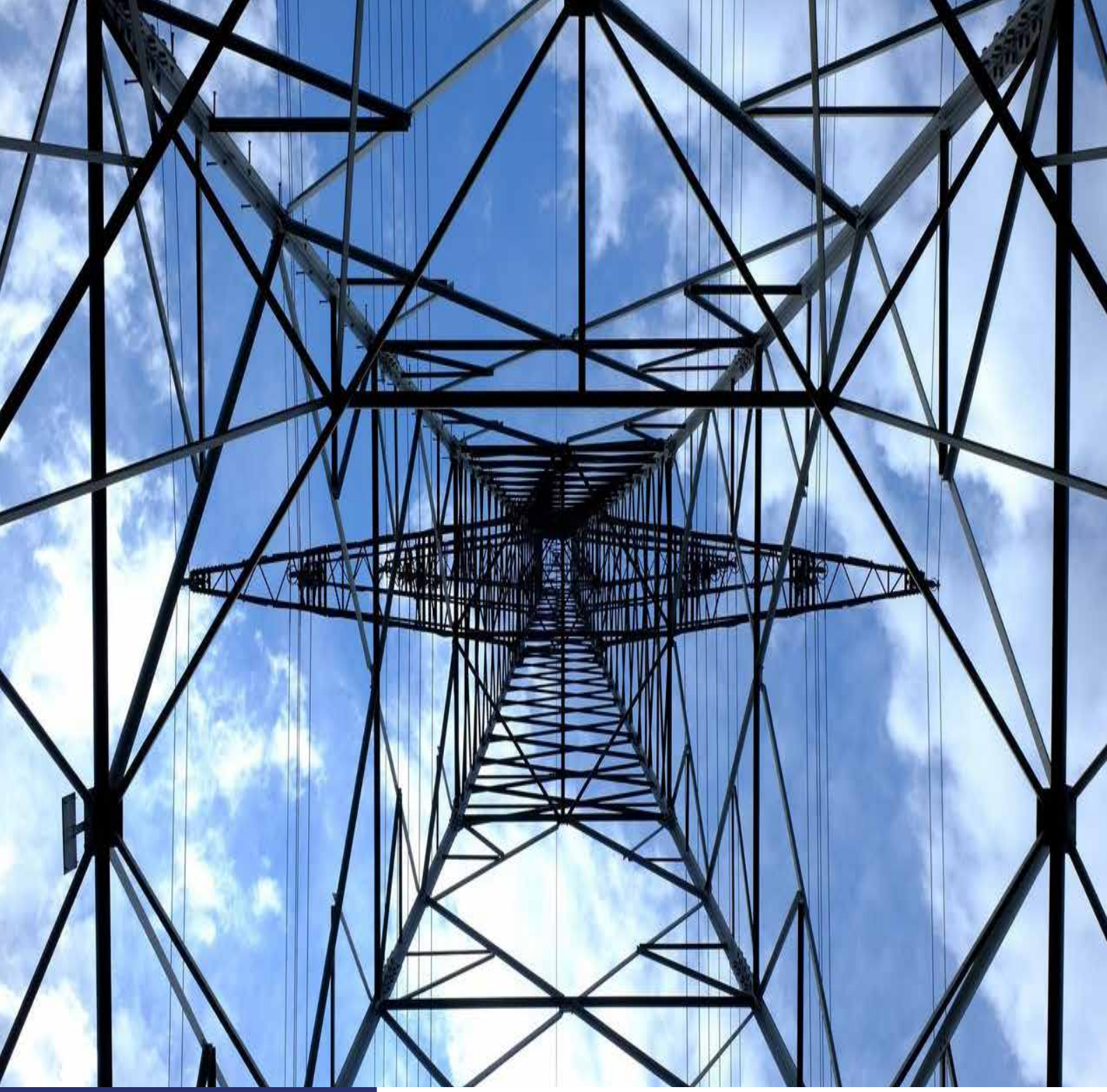

ARE
ASIA RESEARCH & ENGAGEMENT

Tracking the Transition

China's coal-fired power companies' strategic failure to respond to climate change

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Improving Sustainability Across Asia

ARE works with leading investors, banks, companies, and foundations to integrate sustainability and governance factors into risk and strategic processes. Clients benefit from a network of partners and researchers across Asia that provide analysis of the financial relevance of these issues.

We welcome comment on this report and will continue to facilitate the necessary conversations between investors and companies. Please contact us to find out more.

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Acknowledgements: Melissa Brown (Daobridge Capital)
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Tracking the transition

China's coal-fired companies fail to show a strategic response to climate change

Chinese power companies fail to address climate

China's large listed power companies are struggling to take meaningful steps on the transition to cleaner energy. There is little evidence that the major power companies have adjusted their strategies to respond to the challenge of climate change, leaving Chinese companies lagging behind international and regional players. The report finds:

- Only one of the Chinese companies provided basic strategic information on how climate change is being addressed
- 5 out of 6 companies provided greenhouse gas emission intensity figures for the first time in 2017. The 2017-2018 percentage changes reveal mixed trends
- The listed power majors lag the Chinese power industry on transitioning to wind and solar – the companies had 2.0 percentage points higher wind and solar generation between 2015 and 2018 compared to 3.9 percentage points for China as a whole

Six largest listed power companies produce 2.8% of global CO_2

This disappointing performance matters. This benchmarking report provides an expert review of the strategy and environmental performance of the six largest listed coal-fired power companies in China based on company reporting between 2015 and 2018. These companies have among the largest coal-fired fleets among global listed power companies. Together they accounted for one fifth of the power generated in the Chinese market in 2017 and up to 2.8% of global CO_2 emissions in 2017.

Strategies are misaligned with government policy

The listed power producers predominantly focus on coal. With strategies that generally show little appetite for a renewable transition they will remain coal heavy for a long time. While there is basic environmental reporting and an improvement in air quality performance, there is a clear failure to address climate change. The gaps in strategic disclosure point to misalignment with government policies on managing carbon intensity and present fundamental concerns that risks are being mismanaged.

