ASIA RESEARCH & ENGAGEMENT

Time Out:

Why China's Power Companies Should Re-evaluate Their Coal Capex Plans

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"As an asset manager for major pension funds in the Netherlands, APG puts its utmost priority on implementing investment strategies which are strongly aligned with its clients' long-term ambitions. One of the clients' ambitions is to contribute to mitigating climate change risks by reducing the carbon footprint of equity portfolios by a significant 25% by 2020. We trust that this research (and related engagement) project is a crucial step in this direction."

YK Park, Director - Global Responsible Investment and Governance Team, **APG**

"China's 2030 commitments regarding carbon reductions, the launch of local carbon markets and tightening environmental regulations all point at an accelerating shift toward lower carbon power generation. However, the Chinese market remains under-researched as to the implications of this shift and corporate reporting on these impacts remains limited. This report provides a useful starting point by highlighting the risk exposure of key coal power generators in China. Investors now need more information on the extent to which companies stress-test their investment plans and enhance business resilience in the face of the transformation in the power sector."

Matthias Beer, Associate Director - Governance and Sustainable Investment, **BMO Global Asset Management**

"PGGM aims to halve the carbon footprint of the investment portfolio of our clients. This requires the utility companies we are invested in to become more carbon efficient. Expanding coal capacity undermines our carbon efficiency goal, putting the companies at risk of divestment from the portfolio. The potential divestment will also help us in managing climate risk in our portfolio, as high carbon assets will be at increasing risk in a decarbonizing world."

Pieter van Stijn, Senior Advisor Responsible Investment, **PGGM**

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Executive Summary

- **There is a wall of capex flowing into coal power in China with very negative sustainability impacts**
- **At the same time, regulatory and market risks are rising**
- **The companies are failing to clearly communicate their strategy**
- **Investors should ensure money is spent in their interests before financial stresses grow**

The seven leading listed Chinese power companies analysed in this briefing had plans in place at the beginning of 2016 to build up to 89 coal power plants with 68 GW of capacity over the next few years at an estimated cost of RMB 238 billion (USD 35 billion). But does all of this spend make sense?

This year we have seen a long list of regulations that will affect coal power prospects, including on sustainability factors – such as air, water, and carbon. At the same time, many provinces already face overcapacity, while new ultra-high voltage transmission capacity will bring pricing pressure even in poorly supplied regions.

The power companies' 2016 interim results led to downgrades across the sector as analysts digested bad news on sector fundamentals. In our review, we looked for the power companies' strategic responses to the continuing pressures and found worrying gaps. Plant utilisation trends continued to decline, affecting returns, yet the companies have not provided guidance on reductions to capex. They all have plans to build in regions exposed to high regulatory risk including for air and water standards. Overall, the disclosure does not allow investors to assess prospects for any of the companies.

We believe investors should apply greater scrutiny to capital expenditure plans and ask management to provide robust justification for continued spending or to cancel the investments. To support this dialogue, the following pages set out the investment projects per company, together with plant level analysis of air and water risks. This not only makes it clear where companies are taking on new capacity utilization risk, but also where they are compounding those risks with publicly sensitive regulatory risks.

The following table shows the summary figures per company on the basis of planned and permitted plants. Our research provides risk assessments for each plant based on local conditions for air pollution and water stress. The table shows the amount and proportion of capacity per company in the highest risk categories. These total 15 GW or 23% of the proposed 68 GW capacity additions.

While regulators have emphasised air and water, carbon related regulation is also a concern, especially as the Paris Climate Agreement came into force much quicker than expected on November 4, 2016. We estimated lifetime emissions for the plants on the basis of 30 year lifespans at a total of 7.2 $GtCO_2$. This is approximately 1.6% of the total carbon dioxide emissions that can be emitted while holding temperature increases to two degrees. As the effects of climate change increase, so will the willingness to regulate to achieve China's commitment to peak emissions by 2030 or earlier. This increases regulatory risks for plants built today.

Figure 1: Planned coal power plant investments

	Plants	Capacity (GW)	Cost estimate (RMB billion)	Highest risk (GW)	Highest risk (%)	Estimated lifetime CO_2 (Mt)
China Power International	10	9.3	32.6	2.0	21	958
China Resources Power	12	9.8	34.4	1.3	13	1,049
China Shenhua Energy	19	18.6	65.2	4.0	21	1,962
Datang International Power	10	6.0	21.2	0.7	12	672
Guodian Power Development	14	9.4	32.8	2.7	29	1,036
Huadian Power International	9	5.9	20.6	0.7	11	616
Huaneng Power International	15	8.9	31.3	4.0	45	981
TOTAL	**89**	**68**	**238**	**15**	**23**	**7,274**

Source: Company reports, Coal Swarm, Greenpeace, ARE (China Resources Power and China Shenhua Energy do not provide lists of planned plants in their annual reports, so these are based on searches)

For investors in these companies, our top questions are:

- What are your detailed capex plans by plant and by province?
- What are your hurdle rates of return for new coal plants?
- How do the financial models for the new plants change in light of new regulations, particularly on air, water, and carbon, and other market dynamics?
- How have you changed your investment plans to reflect changing market conditions?

Investors should press companies to postpone or cancel spend where companies are unable to satisfactorily answer these questions.

Changing markets, changing regulation

The power sector faces strategic challenges. In 2015 power demand growth sharply decelerated. This contributed to a continued trend of declining capacity utilisation. At the same time a wave of new regulation, particularly due to concerns over air and water pollution have introduced significant uncertainty into coal-fired power expansion plans.

A rash of regulation

Power supply is a central strategic interest for China. The major objectives for power development are set out in five year strategic plans. The latest energy plan, released in November 2016, includes a cap for coal capacity of 1,100 GW by 2020, up from the ceiling of 960 GW for the period to 2015. The plans signal a changing power mix with coal's share set at 55% of the total 2,000 projected capacity in 2020.

