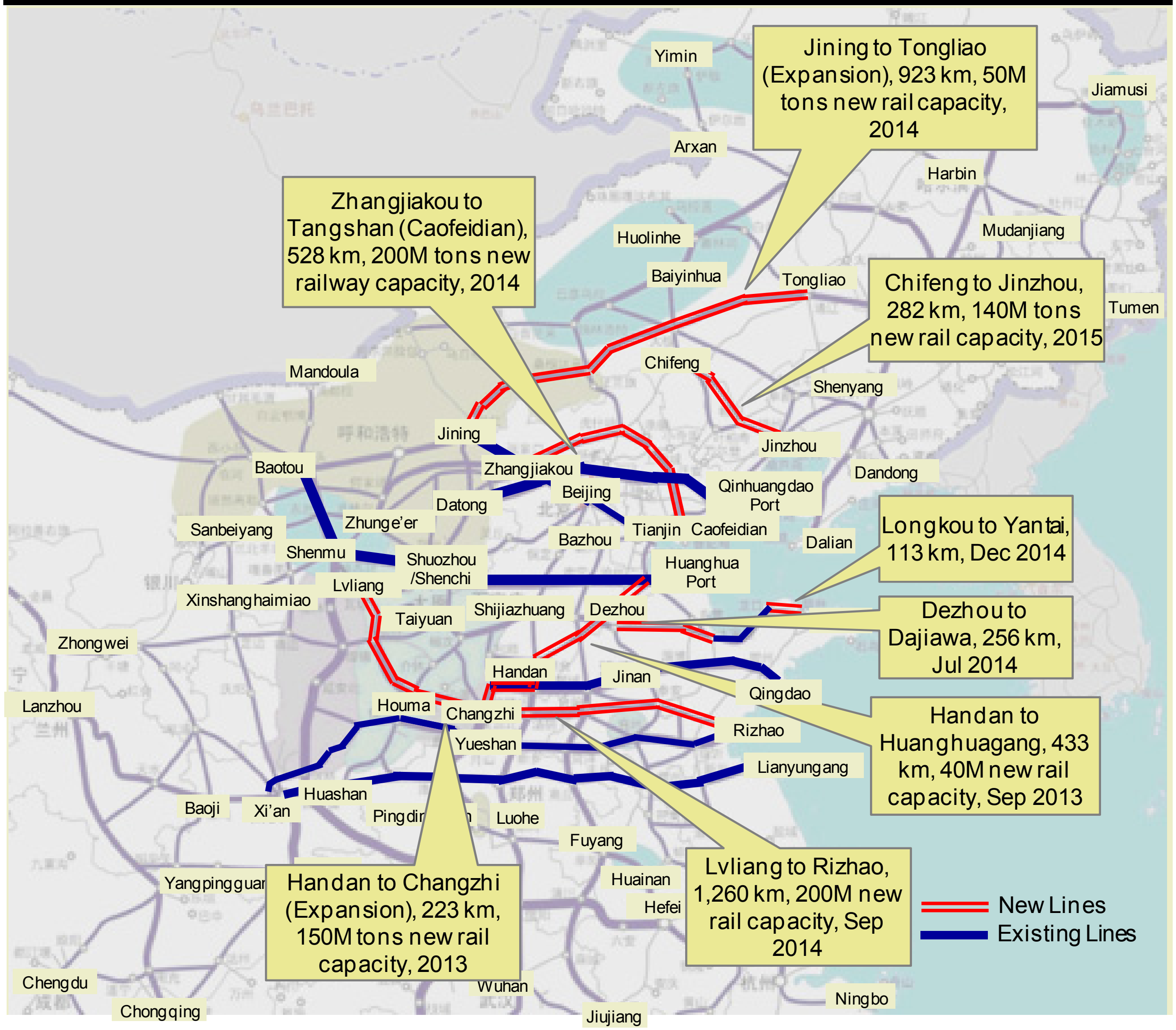
These projects, and their long-dated completion targets, used to be the basis for the bull case on Chinese coal prices because of the high trucking and various grey costs rail bottlenecks created. Today, for the coal stocks, these projects are the heart of the bear case, in particular for Shenhua. Completion of more and more rail transport capacity puts further pressure on coastal coal prices and destroys the value of any synergies in Shenhua's "integrated" model.

Exhibit 177 New Xi-to-Sea Projects — Commissioning Between 2013 and 2015

Start Date	Project Location	Distance (km)	Completion Year	Additional Coal Rail Capacity (M tons)	Details
Mar-10	Handan, Hebei to Changzhi, Shanxi (Expansion)	223	2013E	150	Once the expansion is completed, rail capacity will increase from ~30M tons per annum to 180M tons per annum.
Apr-10	Handan to Huanghuagang, Hebei	433	2013E	-	The rail line will open a new path in Hebei to the Huanghua harbor. Once completed, the rail line will have transportation capacity of 40M tons per annum.
Nov-09	Longkou to Yantai, Shandong	113	2014E	-	A part of the Delongyan Line, which will transport coal through northern Shandong.
Apr-10	Dezhou to Dajiawa, Shandong	256	2014E	-	A part of the Delongyan Line, which will transport coal through northern Shandong.
Jun-08	Chifeng, Inner Mongolia to Jinzhou, Liaoning	282	2015E	140	Connecting eastern Inner Mongolia to Liaoning, this line will have capacity of 22M tons per annum on a single line, and 140M tons once its second line is completed.
Mar-10	Zhangjiakou to Tangshan (Caofeidian), Hebei	528	2014E	200	Connecting Shanjiakou in central Hebei to the ports in Tangshan, this line will have a long-term capacity of 200M tons per annum.
Dec-09	Lvliang, Shanxi to Rizhao, Shandong	1,260	2014E	200	Also known as the "Shanxi South-Central Rail Channel," this line will have a long-term capacity of 200M tons per annum.
Aug-10	Jining to Tongliao, Inner Mongolia (Expansion)	923	2014E	-	Operated by the Inner Mongolia Jitong Railway Company, the expansion project will, including the construction of a second line, which would increase total coal transportation capacity by 35-50+ M tons.
Subtotal		**4,018**		**690**	

Source: Chinese Ministry of Railways, media reports and Bernstein estimates and analysis.

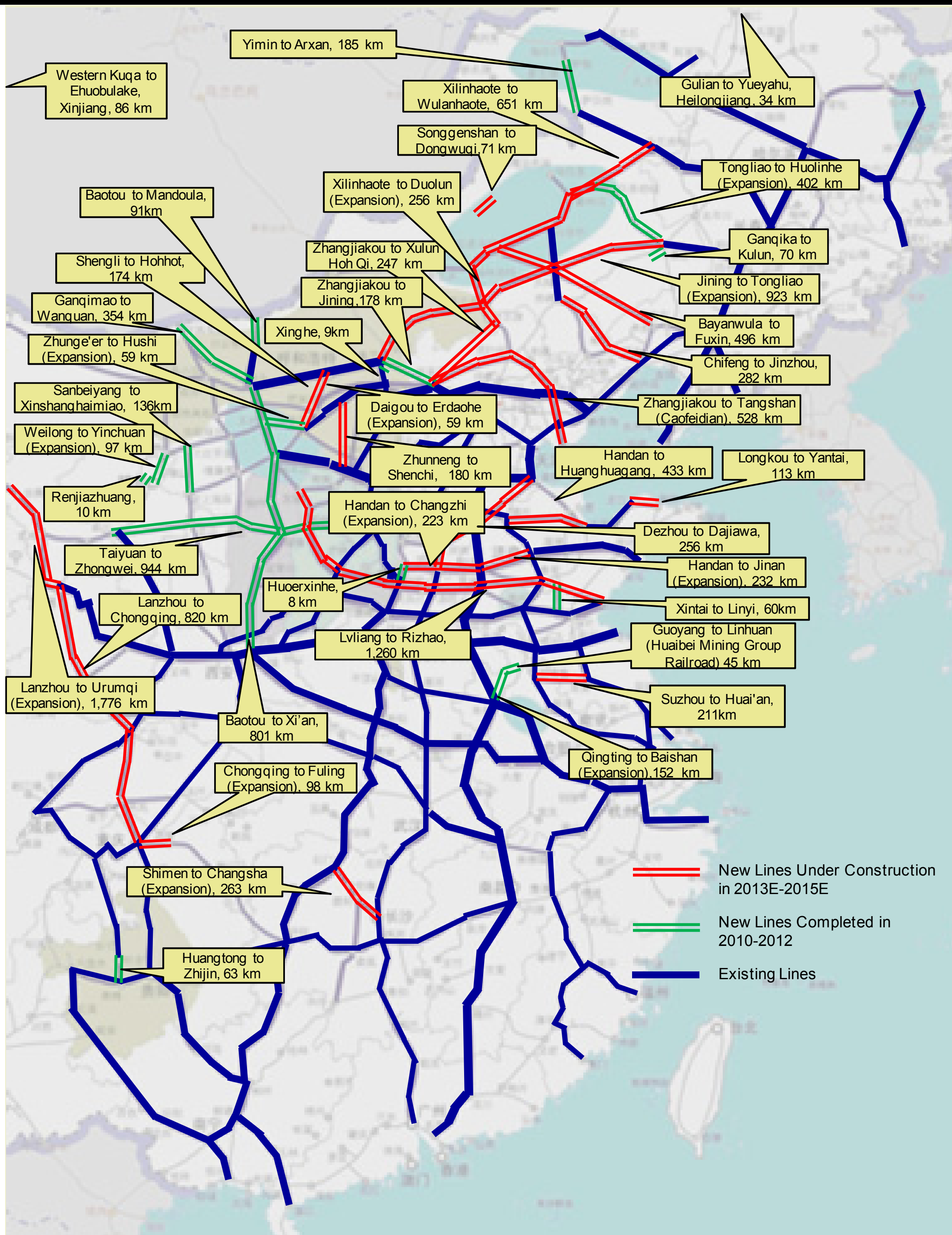
Exhibit 178 **Xi-to-Sea Projects — Origin and Destination, Distance, Transport Capacity and Target Completion Date**



Source: Chinese Ministry of Railways, media reports, corporate reports and Bernstein estimates and analysis.

We have been tracking this same group of projects since September 2010. The projects completed to date are reflected in green in Exhibit 179 (see online version for colors).

Exhibit 179 **Chinese Coal-Dedicated Rail Network — Lines Completed in 2010-12 and New Lines to Be Completed in 2013-15E**

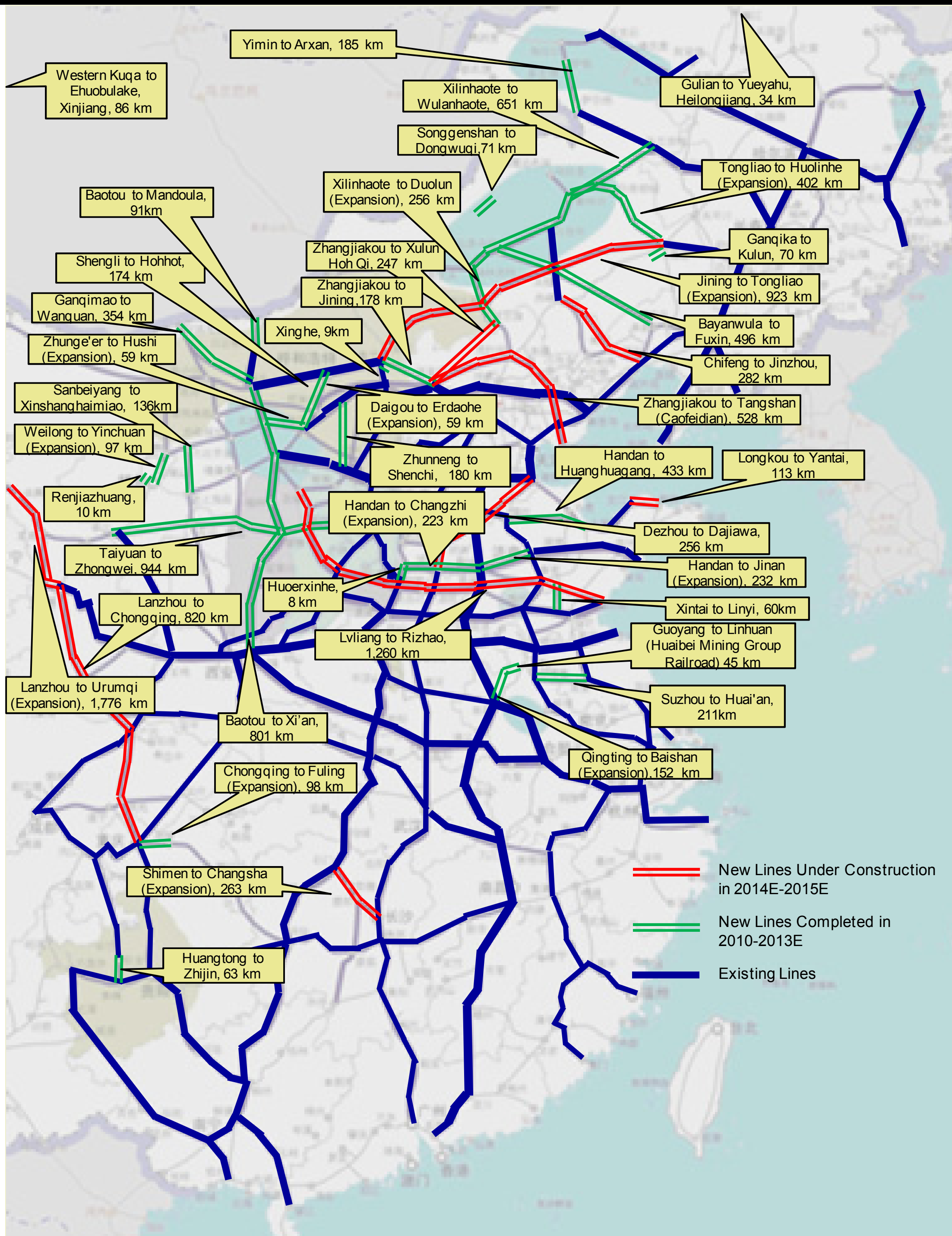


Note: Please see online version for colors.