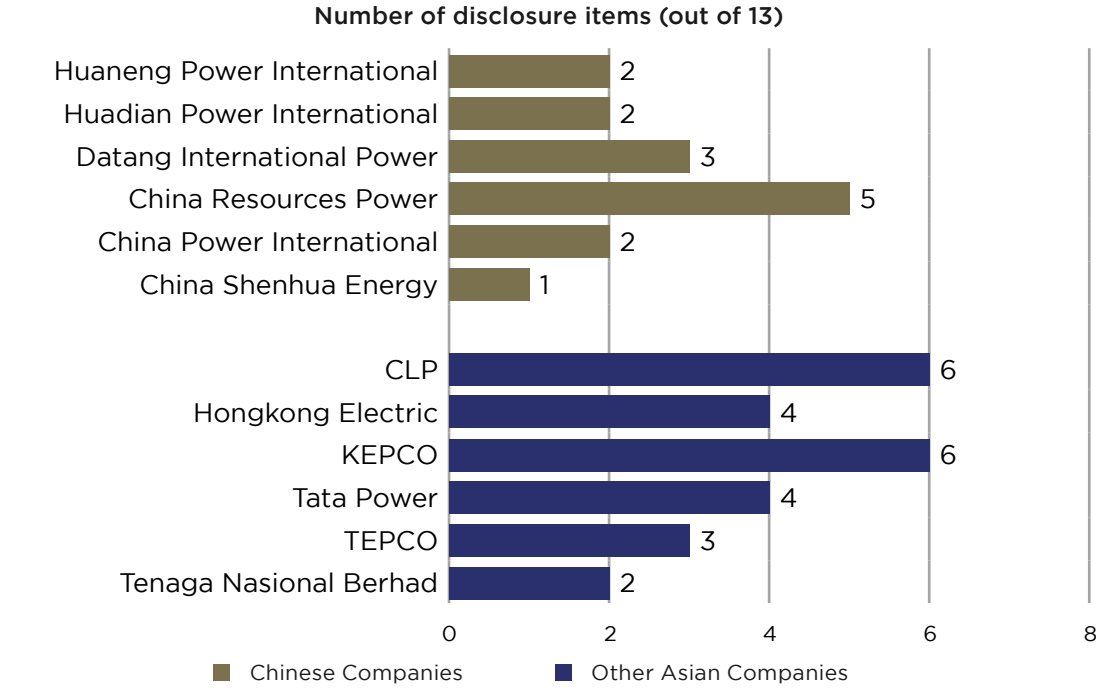
Investors need to push harder for change

Investors should be assertive in stating expectations that go beyond mere disclosure of indicators and require companies to show how they are developing portfolios of long-term assets resilient to the long-term risks from climate change. It is reasonable to expect companies to show how they are aligning to government policy. Leading international power producers provide guidance for carbon intensity and renewable energy portfolio targets. China's leading power players build facilities in line with the highest global standards. There is no reason for them to have sub-par disclosure or strategies.

Including through votes on capital expenditure and debt issuance

Portfolio managers and analysts should challenge the companies to provide clear explanations. Where companies do not, investors should communicate dissatisfaction strongly. This could include voting against debt issuance and capital spending plans where risk management is not suitably explained and against directors that are failing to set appropriate strategies. Investors should also ensure that relevant stock exchanges, particularly in Hong Kong but also Shanghai and New York, enforce listing rules requiring appropriate risk management disclosure.

Figure 1: Chinese power company disclosure scores 2.5 on average against 4.2 for other Asian counterparts and 7.4 for international leaders (refer to Figure 6 for details)



Source: Company reports, ARE

China's power sector

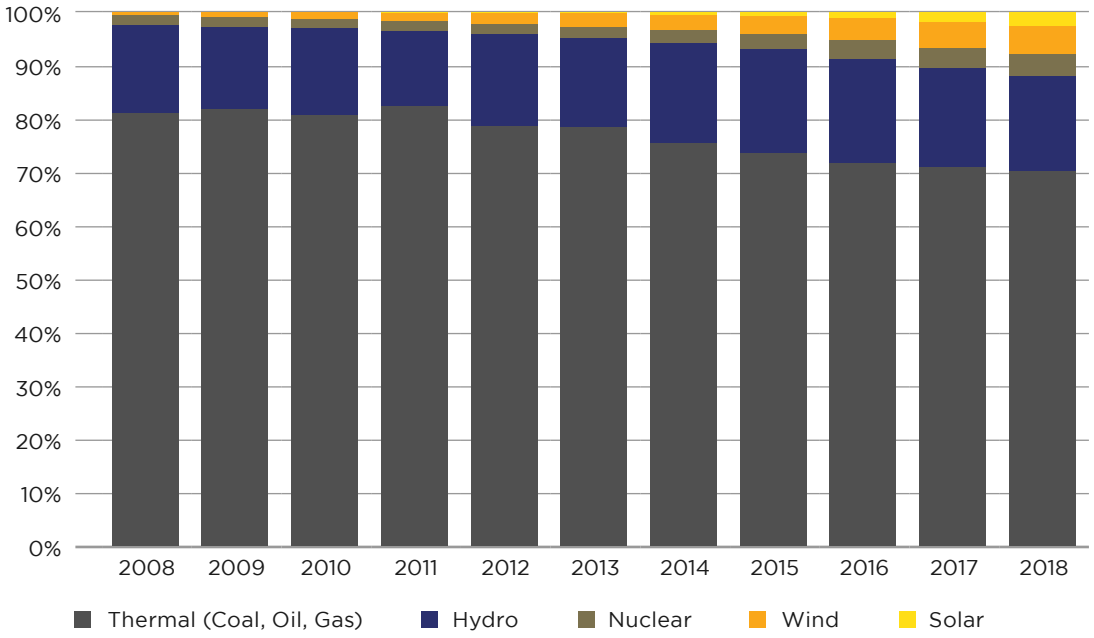
Coal-heavy power results in China's high GHG emissions

China is the world's largest emitter of CO_2 emissions, contributing up to 29% of the global total,[1] having surpassed the United States of America in 2007.[2] The main reason for China's high emissions is its reliance on coal as the primary energy source. Thermal generation provided more than 70% of its electricity production in 2018 according to China Electricity Council.[3]

Air pollution focus has led to changes in mix

The power sector's high use of coal has also resulted in the release of air pollutants, such as SO_2, NO_x, and $PM_{2.5}$, in addition to other greenhouse gas emissions. The national focus on air pollution in recent years has accelerated the drive for cleaner power, resulting in meaningful changes to China's energy mix.

Figure 2: China's electricity production by source shares (2008-2018)



Source: China Electricity Council

The national drive towards renewables continues

China has provided clear policy goals to transition towards cleaner power production that will support efforts to meet its international commitments under the Paris Agreement. These include targets for different types of generation capacity, as well as policies aimed at reducing high renewable energy curtailment rates.

But leading listed players are behind the curve

China has made progress on many of these goals, helped by fast cost declines in renewable production (notably wind and solar). However, the leading listed players are behind the curve, not in front of it.

1 European Commission Joint Research Center, *2018 Fossil CO_2 Emissions of All World Countries.*
2 http://www.theguardian.com/environment/2007/jun/19/china.usnews
3 2019, China Electricity Council. *2018 Annual Electricity Industry Statistical Report Summary*. Extracted 9 May 2019 from: http://www.cec.org.cn/guihuayutongji/tongjxinxi/niandushuju/2018-12-19/187486.html

Figure 3: China's 13th Five Year Plan energy/climate targets (announced 2016)

	13th FYP Targets	Progress to Date[4]
Overall Carbon Intensity	45% reduction from 2005 levels by 2020	46% reduction from 2005
Primary Energy Consumption	Increase share of non-fossil energy in total primary energy consumption to 15% by 2020 and to 20% by 2030. Cap coal share of total energy consumption to 58% by 2020.	Share of non-fossil energy in total primary energy consumption = 13.8%
Renewable Power Capacity Installed	Increase installed renewable power capacity to 680W by 2020.	
Wind	Increase to 210 GW	184 GW
Solar PV	Increase to 110 GW	175 GW
Hydro	Increase to 380 GW	352 GW
Others	Increase to 16.5 GW	NA
Qualitative Targets	Resolve renewable power curtailment problem	New policies developing that may help mitigate curtailment problem

Source: IEA, World Resources Institute, China Electricity Council, Ministry of Ecology and Environment, National Development and Reform Commission

Even when the economics are likely to be favourable

In more developed markets, where power growth has flattened, the energy transition requires replacing existing power plants with new renewable energy capacity. However, electricity consumption in China has continued to grow, following a 8.4% increase in 2018.[5] Consequently, China's energy transition will involve new builds, not just replacement capex.