This announcement is one in a long line of high level policy statements addressing coal-fired power in the last year. In many cases, there are new proposals that will change the return profile for planned power plants. In some cases, there are new regulations that reverse prior approvals. Overall, and despite the raised cap, this creates a highly uncertain basis for undertaking new capacity additions. Figure 2 lists some of the measures.

Figure 2: Selected coal power related regulations in 2016

January	NEA proposal for greener coal fired generation
March	NEA to suggest risk assessment for new coal build
March	NDRC, NEA ask local authorities to slow coal construction
March	NDRC to reform gas market and boost renewable share by 2020
April	National Energy Secretary highlights coal over-capacity risk
April	NDRC, NEA create coal construction risk assessment tools
May	NDRC guidance on promoting alternative energy
June	NEA requires provinces coal approvals to align to national plan
June	NDRC reforms transmission pricing and supports direct sales
July	NDRC, NEA announce multi-source demonstration projects
July	NDRC draft plans to implement market based power reforms
July	NDRC, NEA rules raise dispatch where coal supports renewables
August	Further guidelines on new power plant construction
August	NEA progress report on meeting fossil fuel targets
September	Cancellation of coal fired projects
October	Reiteration of coal fired oversupply and need for reduction
November	China's Power Sector 13th Five Year Plan Announced

Source: Various news, NDRC/NEA websites

Changing market dynamics

From 1999 to 2014 electricity generation in China grew at a compound annual rate of nearly 11% and did not fall below 6% growth in any one year. In 2015 it hit a brick wall, with growth of less than 0.3%. There are multiple changes: lower demand, shifts in market structure, and environmental concerns that now take a far stronger role in policy formation.

Demand has slowed partly as a response to lower economic growth. Beyond this, the link between power demand growth and GDP growth has been broken for a while. This has followed both a stronger emphasis on services over heavy industry and a drive for investments in energy efficient processes. The outlook is for continued, but more subdued growth in electricity demand.

The structure of supply is also changing. The new policy landscape favours a generation mix with less reliance on locally generated power and more direct sales to users. Renewable installations have increased, partly responding to policy and partly because costs have fallen consistently, particularly for solar, to become much more cost-competitive. These changes all place greater reliance on a better national and regional grid. The long distance high voltage transmission lines that bring in electricity from more distant provinces, such as Inner Mongolia, are a major example. This trend is supportive of a pattern of locating new coal-fired units in less urbanized provinces and closer to coal mines which can then export their power to more urbanized high demand provinces.

The big three sustainability factors – air, water, and carbon – are also driving change. Air pollution moved to centre stage in energy policy following the record air pollution in Beijing in January 2013. Water stress has also moved up the agenda. Power is thirsty and many power plants are in locations with constrained resources. These factors have already led to the closure of older coal plants. The risks around air pollution and water stress relate strongly to local conditions and decisions made at the provincial level.

Perhaps the biggest surprise this year has come from global efforts to address carbon. The Paris Climate Agreement was ratified on October 5, 2016, a blistering pace for such international treaties, to come into force on November 4, 2016. China's commitments include:

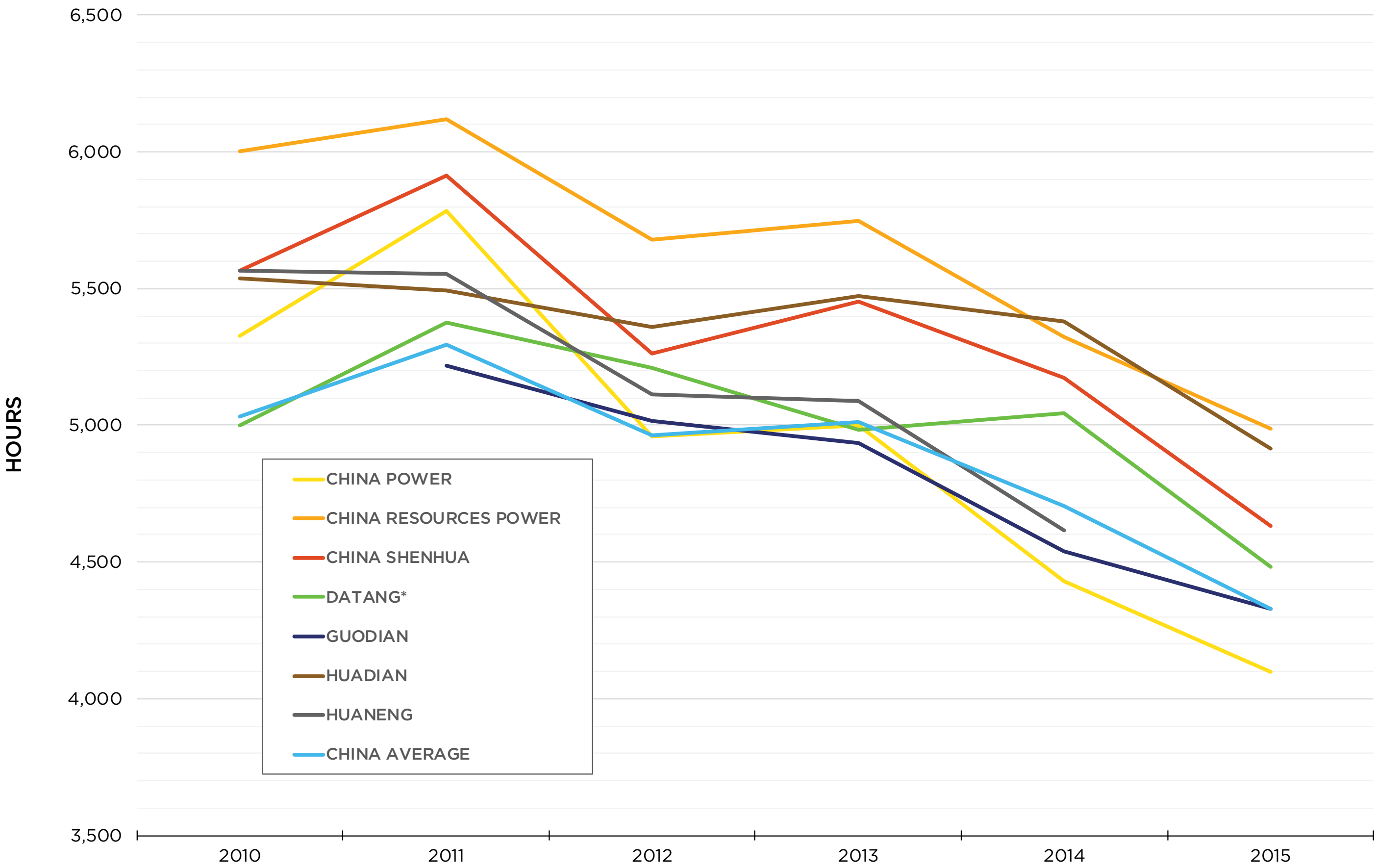
- to peak carbon dioxide emissions by 2030 or sooner
- to lower carbon dioxide emissions per unit of GDP by 60% to 65% from 2005 by 2030
- to increase non-fossil fuels in primary energy consumption to around 20% by 2030