Source: Chinese Ministry of Railways, media reports, corporate reports and Bernstein estimates and analysis.

Projects that, based on our estimates, will be completed by the end of 2013 are reflected in green in Exhibit 180 (see online version for colors).

Exhibit 180 **Chinese Coal-Dedicated Rail Network – 2010-15E Completions at EOY 2013**

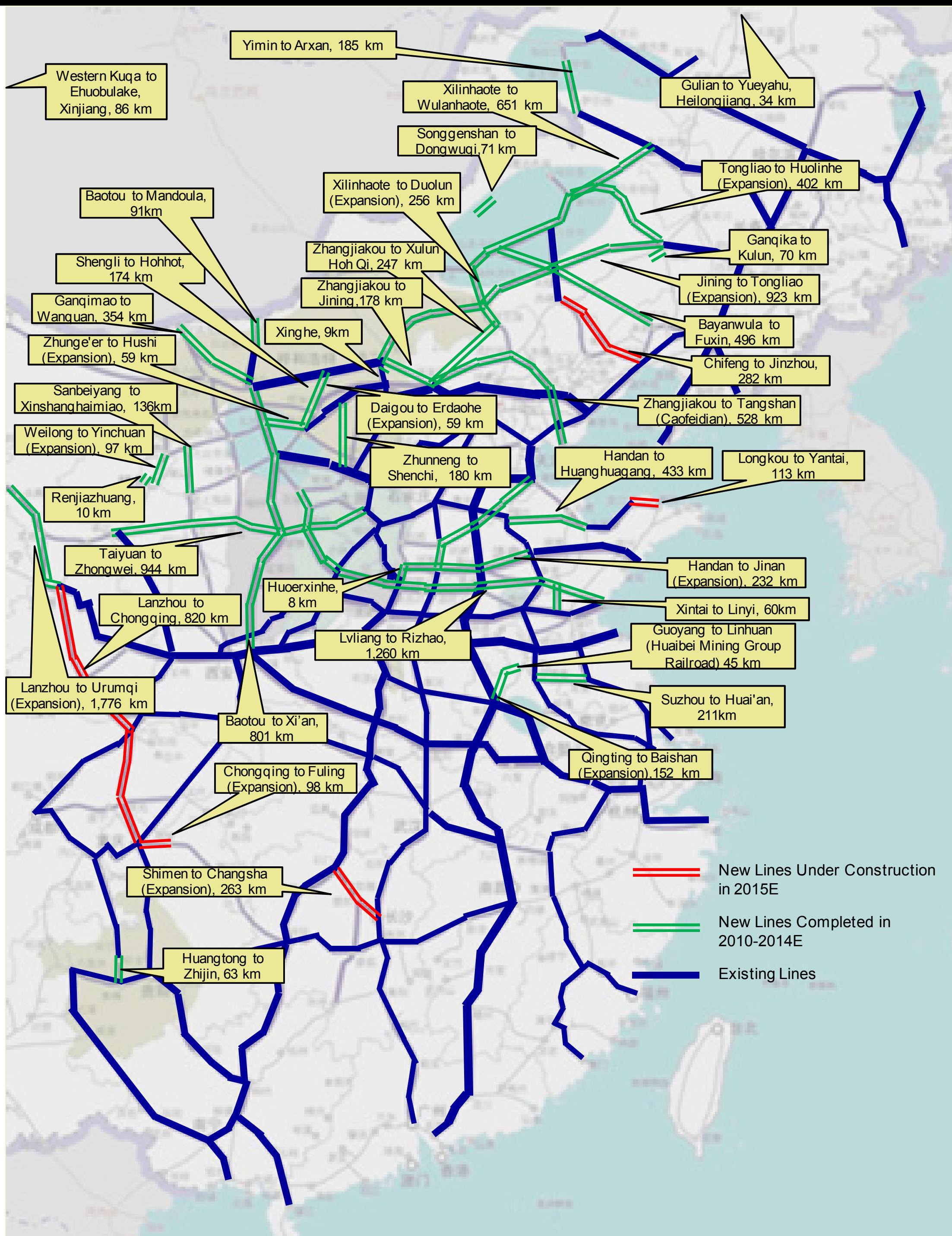


Note: Please see online version for colors.

Source: Chinese Ministry of Railways, media reports, corporate reports and Bernstein analysis.

Projects that, based on our estimates, will be completed by the end of 2013 are reflected in green in Exhibit 181 (see online version for colors).

Exhibit 181 **Chinese Coal-Dedicated Rail Network — 2010-2015E Completions at EOY 2014**

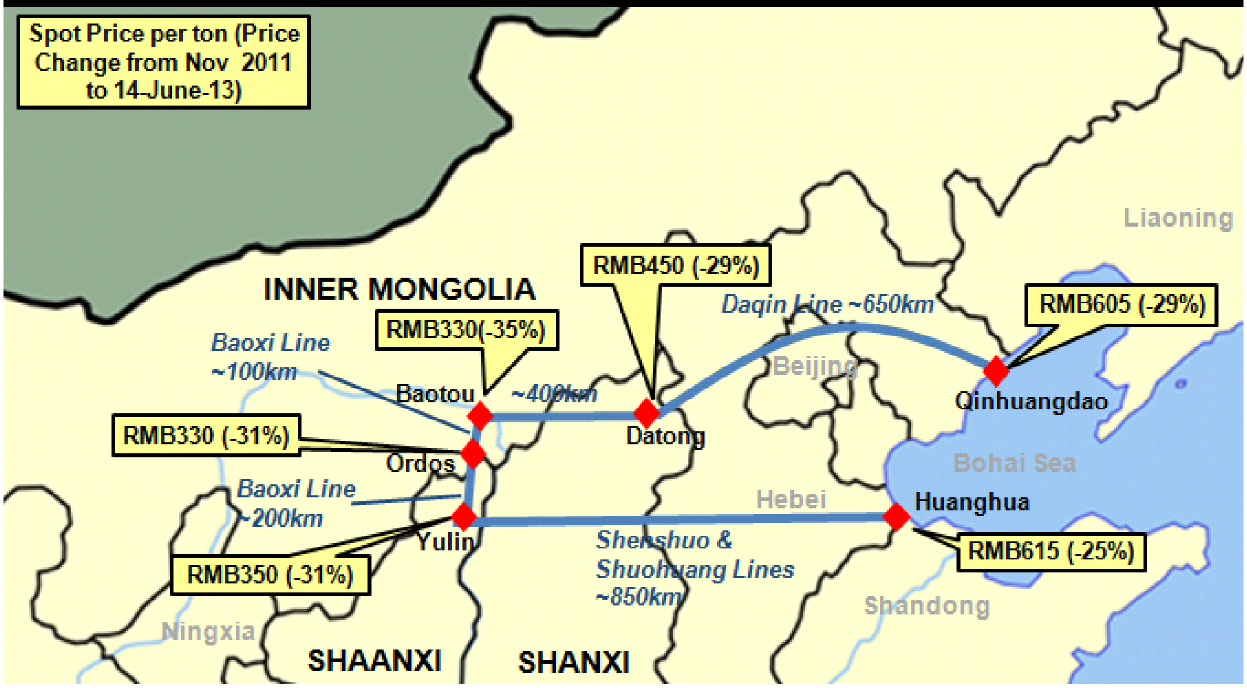


Note: See online version for colors.

Source: Chinese Ministry of Railways, media reports, corporate reports and Bernstein analysis.

Coal prices are down ~30% since November 2011 both on the coast and in the coal-producing interior regions (see Exhibit 182).

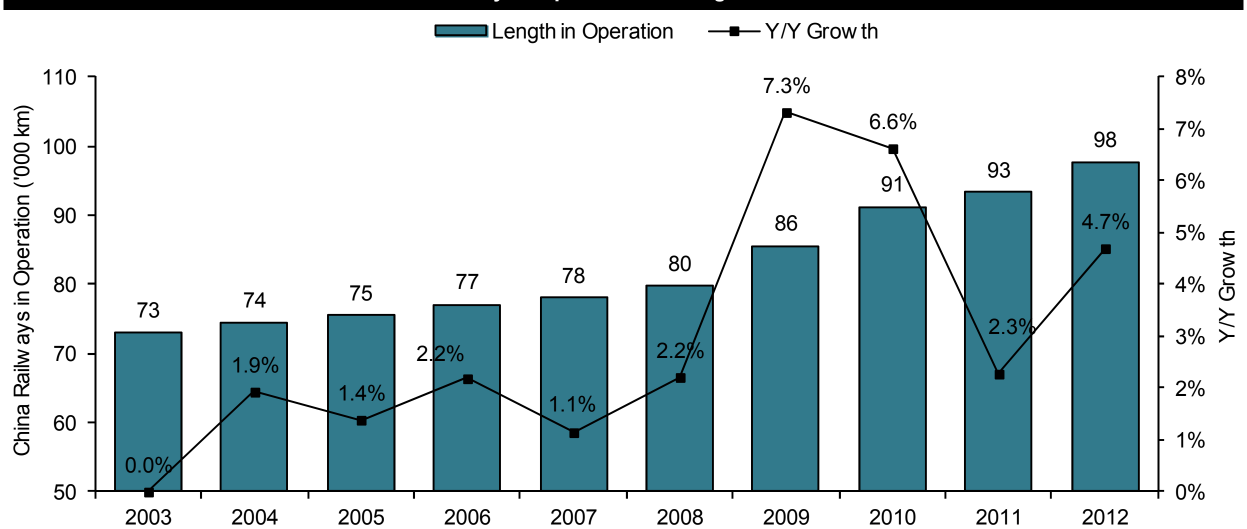
Exhibit 182 **Inner Mongolia, Shaanxi and Shanxi vs. Port Coal Prices**



Source: Wikimedia commons, SX Coal and Bernstein estimates and analysis.

Out of the ~5,000 km of new railway lines added in 2012, only ~180 km were added as coal-dedicated usage. However, the incremental freight lines and passenger lines (including the high-speed rails) should help offloading the non-coal usage in the entire system (see Exhibit 183).

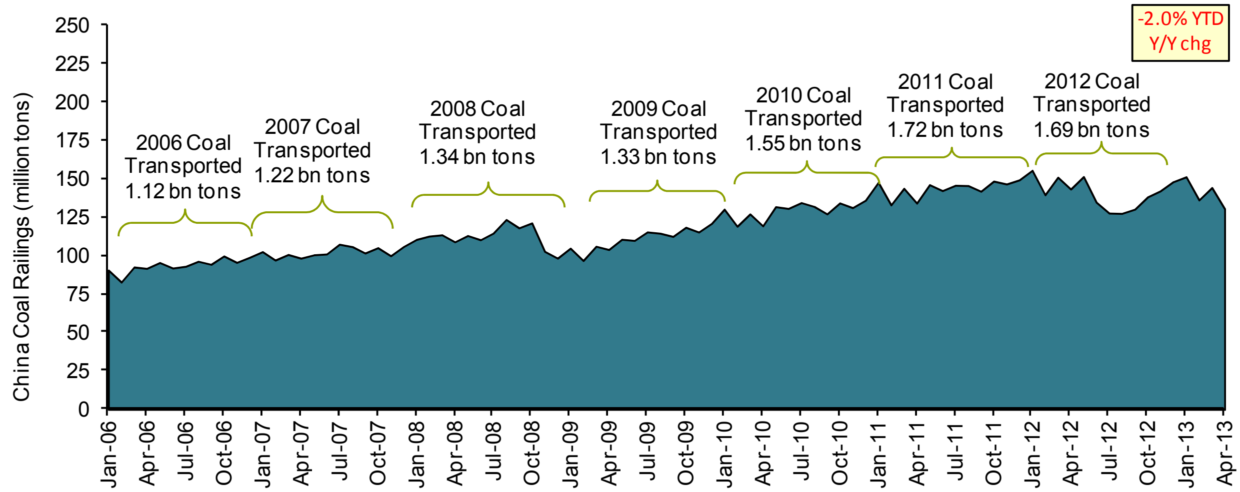
Exhibit 183 **China Railway in Operation — Length**



Source: CEIC and Bernstein analysis.

2012 proved the right year to miss a deadline. The coal transported by rail in China decreased 2.0% year-over-year to 1.69 billion tons in 2012 (see Exhibit 184).