New build renewables replacements compare more favourably to new build coal than to projects that replace existing coal plants with sunk costs that have already been depreciated. As such, the cost assessments could work in favour of an accelerated renewables transition for the Chinese power companies compared to their international peers. Certainly, further investments in grids and redesign of market structures at the national level are still needed to further support renewables to realise this potential.

4 Information on renewable power capacity is as of end of 2018, as downloaded from the China Electricity Council on 9 May 2019. The information on carbon intensity and primary energy consumption is from the *2018 Climate Change Work Progress Report* released by the Ministry of Ecology and Environment on 28 November 2018.

5 2018, China Electricity Council. *2017 Annual Electricity Industry Statistical Report Summary*. Extracted 9 May 2018 from: http://www.cec.org.cn/guihuayutongji/tongjxinxi/niandushuju/2018-12-19/187486.html

The leading listed coal-fired players

The six companies make up 20% of China's power

The six companies reviewed in this report are Huaneng Power International, Huadian Power International, Datang Power International, China Resources Power, China Power International and China Shenhua Energy. They all have listings in Hong Kong and four are dual-listed in Shanghai. All have international shareholders.[6] As at 17 January 2019, the companies had a combined market capitalization of US$93.8bn and accounted for 20% of Chinese power generation in 2018. On our estimates, they were also responsible for 12% of China's CO_2 emissions or 2.8% of the 2017 global total.

The ownership structure of the Chinese power sector creates disadvantages for minority investors in listed players.

But the listed vehicles are a small share of parent capacity

All six companies have state-owned parent companies that control and make key decisions for the listed subsidiaries. The parents hold significant power production capacity outside of their listed subsidiaries. On average, the listed companies represent only 35% of the capacity of their state-owned parent companies (see Figure 4). Where the parent companies face national goals or regulations such as for air pollution, greenhouse gas reduction, or renewable energy curtailment reduction, these often apply across the entire portfolio not just for the listed entities. Consequently, the parent companies will seek to set strategy at the level of the whole portfolio.

Minority investors have to second guess parent company strategy

This leaves minority investors in an unsatisfactory position as the portfolio to which they have exposure may be constrained or disadvantaged as a result of strategic decisions taken by the parent. For example, the parent companies of Datang and Huaneng spun the main renewables portfolios out from the listed coal assets in 2010 and 2011 respectively. The presence of separate listed renewable companies now constrains strategic options for investors in the coal portfolios.

Foreign investors find it harder to justify holding shares

International investors are under pressure to reduce exposure to coal. They are doing so through implementing hard, policy-led divestment measures as well as with softer switching tools such as low carbon indices. Without a transition pathway to generating portfolios with cleaner characteristics the companies will face increasing challenges in marketing their shares internationally.

Chinese power players are at a governance disadvantage

In terms of realigning portfolios, the listed Chinese power companies are arguably in a tougher position than producers in other Asian state-owned power markets where the listed vehicles comprise a higher proportion of state assets. In these contexts, the listed company boards may have greater agency in re-setting their strategic direction – while subject still to national regulatory developments.

6 Examples of international investors that were shareholders as at 11 July 2019 include: The Vanguard Group, BlackRock Group of funds, Lazard Asset Management and Macquarie Funds Management Hong Kong.

Figure 4: Listed Chinese power companies' assets vs parent companies' assets - Controlled generation capacity (GW)

Company	Listco (GW)	Parent (GW)	% of Parent Capacity in Listco	% Parent Ownership
Huaneng Power International	84	165	50.8%	50.9%
Huadian Power International	50	148	33.3%	46.8%
Datang International Power	63	139	45.2%	53.1%
China Resources Power	40	40	100.0%	62.9%
China Power International	20	143	13.9%	56.0%
China Shenhua Energy	43	226	18.8%	73.1%
Total	**299**	**861**	**34.7%**	

Note: The generation capacity for listed companies represent controlled capacity except for Datang where only total capacity was available. Capacity numbers for listed companies are for 2018 except for Huaneng and Shenhua, 2016 and 2017 respectively, to match their parent's most current public disclosures. Parent company information is based on the latest disclosure available on their websites.

Source: ARE, company websites and reports

Figure 5: Company electricity generation (2018)

Company	Market Cap (US$Mn)	Total Gen. (TWh)	Coal Gen. (TWh)	% Coal	% Wind & Solar
Huaneng Power International	12,948	430	395	91.8%	2.6%
Huadian Power International	5,161	210	196	93.3%	3.4%
Datang International Power	7,113	270	232	85.9%	2.2%
China Resources Power	7,007	157	140	89.4%	9.2%
China Power International	2,372	74	54	72.8%	5.0%
China Shenhua Energy	55,992	285	279	97.7%	0.0%
Total (Six Companies)	**90,593**	**1,426**	**1,296**	**88.5%**	**3.7%**
Total (China)		**6,994**	**4,923**	**70.4%**	**7.8%**

Note: Total thermal generation was used for Huadian, China Resources Power and Total (China), which did not provide a breakdown of their thermal generation.

Source: Company reports, FactSet (28 Jun 2019), China Electricity Council

Gaps in disclosure on strategy

Investors should expect sufficient strategic information

The annual reports to investors should serve as a window into strategic decision making for each company with boards and management teams accountable to shareholders for approving and executing these strategies.

Chinese power players disclose little strategy on climate

Compared to their global and regional peers, listed Chinese coal-fired power companies provide scant relevant information on how they are adapting their strategies in line with the energy transition, despite clear government mandates and goals on capping coal use in power in favour of renewable energy. On average, the companies provide answers to less than three questions of the 13 that we used to assess their strategic response to climate change. Significantly, Shenhua did not consider climate change or GHG emissions management as a material issue. The rest of the companies did, but none provided any carbon-related targets and only one company (China Resources Power) provided a near-term renewable energy generation target for 2020.

Asian peers disclose more

Both CLP and KEPCO provided six answers. Hongkong Electric and Tata Power provided four each. From the Chinese companies, only China Resources Power provided more answers.

International peers showed better board oversight

The comparison group of companies provided better guidance on greenhouse gas management. Nine of these companies, including four out of six with Asian headquarters, state clear carbon-related targets. Seven of the comparable companies had renewable energy targets. The five non-Asian players typically demonstrated better board oversight, including board members with experience around sustainability.