China has introduced carbon markets as one of its policy pillars. This creates a clear policy signal for the power sector in the run up to the launch of the market in 2017. In the short term much will depend on the credibility of the implementation process and the price that the markets generate.

These factors have depressed sector fundamentals

This mix of factors has weighed on returns, primarily as it has led to reduced utilisation hours. China average coal utilisation hours declined in both 2014 and 2015 to reach 4329 hours. This is below 50% of available hours in a year (8760 hours for a non-leap year). Figure 3 shows the decline for each of the companies and the national average. This highlights the commercial risks and makes it more important for companies, and investors, to carefully consider the prospects for new plants.

Figure 3: Average coal plant utilisation hours



** For Datang the overall average utilisation hours are used for 2010 to 2013.*
Source: Annual Reports, ARE

Provinces and plants

Many critical success factors for coal plants play out at the provincial level. Power demand and supply are both primarily local. Ultra-high voltage transmission lines change this, but in ways that are still relevant at the provincial level – provinces such as Inner Mongolia will have stronger distribution, whereas generators in Eastern provinces will have new sources of competition.

While some regulations are national, many regulatory decisions, including plant approvals, and monitoring and enforcement of standards are largely determined at the provincial level. This is particularly so for regulations relating to air pollution and water stress, which have a high level of regional variation. Carbon dioxide emissions are global in effect, but again, many regulations will require implementation at the provincial level.

Figure 4 sets out statistics for air pollution and water stress for each province. The air pollution measure considers the average amount of particulate matter smaller than 2.5 microns per cubic metre across each province (PM2.5).[1] For water, the measure used is Baseline Water Stress (BWS), which is the ratio between the amount of water withdrawn per year and the annual renewable water supply. As water stress is always a highly localized phenomenon, the statistic presented is the average across all sites in the province where there is a coal power station. In order to limit distortions from very high water stress sites, the contribution to the average for each site was capped at two.[2]

Figure 4: Air and water stats for each province

Province	Average PM2.5 (Mcg/m^3)	Average capped BWS	Province	Average PM2.5 (Mcg/m^3)	Average capped BWS
Henan	80.7	1.3	Shaanxi	52.0	1.0
Beijing	80.4	2.0	Zhejiang	47.7	0.4
Hebei	77.3	1.9	Sichuan	46.7	0.2
Tianjin	71.5	2.0	Ningxia	45.8	1.0
Shandong	66.4	1.8	Jiangxi	42.8	0.1
Hubei	65.9	0.1	Qinghai	42.6	1.7
Jiangsu	56.6	0.6	Gansu	41.2	1.3

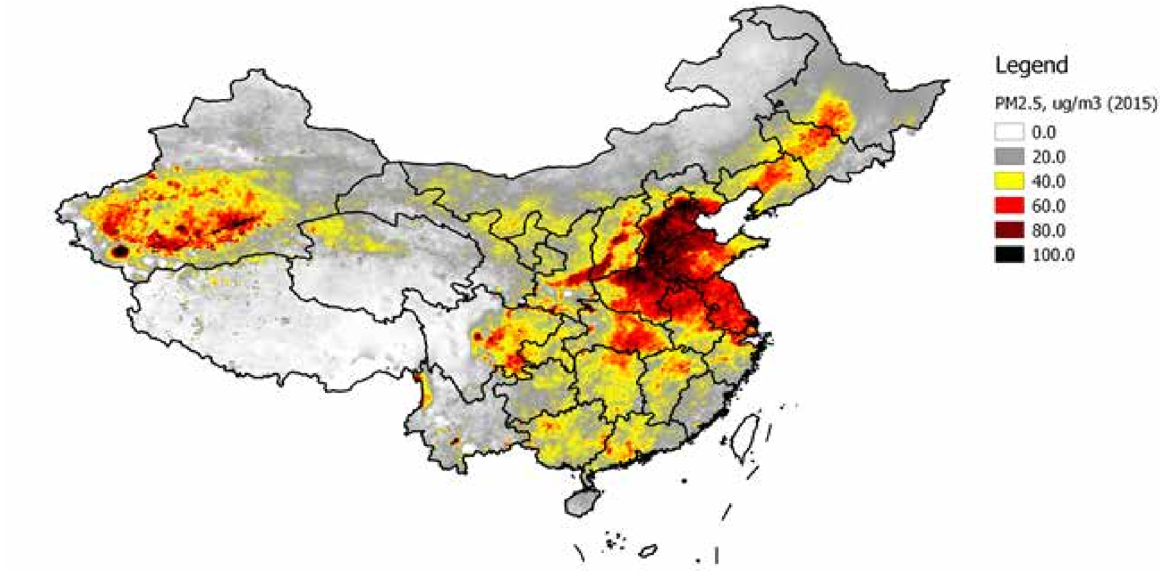
1 Average PM2.5 concentration (ug/m^3) at plant location, based on data available at http://fizz.phys.dal.ca/~atmos/martin/?page_id=140. The dataset is averaged using the tools available at http://giovanni.gsfc.nasa.gov/