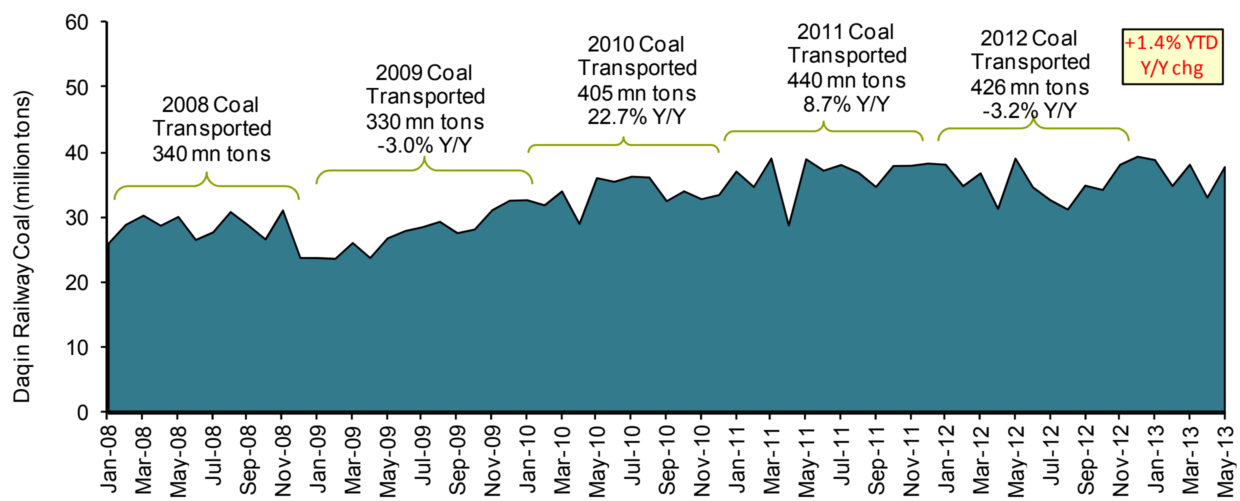
Exhibit 184 **China Coal Transported by Railway — Monthly**



Source: SX Coal and Bernstein analysis.

Total coal transported by the Datong-to-Qinhuangdao line (the Daqin line) fell 3.2% in 2012 (see Exhibit 185).

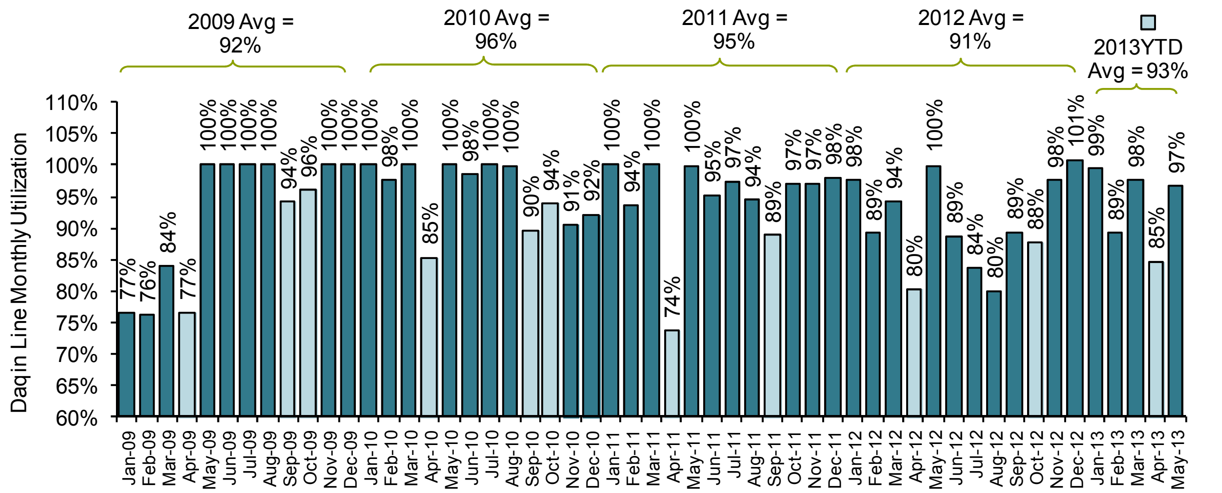
Exhibit 185 **Chinese Coal Transported by Daqin Railway — Monthly Through May 2013**



Source: SX Coal and Bernstein analysis.

The Daqin line operated with excess capacity most of 2012 (see Exhibit 186).

Exhibit 186 **Daqin Line Monthly Utilization (2009 to May 2013)**

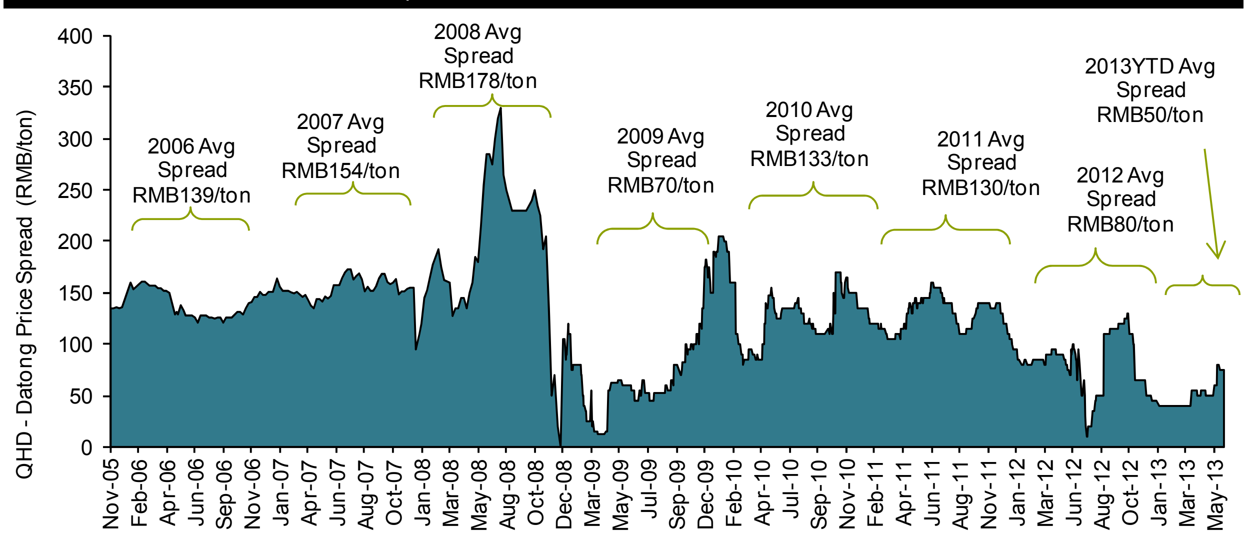


Note: Light blue months are the maintenance months; see online version for colors.

Source: SX Coal and Bernstein estimates and analysis.

The Qinhuangdao-Datong coal price spread fell over the year to RMB50/ton, after the adjustment for transportation costs is made (see Exhibit 187). Said differently, the value of this arbitrage has fallen by ~62% since 2011. More than any other measure, this is ultimately the best indicator of rail transport capacity. To the extent that there are bottlenecks within the coal transportation network, these bottlenecks will maintain themselves in economic rents for intermediaries. That, in turn, will result in the widening of the Datong-Qinhuangdao spread. That spread continues to trend down.

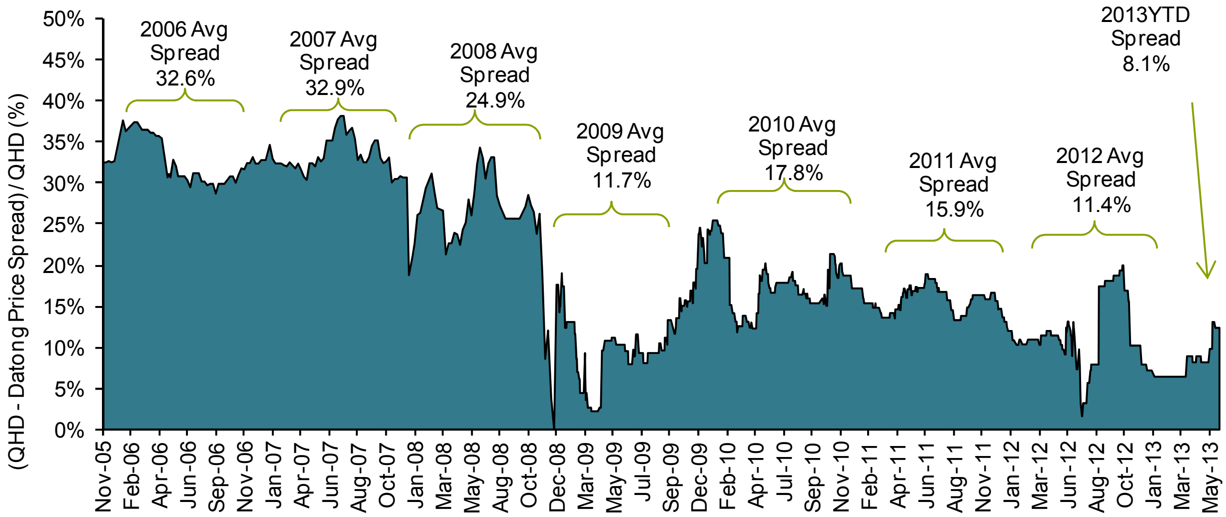
Exhibit 187 **QHD 5,500 and Datong Nanjiao 5,500 Coal Price Spread (Adjusted for Transport Cost)**



Source: SX Coal and Bernstein analysis.

In fact, as a percentage of the final Qinhuangdao price, the Datong-Qinhuangdao spread (adjusted for transportation) has rarely been lower going back to at least 2006 (see Exhibit 188).

Exhibit 188 **QHD 5,500 and Datong Nanjiao 5,500 Coal Price Spread Relative to QHD (Adjusted for Transport Cost)**



Source: SX Coal and Bernstein analysis.

Appendix: Line-by-Line Analysis

We set out below details for each of the rail lines we expect to be completed in 2013 and in 2014:

Yuhuai Railway (North Chongqing to Fuling Section) (98 km) — This project is located within the Chongqing municipality and construction started in September 2009. Press reports blame bad weather for the delay in railway construction. Officials representing the Chongqing government are quoted in the press stating they expect this project to be completed in the first half of 2013 but recent press articles are pointing to the end of 2013. Total investment for the project is RMB3.59 billion and the average train speed on the rail line will be 120 km/hour.

Bayanwula, Inner Mongolia to Fuxin, Liaoning (496 km) — Construction for the Baxin Line was approved in 2007 and construction started in March 2009. The Baxin line has a short-term transportation capacity of 21 million tons with a longer-term capacity expansion plan of 35 million tons. Total investment in the project is RMB5.86 billion. Project construction was suspended in 2010-11 as a result of a lack of funding and was resumed in April 2012. Media reports suggest that colder than expected weather affected the project progress in late 2012 and that this project will be completed by the end of 2013.

Batuta to Zhunge'er, Inner Mongolia (Expansion) (135 km) — Construction for the Bazhu Line was approved in October 2009 and construction started in December 2010. Total investment for the project is RMB7.2 billion. Once the expansion is completed, rail capacity will increase from ~100 million tons per annum to 200 million tons per annum. Shenhua expects that this project will be completed in the second half of 2013.

Zhunge'er, Inner Mongolia, to Shenchi, Shanxi (180 km) — The Zhunchi Line is situated between the Dazhun line and the Shuohuang line and will link the two existing lines upon completion. Total investment for the entire line is RMB13.5 billion, and the line is expected to have near-term transportation capacity of 90.7 million tons per annum and long-term transportation capacity of 200 million tons per annum. The Zhunchi line, together with the existing Dazhun and Shuohuang lines, will create a coal transport network throughout western Inner Mongolia. Media reported that this project would be completed in the second half of 2013.

Handan, Hebei to Changzhi, Shanxi (Expansion) (223 km) — Once this expansion project (second line and electrification) is completed, the rail transportation capacity will increase from ~19 million tons to ~200 million tons in the long term, and average train speed will increase from 60 km/hour to 100 km/hour. Total project cost is RMB5.55 billion. Press reports suggest that railway construction was delayed due to construction difficulties. According to these reports, this project would be completed in the second half of 2013.

Handan to Huanghuagang, Hebei (433 km) — This rail line will open a new path in Hebei to the Huanghua harbor. Once completed, the rail line will have transport capacity of 40 million tons per annum. Total project investment is RMB16.8 billion. Due to difficulty in land acquisition and funding, project construction was suspended in 2011 but resumed in March 2012. According to press reports, the Hebei government expects this project will be completed in September 2013.

Zalantun to Arun, Inner Mongolia (60 km) — Construction for the Aza Line was approved in 2008 and started in June 2009. Total investment for the project is RMB0.8 billion. Initial transportation capacity is 3.8 million tons per annum, expanding to 8.5 million tons per annum in the medium term and 12 million tons in the long term. According to press reports, due to difficulty in obtaining funding for the project, this project was suspended in 2011 but resumed in April 2012. Recent news articles suggest that the project will be completed by the end of 2013.

Suzhou, Anhui to Huai'an, Jiangsu (211 km) — The project will transport coal from the mining regions in Anhui to Jiangsu. Total investment is RMB4.93 billion and the line is expected to have transportation capacity of 25 million tons per annum. The average train speed on the rail line is designed at 120 km/hour. Construction, which was started in July 2009, was suspended in 2011 due to difficulty in obtaining funding but was resumed in early 2012. Media reported that this project will be completed in November 2013.

Xilinhaote to Wulanhaote, Inner Mongolia (651 km) — The Xiwu Line runs across eastern Inner Mongolia and will become the main artery in the region's coal mining region. Total investment for the project is RMB11.3 billion. Construction for the Xiwu Line started in November 2008. Once completed, the line is expected to have a transportation capacity of 30 million tons/year in the short term and 50 million tons/year in the long term. The project was suspended in August 2011 as part of a national railway construction review and lack of funding but construction resumed in September 2012. Media reported that this project would be completed in 2013.