Investors should push companies to address gaps

Overall, there is a clear basis for investors to raise strategic and governance-oriented questions with the Chinese companies about climate change-related risks.

Figure 6: Strategic disclosure relating to climate change

	Mainland Chinese companies						Other Asian companies						International examples				
	Huaneng Power International	Huadian Power International	Datang International Power	China Resources Power	China Power International	China Shenhua Energy	CLP	Hongkong Electric	KEPCO	Tata Power	TEPCO	Tenaga Nasional Berhad	NextEra	South32	Engie	Xcel Energy	AES Corp
ESG metrics included in public reporting	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Climate change or GHG emissions management considered a material issue	Yes	Yes	Yes*	Yes	Yes	No	Yes	Yes*	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Emissions data in sustainability report assured by external auditor	No	No	No	Yes	No	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes
Board member with experience in sustainability	No	No	Yes	No	No	No	No	No	Yes	No	No	No	No	No	Yes	Yes	Yes
Designation of the board member or committee responsible for sustainability	No	No	No	Yes	No	No	Yes	No	No	Yes	No	No	No	Yes	Yes	Yes	Yes
Disclosed the list of plants that are approved but not under construction	No	No	No	No	No	No	No	No	No	No	No	No	No	NA	No	No	No
Targets for non-fossil/renewable capacity or utilisation	No	No	No	Yes	No	No	Yes*	No	Yes	Yes*	No	Yes*	Yes	NA	Yes*	Yes*	No
Financial impact assessment under carbon trading/certificate system	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Scenario analysis on financial impact from transition risks	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes
Targets provided for carbon-related metrics (CO_2, GHG)	No	No	No	No	No	No	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Targets provided for SO_2, NO_x	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Disclosure and closure of all sub-300 MW coal-fired plants	No	No	No	No	No	No	No*	No	No	No	Yes	No	Yes	NA	No	No	No
Timeline and commitment for a complete halt of coal-fired capacity addition	No	No	No	No	No	No	No	No	No	No	No	No	No	NA	Yes	Yes	No

Note: These assessment questions were based on the recommendations of the Task Force on Climate-related Financial Disclosure (TCFD). These consider governance, strategy, scenario analysis and targets and metrics. As South32 is a mining company some of the questions do not apply. These are marked "N/A". Assessments were conducted based on latest Annual Reports and Sustainability Reports (or equivalent) available 5 Jul 2019. For the following companies – Tenaga Nasional Berhad, Tata Power, AES - the Sustainability Reports of the previous financial year was used, as the current year reports were not yet available. Annotations are explained in Appendix: Assessment Methodology of Strategic Disclosures.

* See explanation in appendix.

Source: Company reports

GHG emissions - analysis begins

The Chinese government continues to use regulatory nudges to encourage a slowdown in coal growth and a shift towards renewables. This will limit options for the companies that are already much more GHG- and coal-intensive than the economy and national targets.

For investors concerned that climate change will affect overall portfolios, the focus should be on constraining absolute growth in emissions and not just intensity. Moves to replace smaller inefficient coal plants with larger coal plants that have lower GHG intensity will not ultimately help the climate as they will lock in far higher total GHG emissions over their lifetime. Instead investors will want to see changes in the mix through investment in wind and solar.

At a minimum, investors should expect companies to produce consistent, assured GHG data, but this is not a substitute for discussion of strategy.

Disclosure review

More companies disclose carbon emissions

Overall, there has been a significant improvement in disclosure around total carbon emissions. This followed changes to the Hong Kong Stock Exchange (HKEx) listing rules that now require companies to disclose environmental metrics, including GHG emissions, or explain why they are not doing so. As a result, the number of companies reporting GHG emissions improved from two in 2016 to five in 2017, leaving Shenhua as the only one of the listed companies that has not provided its GHG emissions.

But Shenhua still fails to do so

It is, however, possible to provide a GHG emissions estimate for the power business for Shenhua and to estimate the power generation emissions for all of the companies. Shenhua produced 279 TWh of coal power in 2018, compared to 395 TWh for Huaneng. Assuming that the GHG emissions are in a similar ratio and scaling up as Shenhua is slightly less coal-efficient than Huaneng provides an estimate of 246 $mtCO_2e$. This creates a total GHG estimate for the six companies of 1.3 billion tCO_2e. This is around 12% of China's total CO_2 emissions and 2.8% of the global total for 2017, based on the latest available figures from EDGAR.

GHG data is not comparable

There is enough data to begin the process of analysis, including comparing companies to each other. However, data comparability is an issue, as the companies provide different metrics. Some include all GHG emissions and others only state a number for CO_2 emissions. Some include both Scope 1 and 2, others only Scope 1 (this may be less important as where Scope 2 emissions were disclosed, these made up less than 1% of the total emissions). The GHG emissions intensity figures are sometimes calculated based on total portfolio and sometimes on just the thermal generation portfolio.

Hard to reconcile

For 2018, Datang's emissions disclosure shows a more than 200% increase. The company added around a third of coal capacity. Its own intensity disclosure shows an 11% increase. It is not possible to reconcile these figures. Indeed, Datang's new emissions number is higher than that of Huaneng, which has a much larger coal generation portfolio.

And usually not assured

Aside from comparability there are frequent quality concerns with sustainability data. ESG data is often assured, rather than audited. Only two of the six Chinese companies provided assurance statements with their sustainability reporting. In one case, Shenhua, investors were not informed which KPIs were assured.

Figure 7: Six Chinese companies' GHG emissions disclosure

Company	GHG Emissions (million tonnes of CO_2e) 2016	2017	2018	'17-18 %chg	GHG Emissions Rate (gCO_2e/kWh) 2016	2017	2018	'17-18 %chg
Huaneng Power International	252.4	335.6	348.1	*3.7%*	853.4	903.6	857.5	*-5.1%*
Huadian Power International	undisclosed	147.0	164.3	*11.8%*	undisclosed	819.7	838.4	*2.3%*
Datang International Power	undisclosed	115.2	377.6	*227.9%*	undisclosed	611.7	1,483.0	*142.4%*
China Resources Power	undisclosed	137.3	133.3	*-2.9%*	undisclosed	861.3	849.0	*-1.4%*
China Power International	35.8	36.4	40.8	*12.1%*	588.9	568.3	575.0	*1.2%*
China Shenhua Energy (estimated)	undisclosed	238.9	246.2	*3.1%*	undisclosed	970.2	920.2	*-5.1%*
Average (Unweighted)					**721.2**	**789.1**	**920.5**	**-**
Average (Weighted by power sold)					**-**	**835.9**	**969.1**	**-**

Note: The GHG Emissions figures represent direct GHG emissions only. Disclosures for Datang International Power, China Resources Power and China Power International are only for CO_2 emissions. The GHG Emissions Rate figures are calculated by ARE using companies' public disclosures for consistency. It is calculated as: total direct GHG emissions divided by total power sold, except for China Power Resources, where the denominator is total power generated.