2 WRI Aqueduct baseline water stress queried from geospatial data at http://www.wri.org/resources/data-sets/aqueduct-global-maps-21-data

Shanxi	56.4	1.6	I. Mongolia	41.0	1.0
Anhui	55.1	0.4	Guangxi	40.2	0.1
Chongqing	55.0	0.0	Heilongjiang	39.4	0.5
Liaoning	55.0	1.2	Guangdong	34.0	0.1
Jilin	54.4	0.7	Guizhou	31.7	0.1
Shanghai	53.9	0.3	Fujian	28.7	0.1
Xinjiang	53.7	1.7	Yunnan	28.0	0.1
Hunan	52.5	0.1	Hainan	19.3	0.0

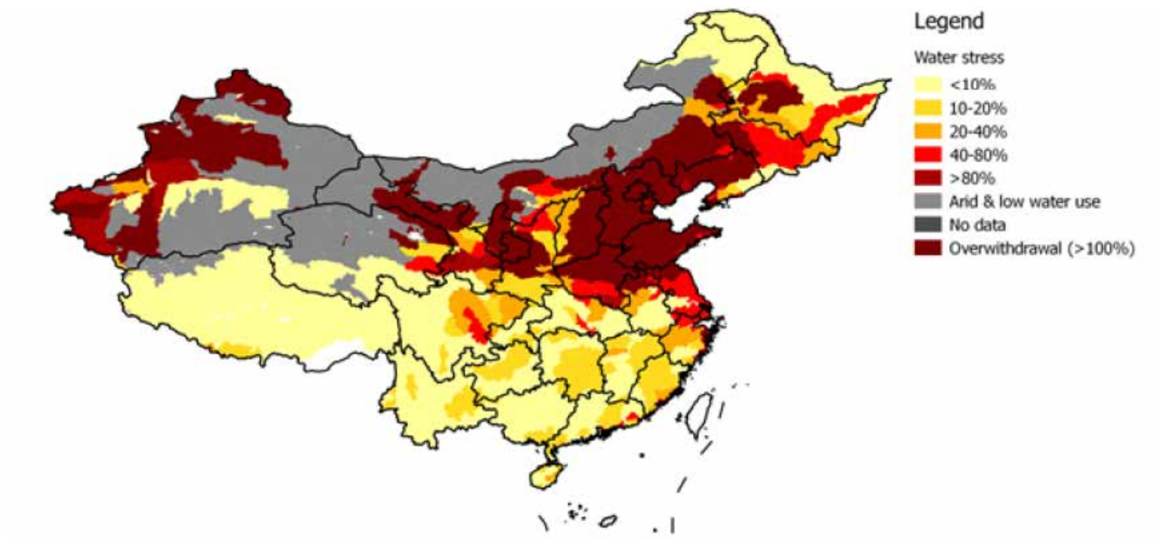
Source: NASA (2015 data), WRI (2010 data)

Figure 5: Air pollution map



Source: NASA, Greenpeace rendering

Figure 6: Water stress map



Source: WRI, Greenpeace rendering

Understanding province risk

We used a two-step process to understand the level of air and water risk in the capacity addition plans of the companies. In the first step we converted the province average air and water pollution data into risk factors.

The National Government has provided a national PM2.5 target of 35 µg/m^3. Consequently, we assigned risks as low for provinces with PM2.5 of less than 35 µg/m^3. We assigned Medium for readings above this level and High for provinces with averages above 50 µg/m^3. For air pollution, there are 16 High risk provinces, nine Medium risk provinces, and five Low risk provinces.

For water stress risk, we assigned as High risk provinces where the China coal-fleet average Baseline Water Stress (BWS) ratio[3] was above 0.8. We assigned Medium risk to provinces with average BWS (capped) between 0.4 and 0.8 and other provinces as Low risk. There were 13 High risk provinces, four Medium risk, and 13 Low risk provinces.

Figure 7 provides a breakdown for the planned capacity additions into provinces and by company, starting with the province with the highest planned capacity. It also provides the risk rating for the provinces.

The table shows a broad geographic spread of planned investments, with 17 provinces represented out of a total of 30 (excluding special administrative regions). Anhui is the province with the highest capacity additions. It has a High air pollution risk rating – the ninth highest average particulate matter, well in excess of government targets, though water is less of a challenge for the province compared to the others.

Shanxi, a major coal mining province, is notable as the province with the second largest additions and a High risk rating for both air pollution and water stress. Shandong, Henan, Shaanxi, Hebei, and Liaoning are also provinces assessed as High for both air and water.

The planned capacity additions in High air risk provinces are 40.8 GW or 60% of total planned additions. The planned capacity additions in High water risk provinces are 29.9 GW or 44% of proposed additions. The amount in provinces assessed as high risk from both air and water perspectives is 20.8 GW or 31%.

3 For the province level average statistic, in order to limit distortions from very high water stress sites, the contribution to the average for each site was capped at two.

Figure 7: Total planned capacity additions by company and province

Province	No. plants	Capacity addition (MW)	China Power International (MW)	China Resources Power (MW)	China Shenhua Energy (MW)	Datang International Power (MW)	Guodian Power Development (MW)	Huadian Power International (MW)	Huaneng Power International (MW)	Air pollution risk	Water stress risk
Anhui	12	10,640	4,000	1,320	3,320	0	2,000	0	0	High	Low
Shanxi	8	8,000	2,000	2,000	0	0	2,000	0	2,000	High	High
Fujian	12	6,840	0	0	2,000	2,000	0	0	2,840	Medium	Low
Hunan	5	6,000	0	0	4,000	0	0	0	2,000	High	Low
Guangdong	8	5,900	0	2,000	2,000	0	0	1,900	0	Low	Low
I. Mongolia	8	5,840	0	1,200	1,320	0	3,320	0	0	Medium	High
Shandong	5	4,660	0	0	0	0	0	2,660	2,000	High	High
Henan	4	4,000	2,000	0	2,000	0	0	0	0	High	High
Ningxia	6	3,300	0	0	0	1,320	660	1,320	0	Medium	High
Jiangsu	5	2,124	0	0	2,000	24	0	0	100	High	Medium
Jiangxi	2	2,000	0	0	0	2,000	0	0	0	Medium	Low
Shaanxi	2	2,000	0	0	2,000	0	0	0	0	High	High
Zhejiang	2	2,000	0	2,000	0	0	0	0	0	Medium	Medium
Hebei	4	1,400	0	0	0	700	700	0	0	High	High
Guizhou	2	1,320	0	1,320	0	0	0	0	0	Medium	Low
Hubei	2	1,320	1,320	0	0	0	0	0	0	High	Low
Liaoning	2	700	0	0	0	0	700	0	0	High	High
TOTAL	**89**	**68,044**	**9,320**	**9,840**	**18,640**	**6,044**	**9,380**	**5,880**	**8,940**		