Handan, Hebei to Jinan, Shandong (Expansion) (232 km) — The original Hanji Line was completed in 2000 and runs from Handan, Hebei to Jinan, Shandong. Total investment for the project is RMB6.98 billion. Once the expansion is completed, rail capacity will increase from ~30 million tons per annum to 180 million tons per annum. This project is one of the railways of main focus in China's 11th Five-Year Plan. The progress of the project construction was slightly delayed due to slower-than-expected land acquisition. Media reported that this project would be completed in 2013.

Sanggedalai to Duolun, Inner Mongolia (Expansion) (103 km) — This project is one of the railways of main focus in China's 12th Five-Year Plan. Total investment for the entire line is RMB 2.8 billion. The Xilinhaote to Sanggedalai segment of the Xiduo line was completed in 2011. The Sanggedalai to Duolun segment of the line began its expansion in August 2010. Recent new articles suggested this project would be completed in August 2013.

In 2014, the following projects will be added:

Dezhou to Dajiawa, Shandong (256 km) — Total investment for the project is RMB2.16 billion. The average train speed on the rail line is designed at 160 km/hour. The line is expected to have transportation capacity of 44.6 million tons per annum. The construction started in July 2010. Media reports state that this project will be completed in July 2014. The Longkou to Yantai line (113 km) should be completed by the end of 2014.

Lvliang, Shanxi to Rizhao, Shandong (1,260 km) — The project will transport coal from the mining regions in Shanxi, through Henan, to Shandong. Total investment for the project is RMB99.8 billion. The average train speed on the rail line is designed at 120 km/hour. This project is one of the railways of main focus in China's 11th Five-Year Plan. The Shandong Government expects this project to be completed in September 2014.

Lanzhou, Gansu to Urumqi, Xinjiang (Expansion) (1,776 km) — This rail line will add a second line to the existing Lanxin Line. The project connects the distant western regions around Xinjiang to the rest of the country, running across Gansu, Qinghai, and Xinjiang province. It is the first high speed railway that China will build in high-altitude regions. Construction for the Lanxin Line was approved in August 2009 and the construction started in November 2009. This project is one of the railways of main focus in China's 12th Five-Year Plan. Total investment for the project is RMB143.5 billion. The progress of the project construction was slightly delayed due to slower-than-expected land acquisition and high construction difficulties. According to press reports, CRCC expects this project to be completed in December 2014.

Zhangjiakou to Tangshan, Hebei (528 km) — Once completed, this Zhantang Line will connect Zhangjiakou to the sea. Total investment for the project is RMB40 billion. Media reported that this project would be completed in 2014.

Jining to Tongliao, Inner Mongolia (Expansion) (923 km) — Media reported this project would be completed in 2014.

Xulun Hoh Qi, Inner Mongolia to Zhangjiakou, Hebei (247 km) — This project is one of the railways of main focus in China's 11th Five-Year Plan. Total investment for the project is RMB8 billion. The construction started in June 2010. The government states that this project would be completed in 2014.

Hohhot to Shengli (174 km) — Total investment for the project is RMB18.8 billion. The line is expected to have transportation capacity of 110 million tons per annum in the near term and 200 million tons per annum in the long term. Media reported that this project would be completed in 2014.

Of the eight high-profile rail projects that are commonly cited as bringing new coal transport capacity into Bohai Bay, the Changzhi-Handan-Huanghua links will be completed this year. Another five projects will be completed in 2014 (see Exhibit 177 and Exhibit 178). Together with the remaining project that is on track for completion through 2015, they will be bringing an incremental 690 million tons of transport capacity.

The Appalachian Butterfly Effect: A Eulogy for the Global Thermal Coal Market

China Has Been 100% of the Growth in the Seaborne Demand Over the Last Five Years; We Think It Will Be a Zero by 2015

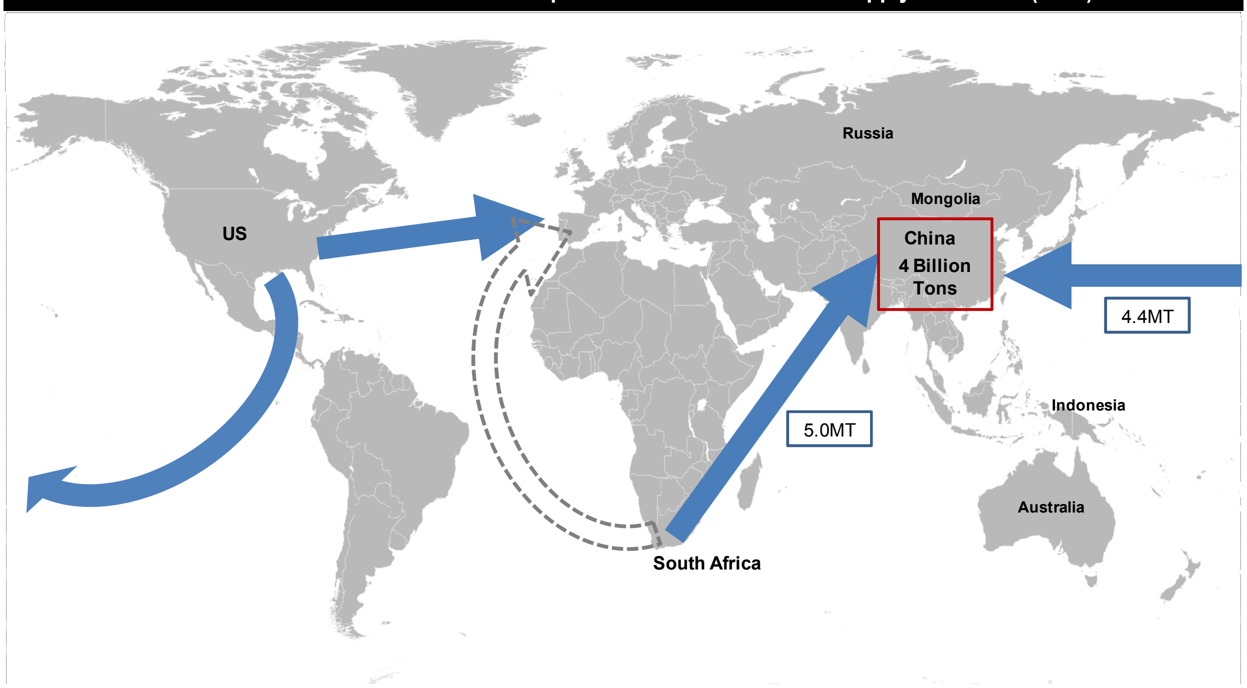
Decelerating power demand growth and structural weakness in other end markets, combined with more hydro, nuclear and renewables and more coal production and rail capacity in China adds up to the once unthinkable — zero net imports in 2015 and falling Chinese demand by 2016.

In our view, from 2015, the large-scale Chinese miners will take over the entire domestic market, pushing out imports and raising, for the first time since 2008, the possibility of Chinese coal net exports. Once Chinese coal demand starts to fall, there is no robust growth market for seaborne thermal coal anywhere. Developed market consumption is weak everywhere due to some combination of low gas prices, rising environmental concerns and low levels of industrial activity. That leaves just one large, structural growth market for coal — India.

A Eulogy for the Global Thermal Coal Market

There is nothing that delights the sell-side more than the thought of being able to describe the world in the context of one grand, unifying idea: *you may understand the movement of the individual pieces, but let us show you the whole board.* For much of 2012, correlated coal price movements in the U.S. and Asia gave rise to the inference that we were seeing the emergence of a global thermal coal market. As coal prices fell in the U.S., exports increased; U.S. coal shipments to Europe displaced South African coal into Asia…and coal prices in China fell. It certainly looked like one market (see Exhibit 189).

Exhibit 189 **Seaborne Coal Displacement and Incremental Supply Into China (2012)**



Source: Wiki commons, SX Coal, Public Press, EIA, BREE, RBCT and Bernstein estimates and analysis.

The elegance of the narrative overwhelmed questions like whether an extra 10 million tons of U.S. coal exports could really tank a 4 billion ton Chinese market; or whether the economics of shipping thermal coal halfway around the world would still work once prices had fallen ~30%.

We believe the impact of imports on the decline in Chinese coal prices in 2012 is often overstated. The risk of this over-attribution is that it creates a tendency to overestimate volatility in the Chinese coal price in 2013 and beyond. In short, the risk of upward pressures on coal prices outside of China resulting in a sharp snap-back in the domestic price is, in our view, lower than what the market generally believes.

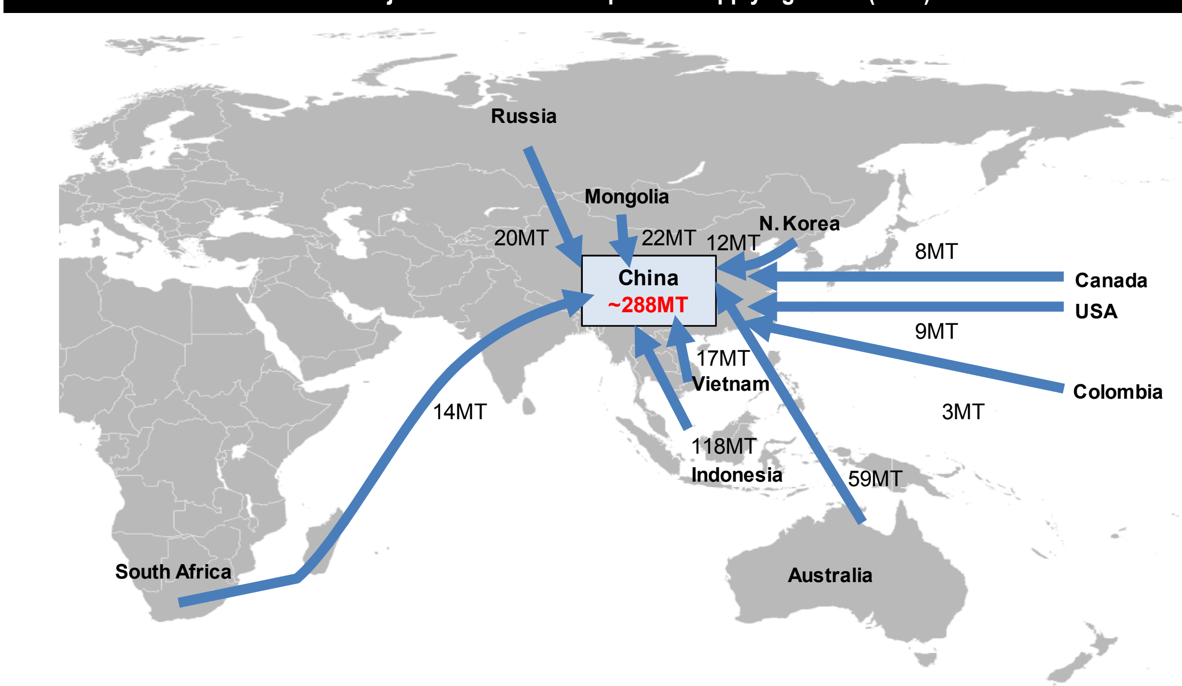
The three primary reasons for the 30% decline in Chinese coal prices since November 2011 have been China (demand), China (supply) and China (transportation). The Appalachian Butterfly Effect — U.S. coal and coal prices into Asia — runs a distant fourth. The ~10 million ton increase in Chinese imports from the U.S. and South Africa in 2012 was simply not large enough, in isolation, to explain the drop in the spot price in the 4 billion ton Chinese coal market (see Exhibit 189).

In 2012, U.S. coal imports into China were 9.3 million metric tons, almost double the 2011 level (4.9 million tons). South African coal exports to China in 2012 more than doubled year-over-year to 14.3 million tons from 9.3 million tons.

On the other hand, Chinese coal imports from Australia and Indonesia increased by 20-30 million tons each in 2012 and were more significant contributors to downward pressure on domestic prices than U.S. coal supply.

But the greater force (by far) in pushing Chinese coal prices down has been domestic production capacity growth (~800 million tons by our estimate since 2011) in a structurally decelerating demand environment. These pressures will persist throughout 2013, 2014 and 2015 regardless of happens to U.S., South African, Colombia, Australian and Indonesia coal exports (see Exhibit 190).

Exhibit 190 **Major Seaborne Coal Exporters Supplying China (2012)**



Source: Wiki commons, SX Coal, Public Press, EIA, BREE, RBCT and Bernstein estimates and analysis.

We believe that Chinese coal imports are likely to fall in absolute terms in 2013 as lower-priced domestic supply pushes out imports. The great hope for the global thermal coal market is now India. However, coal imports (135 million tons in the previous fiscal year) are unlikely to increase over 175 million tons in the next few years due to a combination of port capacity constraints and low power prices, which net back to a low supportable coal price. India will fail to pick up the slack in the seaborne market from the loss of China's volume and, as a marginal buyer, will support a far lower price than China has in recent years.

China and the Seaborne Thermal Coal Market

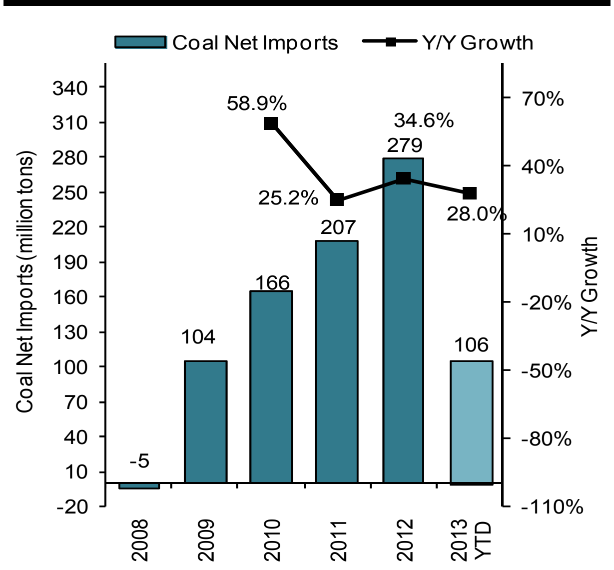
For those watching the thermal coal price in 2012, the grand idea was that of a global thermal coal market taking shape. In 2012, low gas prices in the U.S. pulled down thermal coal prices as North American utilities switched generation from coal-fired to gas-fired units, weakening demand for coal. U.S. coal miners on the east coast — rather than shuttering mines in the wake of falling U.S. demand — started exporting coal to Europe. U.S. coal shipments to Europe displaced South African coal from Europe into Asia. And, as a result, coal prices in China, Australia and Indonesia started to fall.