Source: Company reports, ARE

Investors should demand consistent reporting

In the longer-term, investor interests will only be served when companies use consistent reporting methodologies and strengthen their data collection and assurance methodologies. CDP is one potential tool, where the companies make their disclosures public. Notably, four of the six Other Asian companies have consistently provided responses to CDP since at least 2016, while two of the Chinese listed companies (Shenhua and China Resources Power) just started for 2019.

Absolute vs. intensity

GHG emissions continue to rise

Absolute emissions increased for all the companies except China Resources Power, which had lower coal utilization. For Huaneng and Datang, acquisitions of coal assets from parent companies drove the increases.

Absolute targets should matter most, but the focus is on intensity

Climate change mitigation requires that absolute emissions peak and reduce over time. However, China's overall power needs are rising. This has resulted in a focus on emission intensity management, rather than on absolute emissions. While national indicators are improving, even on this basis the results are mixed for the listed power companies.

The companies perform worse than the national average

We compared four of the companies (excluding Shenhua, which did not disclose a GHG emissions number, and Datang, where the reported number appears too high).

The four companies have a weighted average intensity of 827 gCO2/kWh and a simple average intensity of 780 gCO2/kWh. This is higher than the average carbon intensity for the electricity sector for China of 605 gCO2/kWh, which is higher than the global average of 478 gCO2/kWh.[7]

7 International Energy Administration, *Tracking Clean Energy Progress*. Extracted 11 Jul 2019 from: https://www.iea.org/tcep/power/

Mix is the most important factor for intensity

The intensities increased for two companies and decreased for two companies. China Power International has the lowest intensity due to a significant portion of hydro, but emissions intensity increased as coal generation increased in 2018. China Resources Power's intensity declined with wind and solar replacing coal as part of the mix.

The intensity statistics are calculated as the disclosed GHG emissions figures divided by the number of kilowatt hours each company sold (power produced is used where power sold is not available).

The capex-related factors that affect GHG emissions intensity numbers include:

- Renewable/nuclear capacity additions – where these have low intermittency and good grid connections
- Coal fleet age/management – newer plants are more efficient, while there is potential for optimisation, such as through using better quality coal for burning. Dispatch rates can also be relevant, particularly for polluting plants

Power generation mix

China's renewable ambitions have increased

China has a target of 55% coal-fired capacity by 2020,[8] down from the current level of 60%.[9] China also provides absolute capacity targets at the national level for each major form of renewable energy source, as well as targets for the proportion of non-fossil energy (which includes hydro and nuclear) in primary energy consumption, which is to rise to 15% by 2020 and 20% by 2030. Such targets have stimulated renewable capacity expansion, but there has not always been appropriate infrastructure and policy incentive to ensure renewable generation reaches the grid. Most recently, provincial-level renewable energy quotas for 2019-2020 have been released.[10]

But the listed players have not kept pace

The listed coal-fired companies all have higher proportions of coal than the national target, which will act as a long-term constraint to growth for the companies under their current business models.

With companies' wind and solar generation at only 3.7%

The average decline in their proportion of coal generation was 1.3 percentage points between 2015 and 2018, while the average increase in proportion of wind and solar generation was 2 percentage points to reach an overall average of 3.7% of total generation. This is far lower than the national proportion of 7.8% in wind and solar.

China Resources Power is out in front

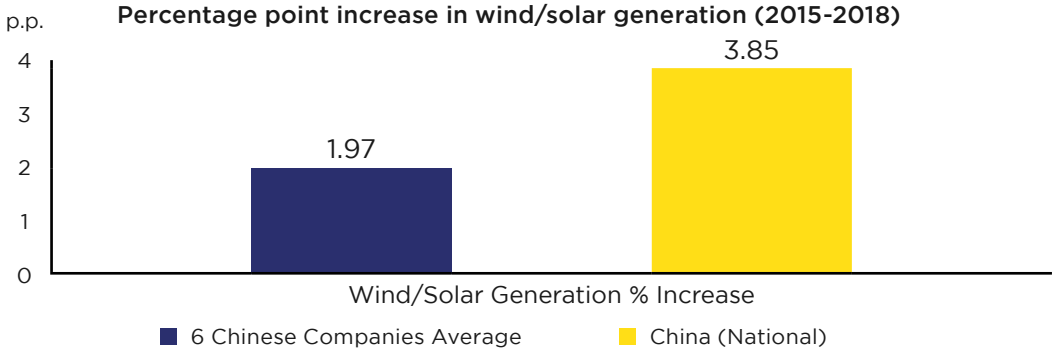
Among the six companies, China Power International increased wind and solar generation the fastest from 0.5% of generation in 2015 to 5.0% in 2018, at the expense of hydro. Only China Resources Power performs better than the national average, at 9.2%. China Resources Power also had the fastest decline in coal. Shenhua is almost exclusively coal and has not added wind or solar to its generation mix. Datang and Huaneng have separate entities that focus on renewable energy, affecting their approach to potential wind and solar additions.

Capacity additions for coal are still higher than for wind and solar

In terms of capacity growth, the power companies added more coal than wind and solar in 2018, even excluding the coal capacity Datang acquired from its parent company. For five of the companies, capacity commitments beyond 2018 for coal (6.4 GW) are higher than for wind and solar (5.9 GW) (Huaneng's disclosure was not consistent and excluded from these figures).

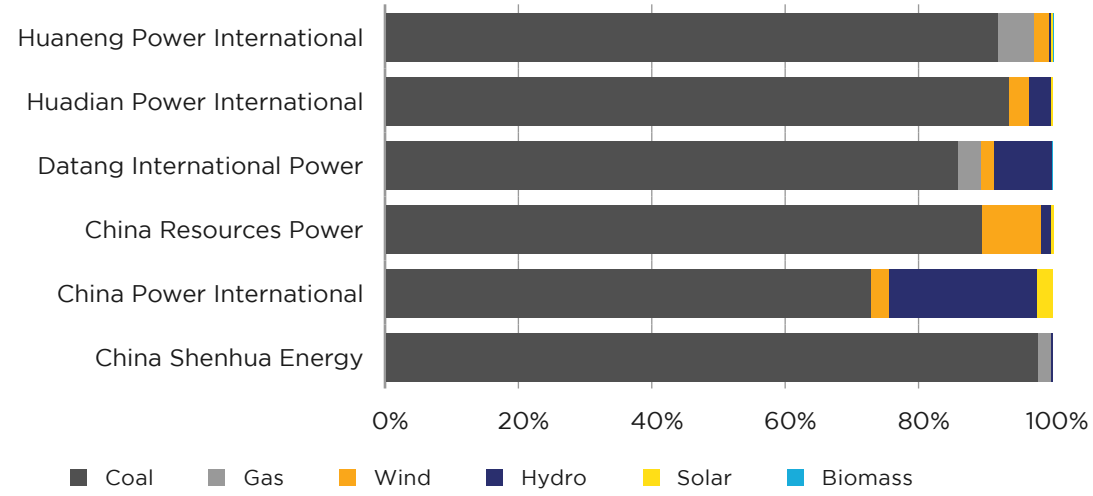
8 National Energy Administration, *2016-2020 13th Five Year Plan for Power Sector Development.*
9 China Electricity Council, *2018 National Electricity Industry Statistics.*
10 Reuters, 15 May 2019. https://www.reuters.com/article/us-china-renewables/china-sets-renewable-power-quotas-for-2019-2020