Source: Company reports, news reports, ARE risk measures based on NASA/WRI

A picture of the risks at the company level already emerges as shown in Figure 8. There are some differences between the air and water risk profiles of the companies. Notably Datang has the lowest proportion of planned capacity additions in High air and water risk provinces at 12%, while Huaneng and Huadian have the highest proportion, both at 45% – Huadian is more exposed to water risk, while Huaneng is more exposed to air risk.

Figure 8: Planned capacity additions in High risk provinces

	China Power International	China Resources Power	China Shenhua Energy	Datang International Power	Guodian Power Development	Huadian Power International	Huaneng Power International	TOTAL
High air risk (GW)	9,320	3,320	13,320	724	5,400	2,660	6,100	40,844
High water risk (GW)	4,000	3,200	5,320	2,020	7,380	3,980	4,000	29,900
High air and water risk (GW)	4,000	2,000	4,000	700	3,400	2,660	4,000	20,760
High air risk (%)	100	34	71	12	58	45	68	60
High water risk (%)	43	33	29	33	79	68	45	44
High air and water risk (%)	43	20	21	12	36	45	45	31

Source: Company reports, news reports, ARE risk measures based on NASA/WRI

Digging down to plant level risk

Many key decisions on plant approvals and factors that can affect the economics of coal power plants are made at the provincial level. However, the environmental factors that shape the provincial risk profile may not apply uniformly across a province. For example, coastal power stations can draw water from the sea irrespective of the level of water stress in the rest of the province. For air pollution, local pollution can create regulatory pressure, but so can high levels of air pollution in cities even a few hundred kilometres away. For these reasons, we took a second step in the assessment and considered plant level factors.

For air pollution, we used two indicators, the PM2.5 measure at the plant location (a local measure) and PM2.5 300 km, which refers to the ninetieth percentile of PM2.5 values within 300 km of the plant location (a surrounding area measure). We assigned risk levels in the same way for each measure – Low = less than 35 $\mu g/m^3$, Medium for the range 35 to 50 $\mu g/m^3$, and High for higher levels.

We assessed water stressed risk using BWS at the plant location, with Low for results below 0.4, Medium for between 0.4 and 0.8, and High for BWS above 0.8. We introduced a further category, "No – coastal", for plants within 5 km of the coast.

We defined plants in the Highest risk category as those for which:

- local area air pollution risk was Medium or High
- surrounding area air pollution risk was High
- water stress risk was High

The data tables in the appendix show the full list of planned plants by company and include the plant level air and water risk factors, highlighting the plants in locations assessed as Highest risk.

Assessing the companies

The plant level statistics allow for a more nuanced assessment of the risks associated with each company's proposed capital expenditure. Overall the proportion deemed in high risk on the combined measures falls from 33% to 23%. Huaneng still has the highest proportion of Highest risk capacity addition at 45%. The biggest difference between the risk measures is for Huadian, primarily because several of its proposed plants are on the coast in provinces with high water stress.

There is also a significant difference in the indicators for China Power International. The company has two proposed plants in Shanxi, which has the eighth highest average PM2.5 pollution of the provinces. However, these plants are in locations that are below the national target and so are not included in the Highest risk assessment.

Figure 9: Planned coal power plant investments with proportions in Highest risk locations

	Plants	Capacity (GW)	Cost estimate (RMB billion)	Highest risk (GW)	Highest risk (%)	High air/ water risk provinces (%)
China Power International	10	9.3	32.6	2.0	21	43
China Resources Power	12	9.8	34.4	1.3	13	20
China Shenhua Energy	19	18.6	65.2	4.0	21	21
Datang International Power	10	6.0	21.2	0.7	12	12
Guodian Power Development	14	9.4	32.8	2.7	29	36
Huadian Power International	9	5.9	20.6	0.7	11	45
Huaneng Power International	15	8.9	31.3	4.0	45	45
TOTAL	**89**	**68**	**238**	**15**	**23**	**33**

Source: Company reports, Coal Swarm, Greenpeace, ARE (China Resources Power and China Shenhua Energy do not provide lists of planned plants in their annual reports, so these are based on searches)

Conclusion

We reviewed the companies' interim results statements to gain a sense of their strategy in light of the emerging risks to prospective returns. This did not provide much clarity. On one level this is not surprising. It is hard to develop strategy against a backdrop of changing market dynamics, consistent regulatory updates, and rising uncertainty.

Yet in uncertain times it is more important that companies exercise scrutiny over decisions that will have a significant effect on their future. It is the role of investors to support companies through asking management about their approach.

For investors in these companies, our top questions are:

- What are your detailed capex plans by plant and by province?
- What are your hurdle rates of return for new coal plants?
- How do the financial models for the new plants change in light of new regulations, particularly on air, water, and carbon, and other market dynamics?
- How have you changed your investment plans to reflect changing market conditions?

Where companies are unable to provide satisfactory answers, investors should press companies to postpone the spending plans until circumstances change, or cancel them altogether.