We like a big idea as much as anyone but there is a problem with this particular explanation of 2012 coal price movements. Yes, the changes in flows as depicted in Exhibit 190 occurred. But these changes in seaborne coal volumes globally in 2012 relative to the size of Chinese market mean that attributing the 25% drop in Chinese coal prices solely to the uptick in U.S. coal exports (~20 million tons) is, in our view, incorrect. Our outlook for 2013-15 for Chinese thermal coal is therefore driven by China, China and China…demand, supply and transportation. The role of Australia, South Africa, Indonesia and the U.S. is a secondary — and diminishing — consideration, in our view.

In this chapter, we set out our view for falling Chinese coal imports in coming years and close to zero net imports in 2015. In addition, we discuss the reasons we believe India will be unable — even at today's lower coal prices — to take up all of the available supply.

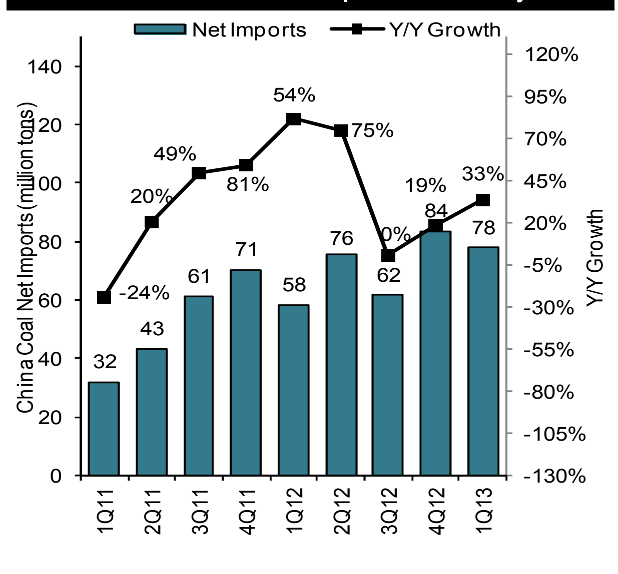
China imported ~280 million tons (net) of coal in 2012, up 35% from 2011 (see Exhibit 191). Imports reached record high at 106 million tons in the first four months (see Exhibit 192). The total seaborne market is roughly 1.1 billion tons.

Exhibit 191 China Coal Net Imports — Annual



Source: CEIC and Bernstein estimates and analysis.

Exhibit 192 China Coal Net Imports — Quarterly



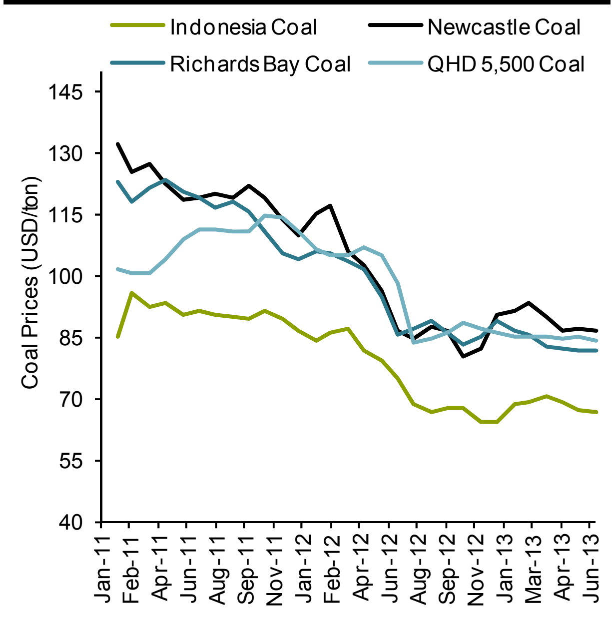
Source: CEIC and Bernstein estimates and analysis.

With Chinese coal imports (net) up almost 80 million tons in a seaborne market of just over one billion tons, it is worth noting the significant trends within Chinese supply, specifically:

- U.S. coal exports were up 17% year-over-year at 114 million tons (126 million short tons) in 2012. U.S. coal imports into China were ~9 million metric tons, almost double the 2011 level (5 million metric tons).
- South African coal exports to China increased over 50% year-over-year to 14.3 million tons in 2012 from 9.3 million tons in 2011.
- Australian coal exports to China increased 82% to 59.5 million tons in 2012 from 32.6 million tons in 2011.
- Indonesia coal exports to China increased 17% to 118.5 million tons in 2012 from 101.0 million tons in 2011.
- Mongolia, Russia, North Korea and Vietnam each supplied roughly 10-20 million tons of coal to China in 2012.

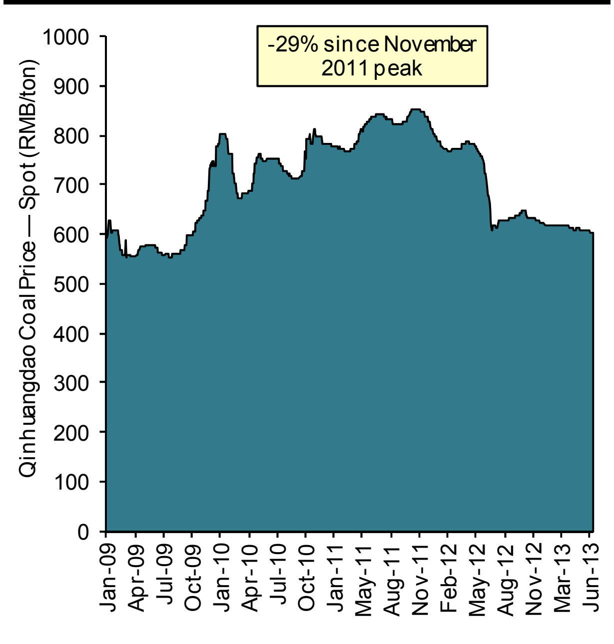
In total, the increase in Atlantic Basin coal exports to China (i.e., from the U.S. and South Africa) was only ~10 million tons. But perhaps the most remarkable aspect of the increase in Chinese coal imports in 2012 is that the ramp-up occurred while coal prices globally continued to fall (see Exhibit 193 and Exhibit 194). The coal price globally fell as demand in the U.S. declined in absolute terms and demand growth in China slowed down.

Exhibit 193 Coal Price Benchmarks



Source: Bloomberg, SX Coal and Bernstein estimates and analysis.

Exhibit 194 QHD 5,500 Coal Price

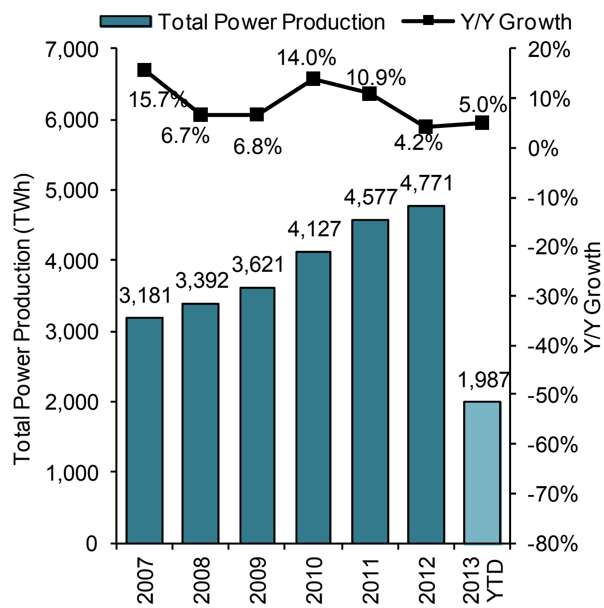


Source: SX Coal and Bernstein estimates and analysis.

In our view, the fall in coal price in China was not triggered primarily by increased, low-priced imports. The primary cause of weakening coal prices in China was weakening demand growth from the power, steel and cement sectors paired with production and transport capacity growth that exceeded demand growth.

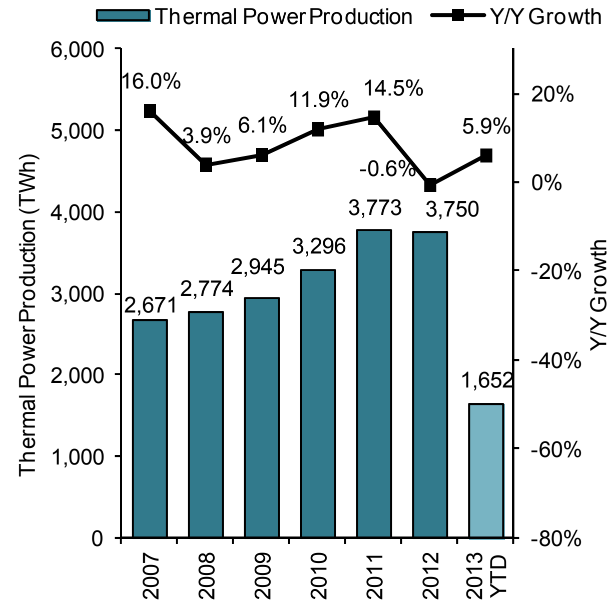
Power production in China was up 4.2% year-over-year in 2012, while thermal power production (which accounts for roughly half of Chinese coal consumption) was down ~1% year-over-year (see Exhibit 195 and Exhibit 196).

Exhibit 195 China Total Power Production — Annual



Source: CEIC and Bernstein estimates and analysis.

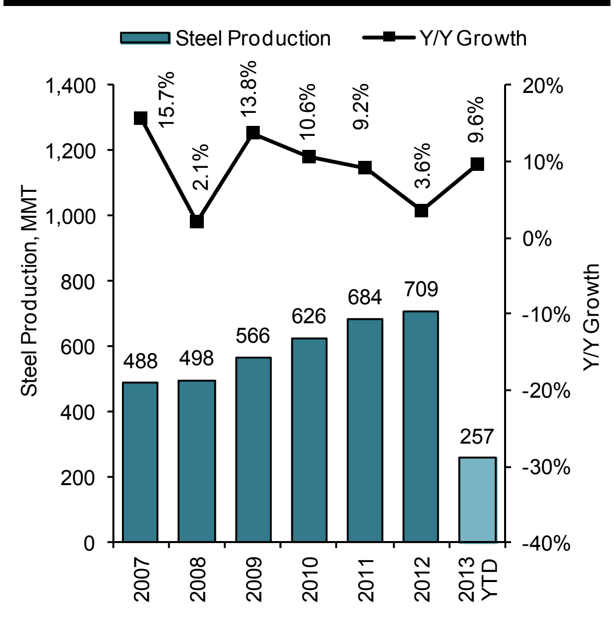
Exhibit 196 China Thermal Power Production — Annual



Source: CEIC and Bernstein estimates and analysis.

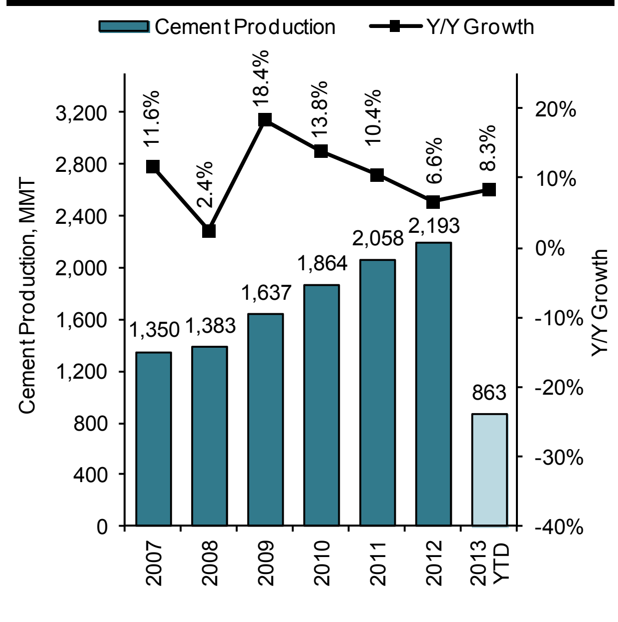
Chinese steel production (which accounts for roughly 18% of coal consumption) increased 3.6% in 2012 while cement production (which accounts for roughly 7% of coal consumption) increased 6.6% last year (see Exhibit 197 and Exhibit 198).

Exhibit 197 China Steel Production — Annual



Source: CEIC and Bernstein estimates and analysis.