Figure 8: Chinese companies' wind and solar generation lags national average



Source: Company reports, ARE

Figure 9: Chinese companies' power generation mix (2018)



Source: Company reports, ARE

Figure 10: Chinese companies' capacity additions

	New Coal Capacity Additions			New Wind & Solar Capacity Additions		
Company	**Added in 2017**	**Added in 2018**	**Approved /Under Construc-tion**	**Added in 2017**	**Added in 2018**	**Approved /Under Construc-tion**
Huaneng Power International	undisclosed	undisclosed	undisclosed	undisclosed	undisclosed	undisclosed
Huadian Power International	660	25	3,010	658	240	362
Datang International Power	684	12,540	1,019	207	721	764
China Resources Power	(1,590)	0	0	1,144	1,387	2,872
China Power International	(310)	1,010	2,330	480	1,723	1,972
China Shenhua Energy	1,537	3,910	undisclosed	0	(16)	undisclosed
Total	**981**	**17,485**	**6,359**	**2,489**	**4,055**	**5,970**

Note: Capacity additions for 2017 and 2018 represent controlled capacity except for Datang where only total capacity was provided. The figures are calculated by ARE using companies' public disclosures for consistency. It is calculated as: controlled capacity of the year under review subtracted by the corresponding data during the previous year. Future additions use 2018 company-disclosed figures for projects under construction except for Datang which only provided approved projects.

Source: Company reports, ARE

Efficiency of coal-fired generation

The companies focus on heat rate

The companies all report the heat rate for their thermal coal generation, which allows a comparison of the efficiency of each of their coal fleets. This shows that coal consumption efficiency has improved across the board (a decline in figures is an improvement in efficiency).

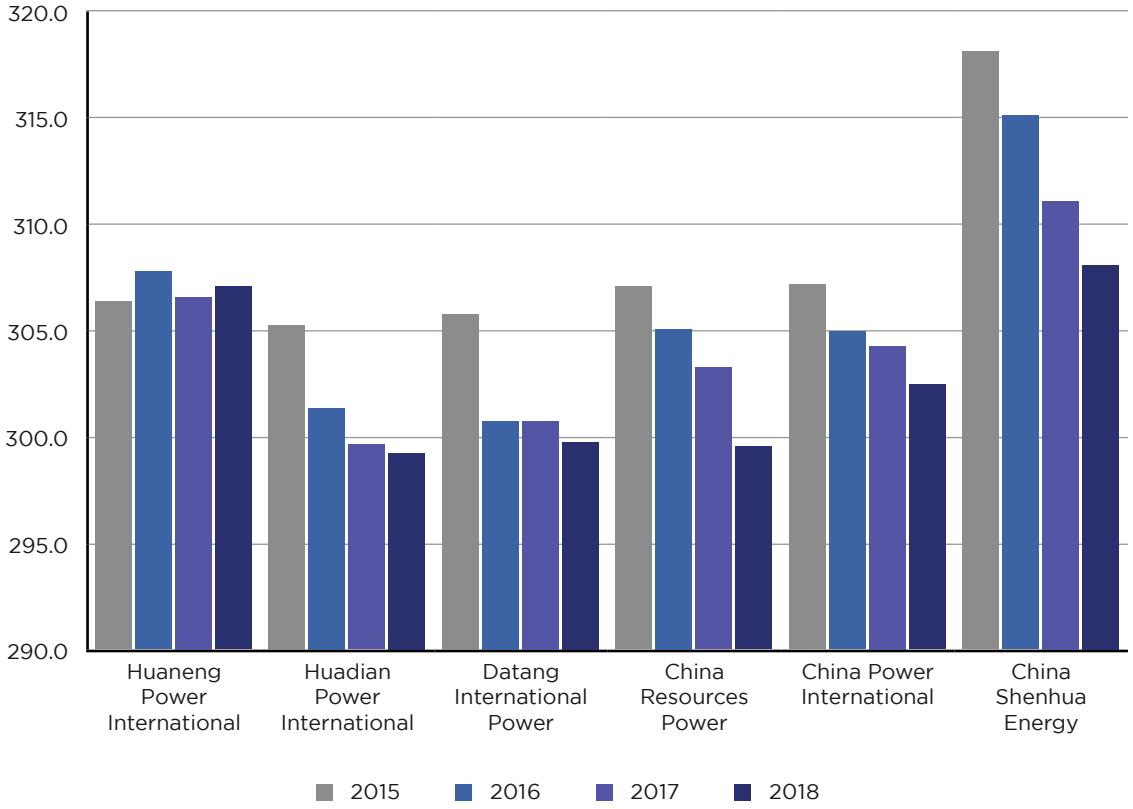
It is hard to improve for plants, easier for portfolios

However, the increases in efficiency are in low single digit percentages. The technical potential for further improvement at the individual plant level is limited. There remain management options at the portfolio level where companies could accelerate the closure of smaller, older units or rationalise dispatch towards higher-efficiency units.

Investors should press for a strategic approach

This is an area where investors should press companies to provide more comprehensive answers on their strategy in the long-term.

Figure 11: Chinese companies' coal consumption efficiency (gce/kWh)



Source: Company reports, ARE

Air pollution

Air pollution has driven regulation

Air pollution, rather than climate change, has been the primary driver for regulation in the sector. It is possible to manage air pollution through plant design and treatment of exhaust gases. There are clear costs for treatment to remove air pollutants such as nitrous oxides (NO_x), sulphur dioxide (SO_2), and particulate matter. However, these are not prohibitive, at least not in China where the government provides generous subsidies. In contrast, large CO_2 reductions typically involve carbon capture and storage (CCS) which creates significant cost implications.

All companies provide disclosures

All of the companies provided NO_x and SO_2 absolute emissions and emissions intensity for 2015-2018 (except Datang, which only provided intensity numbers for 2015-2016, and Huadian, which only provided intensity numbers for 2015-2017).