Appendix: Company Tables

China Power International

Number of plants	Proposed new capacity (GW)	Cost estimation (RMB billion)	Highest risk air and water (GW)	Highest risk air and water (%)	High air/water risk provinces (%)	Total estimated lifetime CO_2 emissions (Mt)
10	9.32	32.6	2.0	21	43	958

Power station	Unit	Capacity (MW)	Technology	Area	Province	Plant type	Estimated cost (RMB billion)	Air pollution		Water	Estimated lifetime CO_2 (Mt)
								Local risk	Surrounding area risk	Stress risk	
CPI Pingwei	CPI Pingwei-IV - Unit 1	1,000	Ultra-supercritical	Huainan	Anhui	Conventional	3,500	High	High	Low	101
CPI Pingwei	CPI Pingwei-IV - Unit 2	1,000	Ultra-supercritical	Huainan	Anhui	Conventional	3,500	High	High	Low	101
CPI Pingwei	CPI Pingwei-IV - Unit 3	1,000	Ultra-supercritical	Huainan	Anhui	Conventional	3,500	High	High	Low	101
CPI Pingwei	CPI Pingwei-IV - Unit 4	1,000	Ultra-supercritical	Huainan	Anhui	Conventional	3,500	High	High	Low	101
Yaomeng	Yaomeng-II - Unit 1	1,000	Ultra-supercritical	Pingdingshan	Henan	Conventional	3,500	High	High	High	101
Yaomeng	Yaomeng-II - Unit 2	1,000	Ultra-supercritical	Pingdingshan	Henan	Conventional	3,500	High	High	High	101
CPI Dabieshan	Dabieshan 3	660	Supercritical	Huanggang	Hubei	Conventional	2,310	Medium	High	Low	73
CPI Dabieshan	Dabieshan 4	660	Supercritical	Huanggang	Hubei	Conventional	2,310	Medium	High	Low	73
CPI Shentou	Shentou 3	1,000	Ultra-supercritical	Shuozhou	Shanxi	Conventional	3,500	Low	High	High	101
CPI Shentou	Shentou 4	1,000	Ultra-supercritical	Shuozhou	Shanxi	Conventional	3,500	Low	High	High	101

China Resources Power

Number of plants	Proposed new capacity (GW)	Cost estimation (RMB billion)	Highest risk air and water (GW)	Highest risk air and water (%)	High air/water risk provinces (%)	Total estimated lifetime CO_2 emissions (Mt)
12	9.8	34.4	1.3	13	20	1,049

Power station	Unit	Capacity (MW)	Technology	Area	Province	Plant type	Estimated cost (RMB billion)	Air pollution		Water	Estimated lifetime CO_2 (Mt)
								Local risk	Surrounding area risk	Stress risk	
Fuyang	Fuyang - Phase II Unit 1	660	Ultra-supercritical		Anhui	Conventional	2,310	High	High	High	68
Fuyang	Fuyang - Phase II Unit 2	660	Ultra-supercritical		Anhui	Conventional	2,310	High	High	High	68
Shanwei Haifeng	Shanwei Haifeng 3	1,000	Ultra-supercritical	Shanwei	Guangdong	Conventional	Low	Low	Medium	No - coastal	101
Shanwei Haifeng	Shanwei Haifeng 4	1,000	Ultra-supercritical	Shanwei	Guangdong	Conventional	Low	Low	Medium	No - coastal	101
CR Liuzhi	CR Liuzhi Unit 3	660	Unknown	Liupanshui	Guizhou	Conventional	Low	Low	Medium	Low	73
CR Liuzhi	CR Liuzhi Unit 4	660	Unknown	Liupanshui	Guizhou	Conventional	Low	Low	Medium	Low	73
China Resources Dengkou	Dengkou 3	600	Subcritical	Bayannur	Inner Mongolia	Conventional	Low	Low	Low	High	70
China Resources Dengkou	Dengkou 4	600	Subcritical	Bayannur	Inner Mongolia	Conventional	Low	Low	Low	High	70
Ningwu Gangue	Ningwu Gangue - Unit 3	1,000	Supercritical	Xinzhou	Shanxi	Conventional	Low	Low	High	High	111
Ningwu Gangue	Ningwu Gangue - Unit 4	1,000	Supercritical	Xinzhou	Shanxi	Conventional	Low	Low	High	High	111
Huarun Cangnan	Cangnan 3	1,000	Ultra-supercritical	Wenzhou	Zhejiang	Conventional	Low	Low	Medium	No - coastal	101
Huarun Cangnan	Cangnan 4	1,000	Ultra-supercritical	Wenzhou	Zhejiang	Conventional	Low	Low	Medium	No - coastal	101

China Shenhua Energy

Number of plants	Proposed new capacity (GW)	Cost estimation (RMB billion)	Highest risk air and water (GW)	Highest risk air and water (%)	High air/water risk provinces (%)	Total estimated lifetime CO_2 emissions (Mt)
19	18.64	65.2	4.0	21	21	1,962