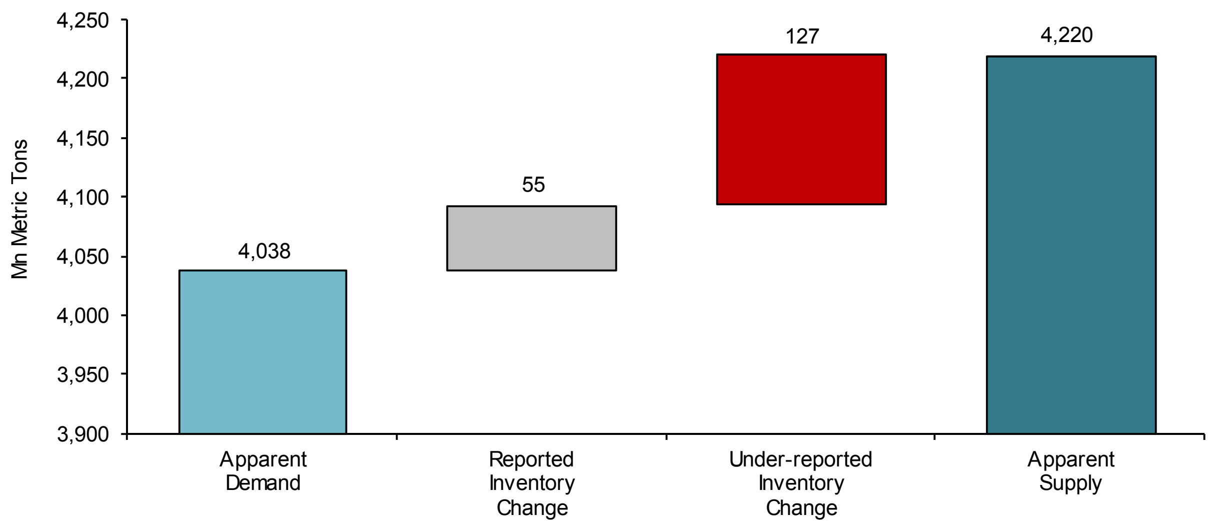
Exhibit 198 China Cement Production — Annual



Source: CEIC and Bernstein estimates and analysis.

Based on a combination of official statistics and our own estimates, Chinese apparent demand held steady at ~4,000 million tons annually in 2012 (see Exhibit 199). And yet coal prices fell.

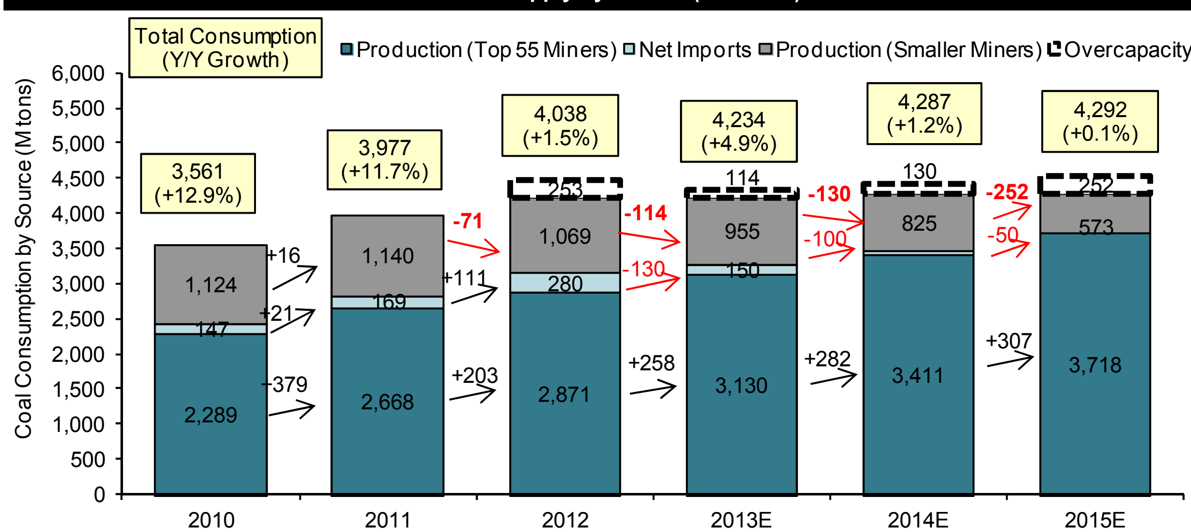
Exhibit 199 China Coal Apparent Demand Analysis (2012)



Source: SX Coal and Bernstein estimates and analysis.

The simplest way to explain the fact that coal prices fell 25% over the course of 2012 despite the fact that, overall, demand for coal was essentially flat, is the share shift within the Chinese coal market sector. In short, the bigger players got bigger and, in the absence of continuing rapid demand growth, the smaller, high-cost miners got squeezed out (see Exhibit 200).

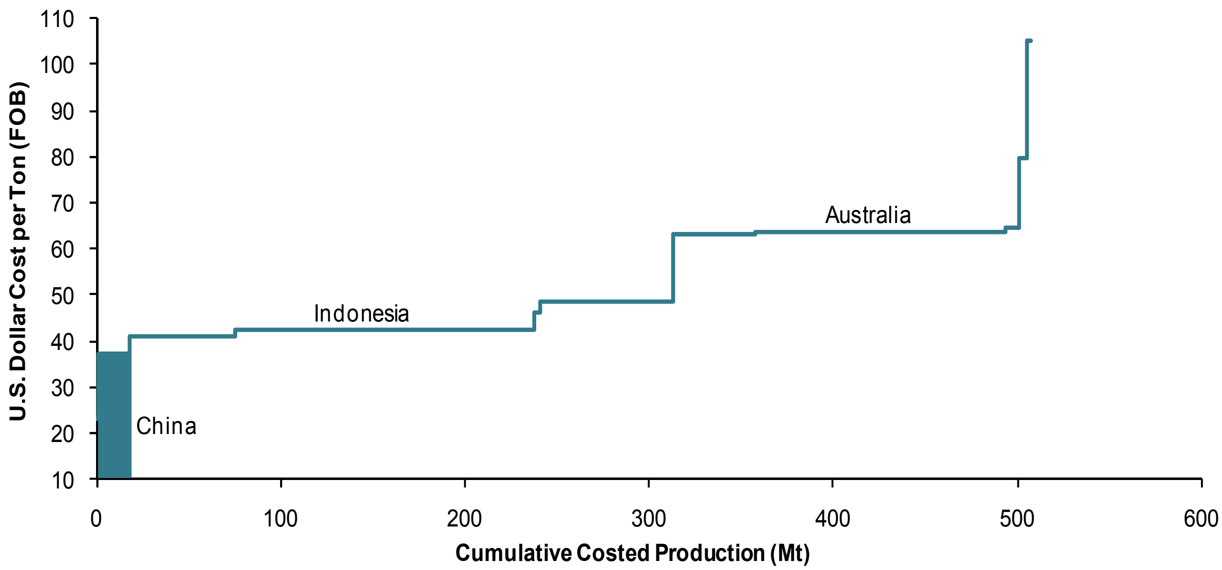
Exhibit 200 Chinese Coal Supply by Source (2010-15E)



Source: SX Coal, CEIC, NBS, China General Administration of Customs and Bernstein estimates and analysis.

To us, this is a far more plausible explanation for the collapse in coal prices and their stubborn refusal to rise again than the idea that ~10 million tons of incremental coal from South Africa and the U.S. resulted in a collapse in pricing in a 4.0 billion ton Chinese coal market. Indeed, the view that the decline in coal prices over the last year is the result of the Appalachian Butterfly Effect assumes a Chinese coal cost curve that is so dramatically S-shaped that it — rather than coal imports — would be, by far, the more important and interesting dynamic (see Exhibit 201). The simplest explanation is that production share was taken by lower-cost Chinese coal miners and that these miners set a low spot price.

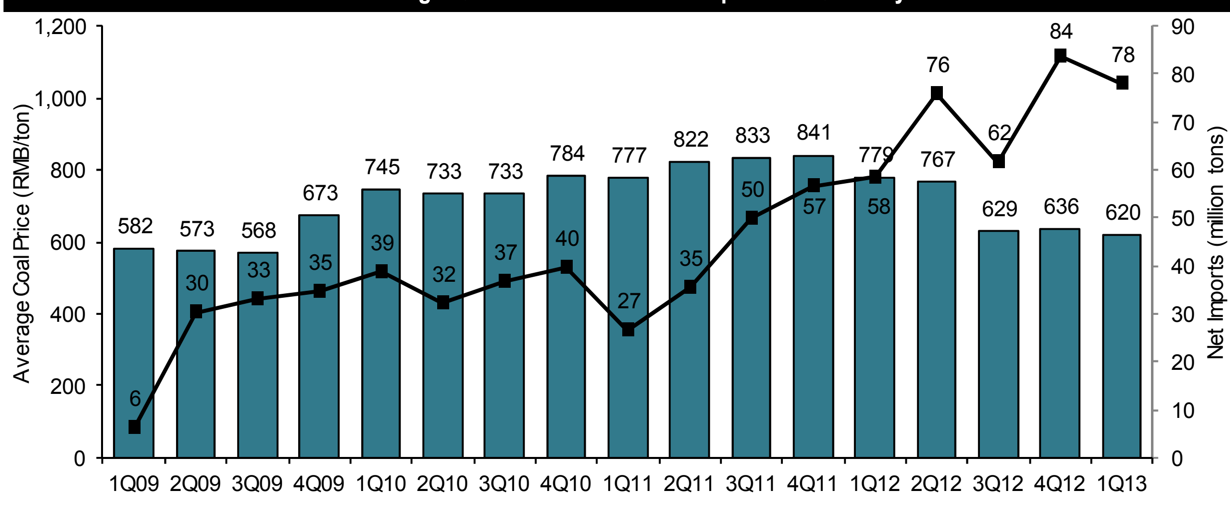
Exhibit 201 Exported Thermal Coal Cost Curve (2010)



Source: AME and Bernstein estimates and analysis.

The Chinese coal traders and power companies have continued to opportunistically increase imports where the seaborne market will supply at less than the falling Chinese domestic coal price (see Exhibit 202). This will continue to happen through 2013, but it will become tougher for the seaborne market to meet the China price. We anticipate that production capacity growth in 2013 domestically is expanding at a similar rate to 2012 and the high-cost domestic producers will continue to lose share. The difference between 2012 and 2013 is that we expect the large-scale Chinese producers to start taking share from the seaborne market too. Cost structures among large-scale miners in each of these markets (even China) will ultimately dictate supply (see Exhibit 201).

Exhibit 202 Average QHD Coal Price vs. Net Imports — Quarterly



Source: CEIC, SX Coal and Bernstein estimates and analysis.

We expect coal prices to trade within a narrow range going forward owing to the fact that there is plenty of supply available both domestically and from the seaborne market if coal prices creep back up. The Qinhuangdao spot price as of mid-June 2013 is RMB605/ton. The summer peak in coal price will be, in part, a function of hydro generation, which is inherently unpredictable. We forecast an average price of RMB630/ton for 2013, 2014 and 2015, down ~10% from 2012 (see Exhibit 203).

Exhibit 203 **SCB QHD Coal Price Forecast**

		Average Annual Price					
RMB/Metric ton, including VAT	Current	2010	2011	2012	2013E	2014E	2015E
Datong Premium (5,800 kcal/kg)	655	790	871	758	664	664	664
Shanxi Premium (5,500 kcal/kg)	620	748	821	699	630	630	630

Source: SX Coal and Bernstein estimates and analysis.

We continue to expect that the large-scale Chinese coal miners will force out both small, high-cost miners and, from 2013, the seaborne market. The seaborne market was ~1.1 billion tons in 2012, and China represented almost 25% of demand. If our forecast of Chinese net imports falling to zero by 2015 is accurate, the question is: *where does all that coal go?*

Can India Take Up the Slack?

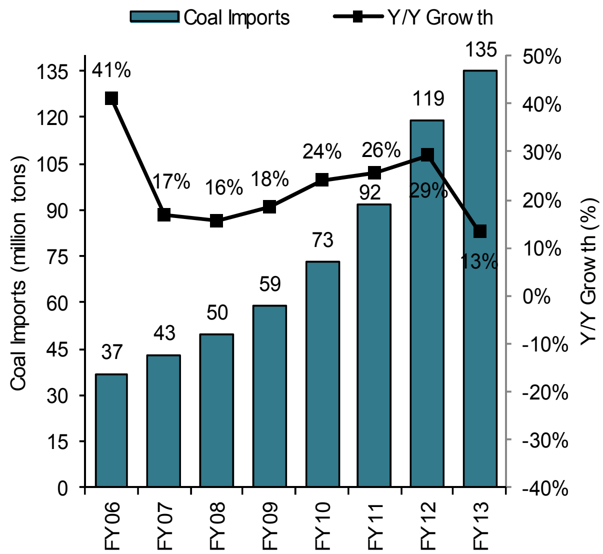
If, as we expect, Chinese demand for seaborne coal begins a period of terminal decline this year, the next and last source of long-term structural demand growth for seaborne thermal coal is India. The problem in India is not lack of coal; according to the BP Energy Survey, India has the fifth-largest coal reserves of any country behind only the U.S., Russia and China and Australia (see Exhibit 205). Yes, Indian coal has a lower calorific value and higher ash, sulfur and moisture content than might be ideal for generating power but this is not news to anyone...least of all the Indian power sector. The coal-fired power fleet has been designed with the limitations of Indian coal in mind. The question is whether the Indian coal mining sector (i.e., Coal India) can mine the coal and the Indian Ministry of Rail can move the coal in the quantities required.

If not, (and the answer to date has been "not"), imported coal is the only remaining option. With China exiting the seaborne market, coal supply will free up at lower prices than have been offered in many years. The second question is therefore: are prices low enough? The final question is: does India have the port and rail infrastructure to import significantly more coal?