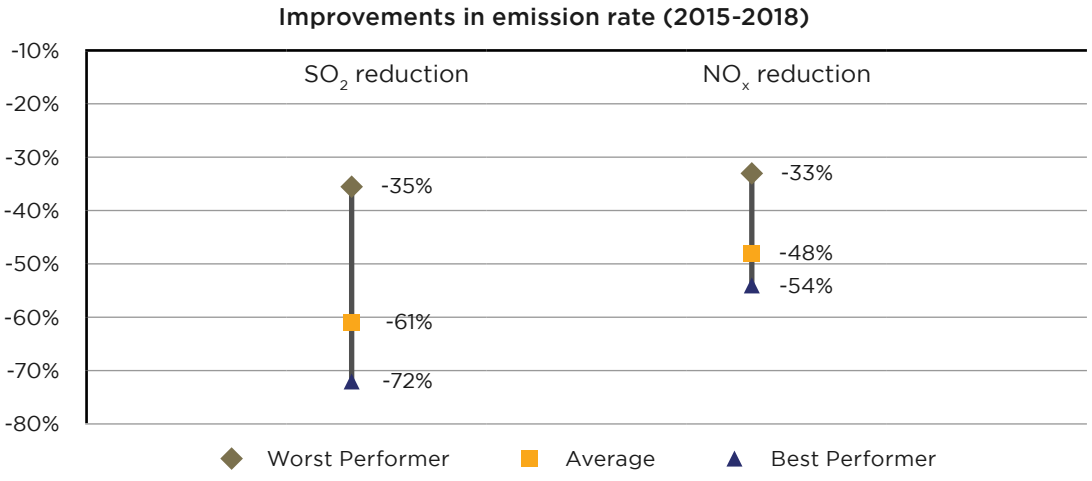
Showing significant improvements

There are good results overall, with a 63% average decline in total SO_2 emissions between 2015 and 2018 for five of the companies (excluding Shenhua, which was an outlier). NO_x emissions also recorded declines, with an average reduction of 38% between 2015 and 2018 and intensity reductions of 42% for the five companies. However, Datang's progress is disappointing. It is still clearly lagging its peers, with both its emissions rates at least 1.5x higher than the best performer in 2018 – China Power International.

And highlighting that real change is possible

The declines follow a high regulatory focus on air pollutants, including NO_x and SO_2, across China in recent years. The progress shows what can be achieved when the government and the companies are committed to acting together.

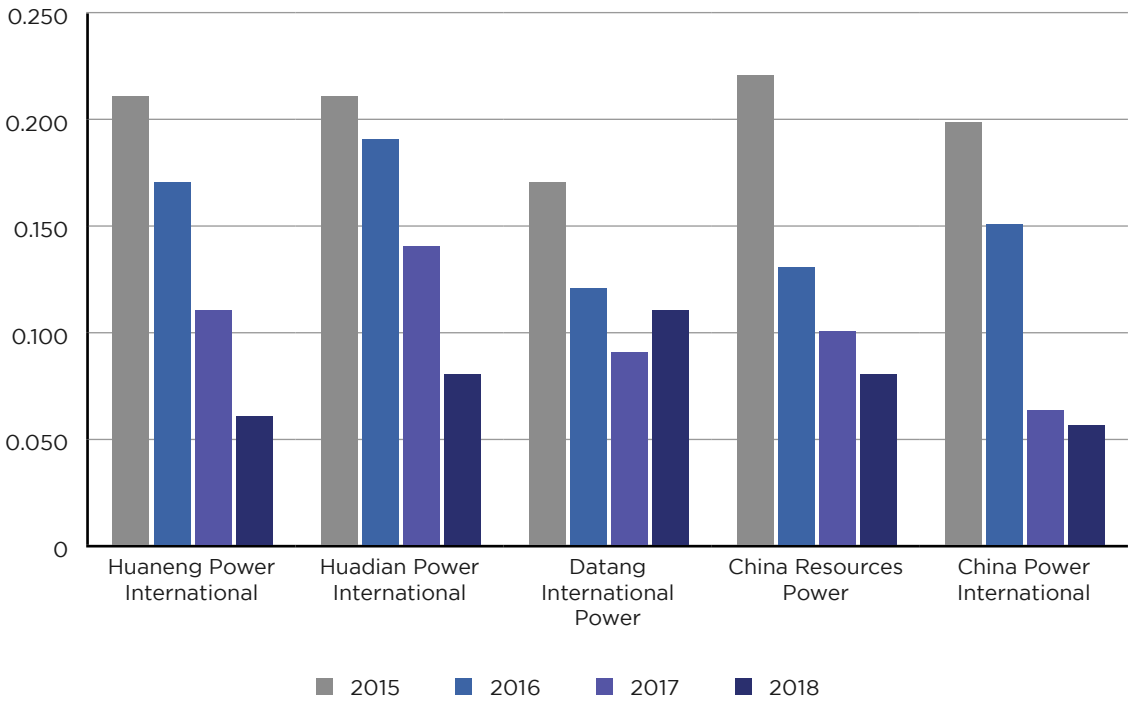
Figure 12: The Chinese companies all show a significant reduction in local air pollution



Note: Shenhua's numbers are not included in the range.

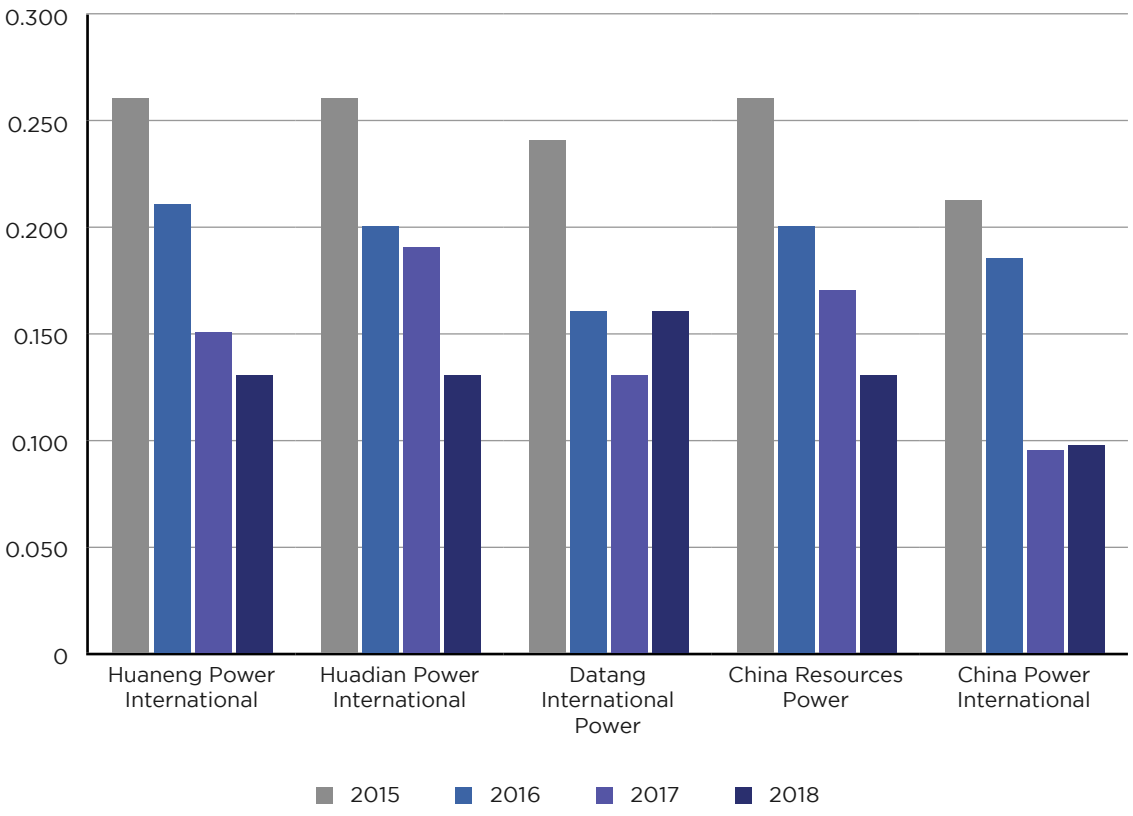
Source: Company reports, ARE

Figure 13: Chinese companies' SO_2 emissions rate (g/kWh)