Power station	Unit	Capacity (MW)	Technology	Area	Province	Plant type	Estimated cost (RMB billion)	Air pollution: Local risk	Air pollution: Surrounding area risk	Water: Stress risk	Estimated lifetime CO_2 (Mt)
Luoyuan Bay	Luoyuan Bay 3	1,000	Ultra-supercritical	Fuzhou	Fujian	Conventional	3,500	Low	Low	Low	101
Luoyuan Bay	Luoyuan Bay 4	1,000	Ultra-supercritical	Fuzhou	Fujian	Conventional	3,500	Low	Low	Low	101
Shenhua Hulunber Baorixile	Phase II Unit 3	660	Unknown	Hulunbuir	Inner Mongolia	Conventional	2,310	Low	Low	Low	73
Shenhua Hulunber Baorixile	Phase II Unit 4	660	Unknown	Hulunbuir	Inner Mongolia	Conventional	2,310	Low	Low	Low	73
Jiangsu Guohua Chenjiagang	Chenjiagang 3	1,000	Unknown	Yancheng	Jiangsu	Conventional	3,500	Medium	High	High	111
Jiangsu Guohua Chenjiagang	Chenjiagang 4	1,000	Unknown	Yancheng	Jiangsu	Conventional	3,500	Medium	High	High	111
Guohua Taishan	Guohua Taishan 8	1,000	Ultra-supercritical	Jiangmen	Guangdong	Conventional	3,500	Low	Medium	No - coastal	101
Guohua Taishan	Guohua Taishan 9	1,000	Ultra-supercritical	Jiangmen	Guangdong	Conventional	3,500	Low	Medium	No - coastal	101
Shenhua Yueyang	Shenhua Yueyang 1	1,000	Ultra-supercritical	Yueyang	Hunan	Conventional	3,500	High	High	Low	101
Shenhua Yueyang	Shenhua Yueyang 2	1,000	Ultra-supercritical	Yueyang	Hunan	Conventional	3,500	High	High	Low	101
Shenhua Yueyang	Shenhua Yueyang Phase II	2,000	Ultra-supercritical	Yueyang	Hunan	Conventional	7,000	High	High	Low	203
Shenhua Guohua Jinjie	PP Phase II Unit 1	1,000	Unknown	Yulin	Shaanxi	Conventional	3,500	Low	Medium	Low	111
Shenhua Guohua Jinjie	PP Phase II Unit 2	1,000	Unknown	Yulin	Shaanxi	Conventional	3,500	Low	Medium	Low	111
Luoyang Mengjin	Luoyang Mengjin 3	1,000	Supercritical	Luoyang	Henan	Conventional	3,500	High	High	High	111
Luoyang Mengjin	Luoyang Mengjin 4	1,000	Supercritical	Luoyang	Henan	Conventional	3,500	High	High	High	111
Chizhou Jiuhua	Chizhou Jiuhua - Unit 3	1,000	Ultra-supercritical	Chizhou	Anhui	Conventional	3,500	Medium	High	Low	101
Chizhou Jiuhua	Chizhou Jiuhua - Unit 4	1,000	Ultra-supercritical	Chizhou	Anhui	Conventional	3,500	Medium	High	Low	101
Hefei Lujiang	Hefei Lujiang - Unit 1	660	Ultra-supercritical		Anhui	Conventional	2,310	High	High	Low	68
Hefei Lujiang	Hefei Lujiang - Unit 2	660	Ultra-supercritical		Anhui	Conventional	2,310	High	High	Low	68

Datang International Power

Number of plants	Proposed new capacity (GW)	Cost estimation (RMB billion)	Highest risk air and water (GW)	Highest risk air and water (%)	High air/water risk provinces (%)	Total estimated lifetime CO_2 emissions (Mt)
10	6.044	21.2	0.7	12	12	672

Power station	Unit	Capacity (MW)	Technology	Area	Province	Plant type	Estimated cost (RMB billion)	Air pollution		Water	Estimated lifetime CO_2 (Mt)
								Local risk	Surrounding area risk	Stress risk	
Datang Ningde	Datang Ningde 5	1,000	Supercritical	Ningde	Fujian	Conventional	3,500	Low	Low	No - coastal	111
Datang Ningde	Datang Ningde 6	1,000	Supercritical	Ningde	Fujian	Conventional	3,500	Low	Low	No - coastal	111
Datang Tangshan Beijiao	Tangshan Beijiao 1	350	Unknown	Tangshan	Hebei	District CHP	1,225	High	High	High	44
Datang Tangshan Beijiao	Tangshan Beijiao 2	350	Unknown	Tangshan	Hebei	District CHP	1,225	High	High	High	44
Datang Pingluo	Pingluo Unit 1	660	Ultra-supercritical	Shizuishan	Ningxia	Conventional	2,310	Low	Low	High	68
Datang Pingluo	Pingluo Unit 2	660	Ultra-supercritical	Shizuishan	Ningxia	Conventional	2,310	Low	Low	High	68
Datang Xinyu	Xinyu-2 No 1	1,000	Supercritical	Xinyu	Jiangxi	Conventional	3,500	Medium	Medium	Low	111
Datang Xinyu	Xinyu-2 No 2	1,000	Supercritical	Xinyu	Jiangxi	Conventional	3,500	Medium	Medium	Low	111
Datang Rugao	Rugao Unit 1	12	Unknown	Rugao	Jiangsu	District CHP	42	High	High	Medium	3
Datang Rugao	Rugao Unit 2	12	Unknown	Rugao	Jiangsu	District CHP	42	High	High	Medium	3

Guodian Power Development

Number of plants	Proposed new capacity (GW)	Cost estimation (RMB billion)	Highest risk air and water (GW)	Highest risk air and water (%)	High air/water risk provinces (%)	Total estimated lifetime CO_2 emissions (Mt)
14	9.38	32.8	2.7	29	36	1,036

Power station	Unit	Capacity (MW)	Technology	Area	Province	Plant type	Estimated cost (RMB billion)	Air pollution: Local risk	Air pollution: Surrounding area risk	Water: Stress risk	Estimated lifetime CO_2 (Mt)
Tongling Guodian	Tongling Guodian-2 - Unit 1	1,000	Ultra-supercritical	Tongling	Anhui	Conventional	3,500	High	High	Low	101
Tongling Guodian	Tongling Guodian-2 - Unit 2	1,000	Ultra-supercritical	Tongling	Anhui	Conventional	3,500	High	High	Low	101
Guodian Dawukou	Dawukou 7	330	Supercritical	Shizuishan	Ningxia	District CHP	1,155	Low	Medium	High	41
Guodian Dawukou	Dawukou 8	330	Supercritical	Shizuishan	Ningxia	District CHP	1,155	Low	Medium	High	41
Pulandian Cogen	Pulandian Cogen 1	350	Subcritical	Dalian	Liaoning	District CHP	1,225	Medium	High	No - coastal	46
Pulandian Cogen	Pulandian Cogen 2	350	Subcritical	Dalian	Liaoning	District CHP	1,225	Medium	High	No - coastal	46
Guodian Zunhua-2	Zunhua-2 No 1	350	Supercritical	Tangshan	Hebei	District CHP	1,225	High	High	High	44
Guodian Zunhua-2	Zunhua-2 No 2	350	Supercritical	Tangshan	Hebei	District CHP	1,225	High	High	High	44
Guodian Shuangwei Shanghaimiao	Unit 1	1,000	Ultra-supercritical	Ordos	Inner Mongolia	Conventional	3,500	Low	Medium	Low	101
Guodian Shuangwei Shanghaimiao	Unit 2	1,000	Ultra-supercritical	Ordos	Inner Mongolia	Conventional	3,500	Low	Medium	Low	101
Guodian Zhunger Changtan	Phase I Unit 1	660	Unknown	Ordos	Inner Mongolia	Conventional	2,310	Low	Medium	Low	73
Guodian Zhunger Changtan	Phase I Unit 2	660	Unknown	Ordos	Inner Mongolia	Conventional	2,310	Low	Medium	Low	73
GuodianDatong Donghu	Datong Hudong Unit 1	1,000	Unknown	Datong	Shanxi	Conventional	3,500	Medium	High	High	111
GuodianDatong Donghu	Datong Hudong Unit 2	1,000	Unknown	Datong	Shanxi	Conventional	3,500	Medium	High	High	111