India's coal imports have been increasing in recent years (see Exhibit 204). In FY 2013 (ending March 31, 2013), coal imports increased 13% year-over-year. The Planning Commission of India projects India's coal imports to increase to 185 million tons by FY 2017 (ending March 31, 2017).

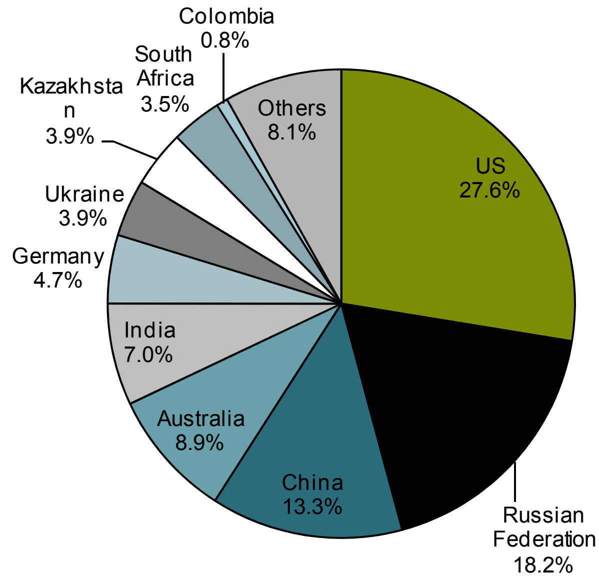
Coal India accounts for about 80% of total coal production in India. The company reported only 3.8% production growth in FY 2013 (see Exhibit 206), primarily owing to monsoon and labor issues. This weak domestic supply growth suggests that there is plenty of opportunity to increase coal imports.

Exhibit 204 India Coal Imports by Fiscal Year (March 31 Year End)



Source: Ministry of Coal, RBI, CEIC, Public Reports and Bernstein analysis.

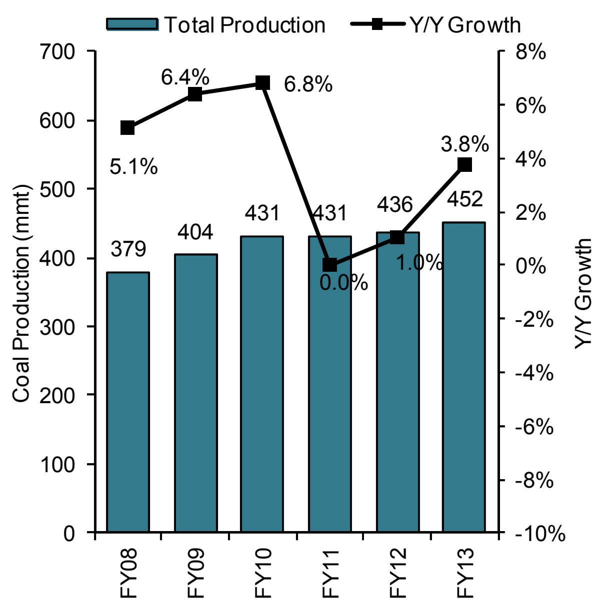
Exhibit 205 Global Coal Reserves by Country (2012)



Source: BP Energy 2013 and Bernstein analysis.

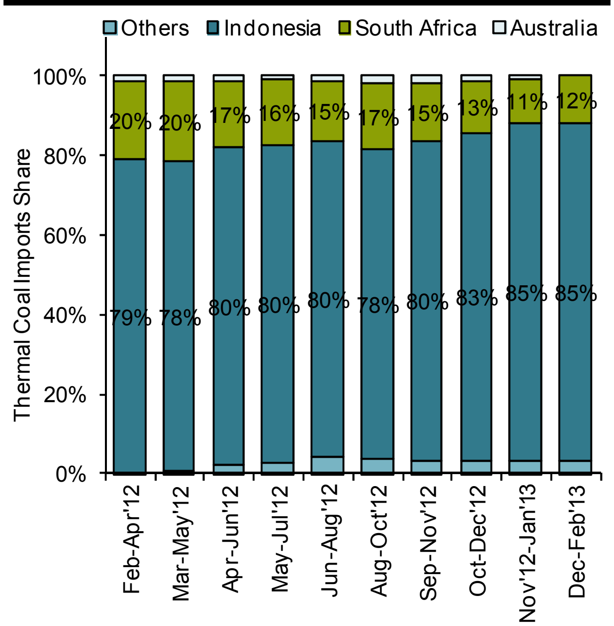
Indonesia dominates coal imports to India, followed by South Africa, while Australia is not a significant source of coal imports to India (see Exhibit 207). Constraints on importing more coal are therefore infrastructure (port and rail capacity) and the fact that the seaborne coal price remains above the regulated price that Coal India charges for domestic coal (even once the adjustment has been made for calorific value).

Exhibit 206 Coal India Production and Y/Y Growth (Annual)



Source: Corporate reports and Bernstein estimates and analysis.

Exhibit 207 India Thermal Coal Rolling 3 Million Imports by Supply at Top Ports (February YE)



Source: Coal Insight and Bernstein analysis.

All of the 10 coastal states in India have at least one port to handle coal (see Exhibit 208) — some ports (like Karaikal in Puducherry) cater to the neighboring states (Tamil Nadu). By our estimate, total port capacity is ~265 million tons annually. The ports on the eastern side of India handle more coal cargo — approximately 15 million tons more than the one on the western side.

Exhibit 208 **India Coal Handling Ports — February 2012 to January 2013 Coal Imports Volume and Current Industrial Tariff Rates**

Source: India Coal Market Watch, SEBs reports, Wikimedia commons and Bernstein estimates and analysis.

In short, the limitation on increasing Indian coal imports is not — on its face — lack of port capacity.

There are, of course, other considerations. Due to the cost of railing coal around India, the ability of a port to increase coal imports is largely a function of port capacity, seaborne coal price, availability of coal-fired power stations in the importing coastal state and the local power price. Maharashtra has the highest average industrial power tariff of INR7.63/KWh while Kerala has the lowest at INR4.20/KWh. Ports, handling capacity, average power prices, current imports and co-located coal-fired generation capacity are set out in Exhibit 209.

Exhibit 209 **Indian Coal Receiving Ports Represent Around 91% of Total Coal Imports (February 2012 to January 2013)**

State	Port	Coal Capacity / Imports (mtpa)	Coal Import LTM (mt)	Coal Capacity (mtpa)	Avg Domestic Tariff (INR/unit)	Avg Industrial Tariff (INR/unit)	Coal Based Plant (MW)
Gujarat	Mundra	60.00	19.24	60	3.6	4.5	15,190
	Kandla	4.03	4.03				
	Magdalla	4.80	4.80				
	Dahej	20.00	6.33	20			
Maharashtra	Mumbai Port Trust	4.05	4.05		5.2	7.3	15,866
	Jaigarh	2.89	2.89				
Goa	Mormugao	11.00	7.84	11	Between Maharashtra and Karnataka		0
Karnataka	NMPT	6.44	6.44	5	4.0	4.9	4,780
Kerala	Cochin	0.05	0.05		4.5	4.2	0
Tamil Nadu	Tuticorin	12.55	3.43	13	3.2	5.5	8,160
	Ennore	21.00	5.73	21			
	Chennai	3.270	0.004	3			
Puducherry	Karaikal	16.00	2.38	16	On Tamil Nadu Border		0
Andhra Pradesh	Vizag	25.00	13.16	25	4.9	4.5	10,143
	Krishnapatnam	12.56	12.56				
	Gangavaram	20.00	9.15	20			
	Kakinada	4.00	1.98	4			
Orissa	Paradip	21.50	14.41	22	4.1	4.9	6,790
West Bengal	Kolkata Port Trust	14.50	7.48	15	5.6	5.9	12,065
Total		**263.64**	**125.94**				**72,994**

Source: Indian Ports Association, India Coal Market Watch, Coal Insight, Coal Portal report, CEA, SEBs reports and Bernstein analysis.

All of the state electricity boards raised power tariffs in 2012 and still raising in 2013.

Exhibit 210 **Average Power Tariff Rates of Domestic Consumers**

AVERAGE DOMESTIC TARIFF RATES

State	Date	New Avg. (Rs./unit)	Date	Old Avg. (Rs./unit)	% Chg
Uttar Pradesh	May 31 2013	3.80	Oct 1 2012	3.08	23.38%
Maharashtra	Aug 1 2012	5.17	Nov 1 2011	4.82	7.16%
Bihar	Apr 1 2012	3.10	May 1 2011	2.99	3.55%
West Bengal	Mar 6 2012	5.63	Dec 30 2011	4.96	13.54%
Andhra Pradesh	Apr 1 2012	4.85	Apr 1 2011	4.05	19.75%
Madhya Pradesh	Apr 2012	4.28	FY2012	3.87	10.47%
Rajasthan	May 17 2013	4.25	Aug 10 2012	4.05	4.94%
Tamil Nadu	Apr 1 2012	3.16	FY2012	2.85	11.03%
Karnataka	Apr 30 2012	4.00	Oct 28 2011	3.90	2.56%
Gujarat	Jun 1 2012	3.61	Sep 1 2011	3.54	2.12%
Orissa	Apr 1 2012	4.08	Apr 1 2011	3.50	16.43%

Source: State Electricity Boards' Reports and Bernstein analysis.

The average hike in 2012 for the 11 largest states by population (accounting for ~80% of India's total population) was ~9% for domestic consumers and 12-14% for industrial customers (see Exhibit 210 and Exhibit 211).

Exhibit 211 **Average Tariff Rates for Low Tension (LT) and High Tension (HT) Industrial Consumers**

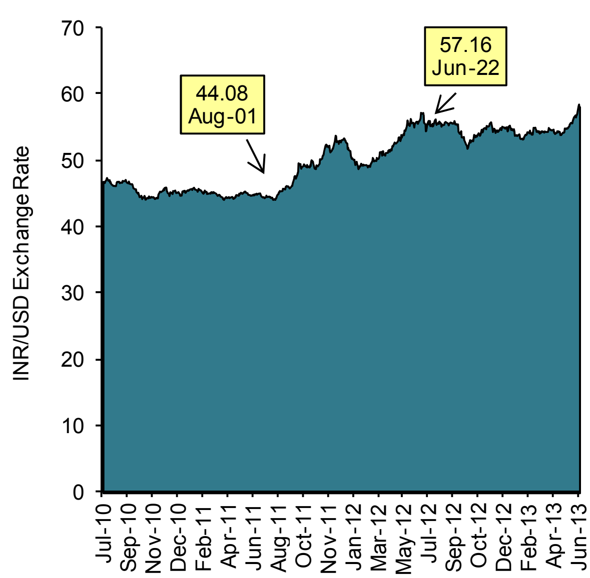
AVERAGE INDUSTRIAL TARIFF RATES

State	Section	Date	New Avg. Rs/Unit	Date	Old Avg. Rs/Unit	% chg
Uttar Pradesh	Industrial LT	May 31 2013	6.00	Oct 1 2012	5.85	2.56%
	Industrial HT		5.53		5.53	0.00%
Maharashtra	Industrial LT	Aug 1 2012	7.19	Nov 1 2011	6.80	5.74%
	Industrial HT		7.47		6.97	7.17%
Bihar	Industrial LT	Apr 1 2012	5.13	May 1 2011	4.65	10.22%
	Industrial HT		4.59		4.20	9.23%
West Bengal	Industrial LT	Mar 6 2012	6.18	Dec 30 2011	5.50	12.20%
	Industrial HT		5.61		5.23	7.30%
Andhra Pradesh	Industrial LT	Apr 1 2012	4.20	Apr 1 2011	3.33	26.11%
	Industrial HT		4.85		4.09	18.53%
Madhya Pradesh	Industrial LT	Apr 2012	4.90	FY2012	4.54	7.99%
	Industrial HT		4.39		4.00	9.65%
Rajasthan	Industrial LT	May 17 2013	4.87	Aug 10 2012	4.87	0.00%
	Industrial HT		5.38		5.38	0.00%
Tamil Nadu	Industrial LT	Apr 1 2012	5.50	FY2012	4.50	22.22%
	Industrial HT		5.50		4.00	37.50%
Karnataka	Industrial LT	Apr 30 2012	4.57	Oct 28 2011	4.37	4.58%
	Industrial HT		5.30		5.10	3.92%
Gujarat	Industrial LT	Jun 1 2012	4.40	Sep 1 2011	4.21	4.51%
	Industrial HT		4.68		4.56	2.47%
Orissa	Industrial LT	Apr 1 2012	5.30	Apr 1 2011	4.80	10.42%
	Industrial HT		4.47		4.25	5.10%

Source: State Electricity Boards' Reports and Bernstein analysis.

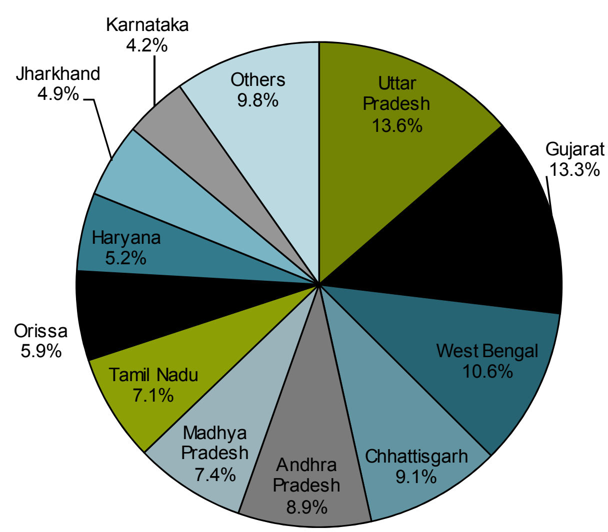
As coal prices have fallen since November 2011, the rupee has weakened meaning that the benefit of the lower seaborne coal price in India has been muted (see Exhibit 212).

Exhibit 212 **INR-USD Exchange Rate**



Source: Bloomberg L.P. and Bernstein analysis.

Exhibit 213 **Coal Plant Capacity by State (April 2013)**



Source: CEA and Bernstein analysis.

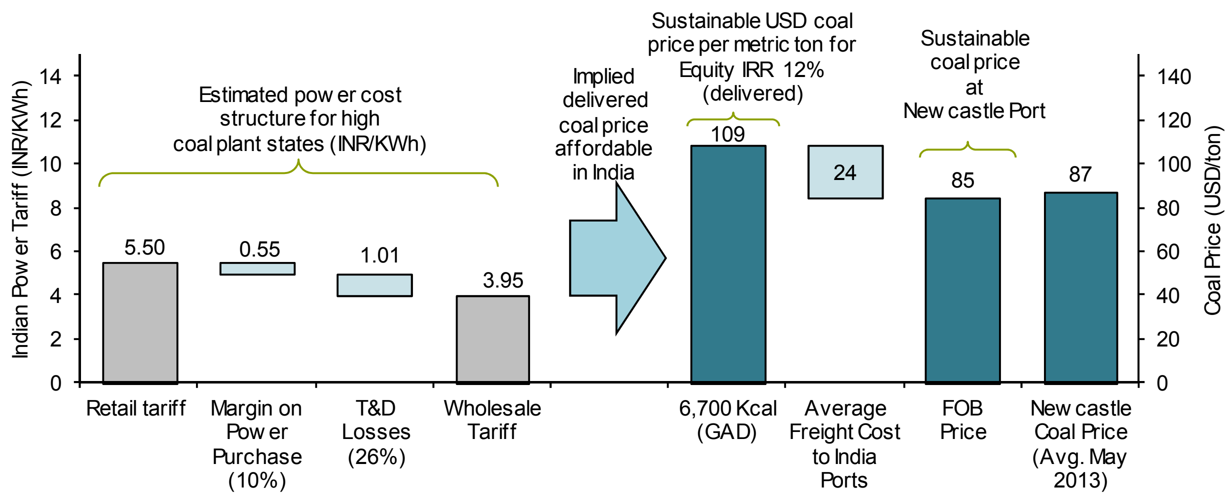
The average retail price of electricity for industrial consumers in the largest 12 states in India (as measured by coal-plant-installed capacity) is INR5.50/KWh (or ~US$0.10/KWh) — see Exhibit 211. These states have around 91% of total coal-fired power station capacity in India.

Given that a reasonably effective pass-through mechanism exists in the Indian power sector for coal costs, the amount of coal that the country may purchase is a function of port capacity, coal-fired power generation capacity, the seaborne coal price, the retail power price and the level of demand for electricity given that power price. Assuming the country-wide Transmission & Distribution losses (T&D) as 26% and margin on power purchase of State Electricity Boards (SEBs) as 10%, the average retail tariff of INR5.50/KWh converts to the required levelized cost of electricity at the power station of ~INR3.95/KWh or ~US$0.07/KWh (see Exhibit 214).

A generic coal-fired power station in India operating at 62% utilization, charging INR3.95/KWh wholesale tariff and using blended coal of 4,250Kcal/Kg GAR, can achieve a return on equity of 12% using coal with a delivered price at port of US$109/ton (Newcastle 6,700 GAD), US$110/ton (Richards Bay 6,000 NAR) and US$91/ton (Indonesia 5,900 GAR).

Incorporating the average shipping cost of ~US$24/ton to India ports from Newcastle, the supportable FOB price comes to be US$85/metric ton at Newcastle — below the May average FOB price of US$87/ton.

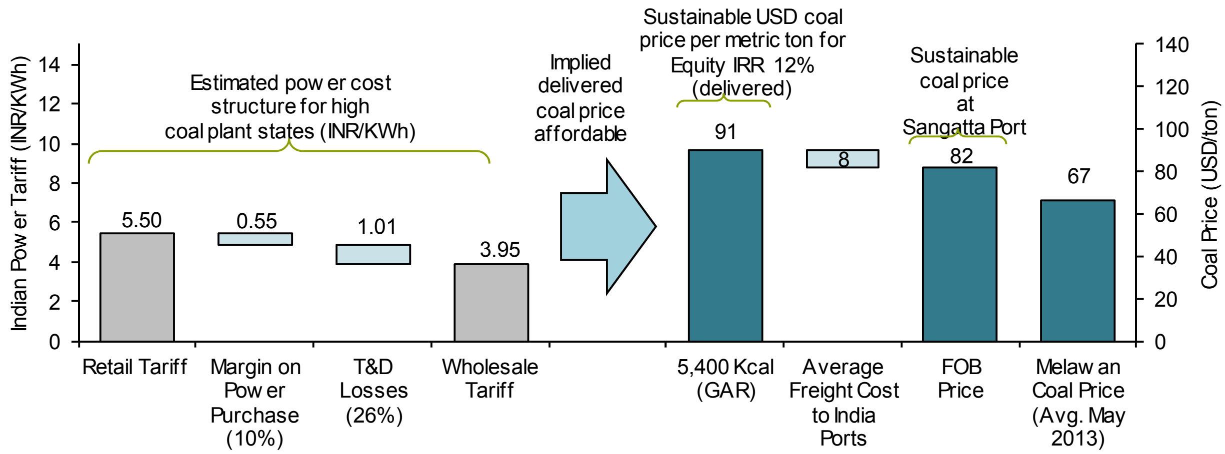
Exhibit 214 **India: Implied Affordable Newcastle Coal Price for Top 12 States by Coal-Based Plant Capacity**



Source: Government announcements, SEB Annual Reports, Coal Insight, Bloomberg L.P. and Bernstein estimates and analysis.

The supportable FOB price in Indonesia is US$82/ton, taking average shipping cost to ports of India at around US$8/ton (see Exhibit 215). The sustainable price is around $15/ton higher than May average Indonesian coal price.

Exhibit 215 **India: Implied Affordable Indonesia Coal Price for Top 12 States by Coal-Based Plant Capacity**



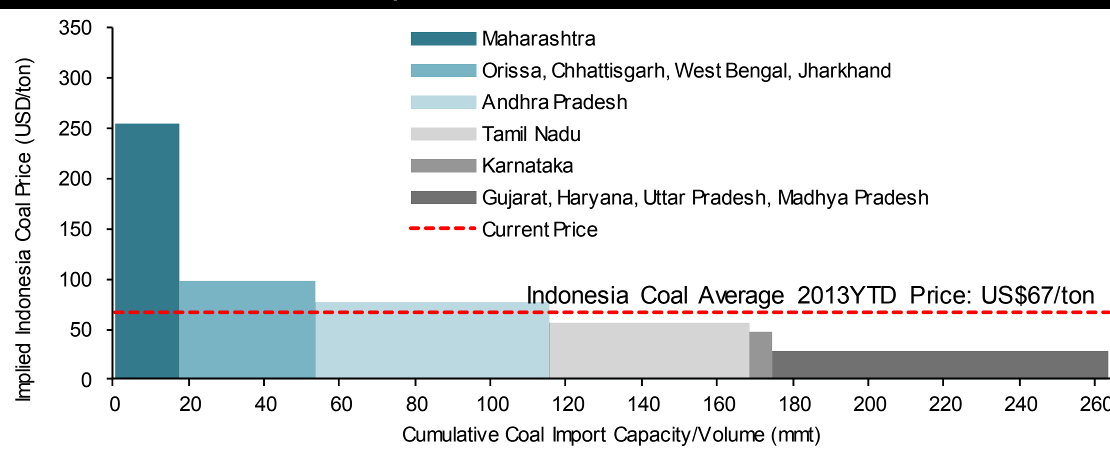
Source: Government announcements, SEB Annual reports, Coal Insight, Bloomberg L.P. and Bernstein estimates and analysis.

In short, at a national level, Indonesia is likely to continue to dominate coal sales to India as Australian and South African coal prices, even at current levels, remain challenging.

But the Economics of the "Average" Power Station Doesn't Matter

Of course, this approach looks at *average* power prices in coastal states. That consideration is not the correct one in the short term. A more sophisticated approach is to layer the ability to pay at a state level with port capacity at a state level. On that view, only four coastal states — Maharashtra, Orissa, West Bengal and Andhra Pradesh, totaling to 116 million metric tons of imported coal handling capacity — can afford to import coal priced at levels greater than or equal to the current Indonesian coal FOB price (see Exhibit 216).

Exhibit 216 **India Imported Coal Cost Curve — Indonesia**



Source: Indian Ports Association, India Coal Market Watch, Bloomberg L.P., SEB Annual reports, Coal Insight and Bernstein estimates and analysis.

Because of lower shipping costs, Indonesian and South African coal is viable in Tamil Nadu and Karnataka too. However, there is, in total, only 175 million tons of port capacity for seaborne coal at current prices. India is importing 135 million tons today. And China is about to give back 280 million tons to the seaborne market. Prospects for seaborne coal are going to continue to deteriorate, almost regardless of power demand in India.

Index of Exhibits

Disclosure Appendix

VALUATION METHODOLOGY

Chinese Coal Miners: We value China Shenhua at HK$20.00 per share on a P/E basis by applying a forward multiple of ~8x to our 2014 EPS estimate of RMB1.95. Further, assuming that the company maintains a ~40% dividend payout ratio, a $20 share price implies a 5% dividend yield, which we believe investors will require given the continuing deteriorating profile of the industry. We value China Coal Energy at HK$3.00 per share by taking the average of (i) a forward P/E multiple of ~8x to our 2014 EPS estimate of RMB0.19 and (ii) a P/B multiple at the average of the lower quintile of global coal mining peers. We value Yanzhou at HK$5.00 per share on a P/E basis by taking the average of (i) a forward P/E multiple of ~8x to our 2014 EPS estimate of RMB0.38 and (ii) a P/B multiple at the average of the lower quintile of global coal mining peers. Our valuation for Yanzhou (ticker YZC; the NYSE-listed ADR) multiplies Hong Kong valuation by 10.0 (the number of H-shares each ADR represents) and divides by the HK$ exchange rate. We believe China Coal Energy and Yanzhou can find some support at these levels. On a DCF basis, we believe that China Coal Energy and Yanzhou stocks are worth zero. However, we do not believe that will be reflected in valuation over the next 12 months.

Chinese Renewable Operators: We value China Longyuan at HKD11.00 by applying an average P/E ratio of ~13x to our 2014 EPS estimate of RMB 0.67/share. The valuation reflects an equity raise in 2013 that the company announced on May 2012. We value Datang Renewable at HKD1.60 by applying an average P/E ratio of ~16x to our 2014 EPS estimate of RMB 0.08/share. Valuation is stretched due to concerns around the company's debt levels and the potential for an equity raise in 2013. We value Huaneng Renewables at HKD4.00 by applying an average P/E ratio of ~16x to our 2014 EPS estimate of RMB 0.20/share.

RISKS

There are numerous risks to our investment thesis on Shenhua, China Coal Energy and Yanzhou. Some of these risks are below.

First, contrary to our expectations, electricity demand growth may continue to grow at its historically high rate, increasing demand for thermal coal. Second, contrary to our expectations, steel growth may accelerate, increasing demand for coking coal. Third, coal production and rail transportation capacity may not increase at the rate that we are forecasting over the long term. As a result, coal pricing may not decline in the manner we are anticipating. Further, in the event that rail transportation capacity expansion fails to materialize, movement of coal resources across internally owned logistics and shipping assets may benefit diversified coal and generation companies like Shenhua. Fourth, the companies may decide to alter their investment strategies or enter into new business segments, changing capital expenditures or dividend payout rates and dividend growth rates. Fifth, China may relax its coal export quotas and India may become a more significant importer of coal than we are forecasting, providing a source of additional growth for the coal companies that are not currently included within our estimates. Sixth, the global economy may accelerate, leading to higher-than-anticipated demand for Chinese manufactured goods, increasing demand for Chinese coal and pushing up the price of seaborne coal. Seventh, the Chinese government may choose to stimulate the economy, resulting in an increase in demand for steel, power, cement and — ultimately — thermal and coking coal.

The key risks to the wind power companies' business model are: a reduction in the wind installed capacity target in China or a change to the mandatory tariff, grid connection and dispatch policy. In addition, a reduction in the amount of debt financing available for renewable energy projects in China would negatively impact growth rates both in terms of installed capacity and earnings. An increase in wind turbine prices is a risk given that more than 50% of construction costs relate to turbines. Finally, a reduction in transmission infrastructure construction in China would negatively affect the sector.

An increase in interest rates would negatively affect the companies as they are all highly levered. As with most utilities, given the stable nature of the revenues, high levels of debt are warranted. As a natural consequence of falling manufacturing costs, a stable regulatory environment and improved infrastructure, we anticipate an increasing sophistication among the renewable energy generators over sources of debt funding (more corporate bonds, less bank borrowing) and lower cost of debt over time. Accelerating inflation over the medium term and continuing monetary tightening are risks to our positive stance on the sector.

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Ticker	Rating Changes	
1088.HK	U (RC) 12/14/11	
1171.HK	U (RC) 12/14/11	
1798.HK	M (RC) 05/22/12	
1898.HK	U (RC) 06/13/12	
916.HK	O (RC) 01/31/13	M (RC) 05/22/12
958.HK	O (RC) 01/31/13	M (RC) 05/22/12
YZC	U (RC) 12/14/11	

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