Huadian Power International

Number of plants	Proposed new capacity (GW)	Cost estimation (RMB billion)	Highest risk air and water (GW)	Highest risk air and water (%)	High air/water risk provinces (%)	Total estimated lifetime CO_2 emissions (Mt)
9	5.88	20.6	0.7	11	45	616

Power station	Unit	Capacity (MW)	Technology	Area	Province	Plant type	Estimated cost (RMB billion)	Air pollution: Local risk	Air pollution: Surrounding area risk	Water: Stress risk	Estimated lifetime CO_2 (Mt)
Huadian Shiliquan	Shiliquan-III No 2	660	Ultra-supercritical	Zaozhuang	Shandong	Conventional	2,310	High	High	High	68
Huadian Laizhou	Huadian Laizhou 3	1,000	Ultra-supercritical	Yantai	Shandong	Conventional	3,500	Medium	High	No - coastal	101
Huadian Laizhou	Huadian Laizhou 4	1,000	Ultra-supercritical	Yantai	Shandong	Conventional	3,500	Medium	High	No - coastal	101
Huadian Yongli	Huadian Yongli Unit 1	660	Ultra-supercritical	Yinchuan	Ningxia	Conventional	2,310	Low	Medium	High	68
Huadian Yongli	Huadian Yongli Unit 2	660	Ultra-supercritical	Yinchuan	Ningxia	Conventional	2,310	Low	Medium	High	68
Huadian Shantou Fengsheng	Unit 1	600	Ultra-supercritical	Shantou	Guangdong	Conventional	2,100	Low	Low	No - coastal	61
Huadian Shantou Fengsheng	Unit 2	600	Ultra-supercritical	Shantou	Guangdong	Conventional	2,100	Low	Low	No - coastal	61
Huadian Nanxiong	Huadian Nanxiong - Unit 1	350	Supercritical	Shaoguan	Guangdong	District CHP	1,225	Medium	Medium	Low	44
Huadian Nanxiong	Huadian Nanxiong - Unit 2	350	Supercritical	Shaoguan	Guangdong	District CHP	1,225	Medium	Medium	Low	44

Huaneng Power International

Number of plants	Proposed new capacity (GW)	Cost estimation (RMB billion)	Highest risk air and water (GW)	Highest risk air and water (%)	High air/water risk provinces (%)	Total estimated lifetime CO_2 emissions (Mt)
15	8.94	31.3	4.0	45	45	981

Power station	Unit	Capacity (MW)	Technology	Area	Province	Plant type	Estimated cost (RMB billion)	Air pollution		Water	Estimated lifetime CO_2 (Mt)
								Local risk	Surrounding area risk	Stress risk	
Huaneng Yueyang	Huaneng Yueyang - Unit 7	1,000	Ultra-supercritical	Yueyang	Hunan	Conventional	3,500	High	High	Low	101
Huaneng Yueyang	Huaneng Yueyang - Unit 8	1,000	Ultra-supercritical	Yueyang	Hunan	Conventional	3,500	High	High	Low	101
Huaneng Gulei	Gulei Unit 1	660	Ultra-supercritical	Zhangzhou	Fujian	District CHP	2,310	Low	Low	No - coastal	82
Huaneng Gulei	Gulei Unit 2	660	Ultra-supercritical	Zhangzhou	Fujian	District CHP	2,310	Low	Low	No - coastal	82
Huaneng Gulei	Gulei Unit 3	50	Unknown	Zhangzhou	Fujian	District CHP	175	Low	Low	No - coastal	10
Huaneng Gulei	Gulei Unit 4	50	Unknown	Zhangzhou	Fujian	District CHP	175	Low	Low	No - coastal	10
Huaneng Gulei	Gulei Unit 5	50	Unknown	Zhangzhou	Fujian	District CHP	175	Low	Low	No - coastal	10
Huaneng Gulei	Gulei Unit 6	50	Unknown	Zhangzhou	Fujian	District CHP	175	Low	Low	No - coastal	10
Huaneng Luoyuan	Luoyuan 1	660	Ultra-supercritical	Fuzhou	Fujian	Conventional	2,310	Low	Low	No - coastal	68
Huaneng Luoyuan	Luoyuan 2	660	Ultra-supercritical	Fuzhou	Fujian	Conventional	2,310	Low	Low	No - coastal	68
Huaneng Nanjing	Huaneng Nanjing-1 - Unit 3	100	Unknown	Nanjing	Jiangsu	Conventional	350	High	High	Low	12
Huaneng Zhanhua	Zhanhua 5	1,000	Supercritical	Binzhou	Shandong	Conventional	3,500	High	High	High	111
Huaneng Zhanhua	Zhanhua 6	1,000	Supercritical	Binzhou	Shandong	Conventional	3,500	High	High	High	111
Huaneng Shanyin	Huaneng Shanyin 1	1,000	Ultra-supercritical	Shuozhou	Shanxi	Conventional	3,500	Medium	High	High	101
Huaneng Shanyin	Huaneng Shanyin 2	1,000	Ultra-supercritical	Shuozhou	Shanxi	Conventional	3,500	Medium	High	High	101

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