Source: Company reports, ARE

Figure 14: Chinese companies' NO_x emissions rate (g/kWh)



Source: Company reports, ARE

Appendix: Statistics

Coal / Total Power Generation (%)

Company	2015	2016	2017	*2018*	*p.p. chg 2015-18*
Huaneng Power International	94.3%	93.2%	92.8%	91.8%	*-2.4*
Huadian Power International	93.8%	93.4%	93.3%	93.3%	*-0.4*
Datang International Power	85.6%	82.9%	83.4%	85.9%	*0.3*
China Resources Power	93.5%	92.7%	91.6%	89.4%	*-4.2*
China Power International	70.3%	70.4%	72.0%	72.8%	*2.5*
China Shenhua Energy	98.2%	97.3%	97.7%	97.7%	*-0.5*
Total	**92.2%**	**91.2%**	**91.2%**	**90.8%**	***-1.3***

Source: Company reports, ARE

Wind & Solar / Total Power Generation (%)

Company	2015	2016	2017	2018	*p.p. chg 2015-18*
Huaneng Power International	0.9%	1.3%	2.1%	2.6%	*1.7*
Huadian Power International	2.0%	2.7%	3.2%	3.4%	*1.4*
Datang International Power	2.1%	2.5%	2.6%	2.2%	*0.0*
China Resources Power	5.0%	6.1%	7.1%	9.2%	*4.2*
China Power International	0.5%	1.1%	2.4%	5.0%	*4.5*
China Shenhua Energy	0.0%	0.0%	0.0%	0.0%	*0.0*
Average (Unweighted)	**1.8%**	**2.3%**	**2.9%**	**3.7%**	***2.0***

Source: Company reports, ARE

Coal Consumption Efficiency (gce/kWh)

Company	2015	2016	2017	2018	*%chg 2015-18*
Huaneng Power International	306.3	307.7	306.5	307.0	*0.3%*
Huadian Power International	305.2	301.3	299.6	299.2	*-2.0%*
Datang International Power	305.7	300.7	300.7	299.7	*-2.0%*
China Resources Power	307.0	305.0	303.2	299.5	*-2.4%*
China Power International	307.1	304.9	304.2	302.4	*-1.5%*
China Shenhua Energy	318.0	315.0	311.0	308.0	*-3.1%*
Total (Unweighted)	**308.2**	**305.8**	**304.2**	**302.7**	***-1.8%***

Note: The lower the value, the better the company is performing.

Source: Company reports, ARE

SO_2 Emissions (tonnes)

Company	2015	2016	2017	2018	*%chg 2015-18*
Huaneng Power International	67,312	52,452	43,393	26,104	*-61%*
Huadian Power International	undisclosed	undisclosed	29,412	15,950	-
Datang International Power	undisclosed	undisclosed	14,100	42,100	-
China Resources Power	33,700	21,100	17,200	13,600	*-60%*
China Power International	8,864	6,583	3,035	2,952	*-67%*
China Shenhua Energy	126,500	22,500	20,500	18,500	*-85%*
Total	**236,376**	**102,635**	**127,640**	**119,206**	
Average					***-63%***

Note: The 2017 figure for Huadian is an ARE estimate based on the company disclosure. Shenhua's disclosures were left out of the average analysis because the large reduction was inconsistent with the rest of the companies' experience.

Source: Company reports, ARE

SO_2 Emissions Rate (g/kWh)

Company	2015	2016	2017	2018	*%chg 2015-18*
Huaneng Power International	0.210	0.170	0.110	0.060	*-71%*
Huadian Power International	0.210	0.190	0.140	0.080	*-62%*
Datang International Power	0.170	0.120	0.090	0.110	*-35%*
China Resources Power	0.220	0.130	0.100	0.080	*-64%*
China Power International	0.198	0.150	0.063	0.056	*-72%*
China Shenhua Energy	0.570	0.096	0.080	0.070	*-88%*
China Average (Unweighted)	**0.263**	**0.143**	**0.097**	**0.076**	***-61%***

Note: Shenhua's disclosures were left out of the average analysis because the large reduction was inconsistent with the rest of the companies' experience.

Source: Company reports, ARE

NO_x Emissions (tonnes)

Company	2015	2016	2017	2018	*%chg 2015-18*
Huaneng Power International	83,339	66,170	59,790	56,044	*-33%*
Huadian Power International	undisclosed	undisclosed	39,917	26,329	*undisclosed*
Datang International Power	undisclosed	undisclosed	20,400	64,000	*undisclosed*
China Resources Power	42,600	32,200	28,600	22,600	*-47%*
China Power International	9,451	8,158	4,540	5,097	*-46%*
China Shenhua Energy	196,000	37,300	39,400	28,200	*-86%*
Total	**331,390**	**143,828**	**192,647**	**202,270**	
Average					***-42%***

Note: The 2017 figure for Huadian is an ARE estimate based on the company disclosure. Shenhua's disclosures were left out of the average analysis because the large reduction was inconsistent with the rest of the companies' experience.

Source: Company reports, ARE

NO_x Emissions Rate (g/kWh)

Company	2015	2016	2017	2018	*%chg 2015-18*
Huaneng Power International	0.260	0.210	0.150	0.130	*-50%*
Huadian Power International	0.260	0.200	0.190	0.130	*-50%*
Datang International Power	0.240	0.160	0.130	0.160	*-33%*
China Resources Power	0.260	0.200	0.170	0.130	*-50%*
China Power International	0.212	0.185	0.095	0.097	*-54%*
China Shenhua Energy	0.880	0.160	0.150	0.140	*-84%*
China Average (Unweighted)	**0.352**	**0.186**	**0.148**	**0.131**	***-48%***

Note: Shenhua's disclosures were left out of the average analysis because the large reduction was inconsistent with the rest of the companies' experience.

Source: Company reports, ARE

Appendix: Assessment methodology of strategic disclosures

We developed thirteen questions to assess how much clarity power companies give their investors on how they consider, mitigate and manage the transition risks from climate change. These questions are aligned to TCFD recommendations and cover governance, strategy, risk management and implementation (through trackable targets and metrics). The questions focus on transition risks, not physical risks. Investors increasingly use TCFD as the framework to assess company strategy in light of climate change risks and opportunities.

Assessment guidelines

The following table provides guidance notes used to assess company disclosure.

No.	Assessment questions on strategic disclosures	"Yes, if..."
1	ESG metrics included in public reporting	Key environmental performance metrics of latest financial year are disclosed in public ESG reporting. This would need to be GHG metric and one other pollutant metric (air or water)
2	Climate change or GHG emissions management considered a material issue	Either included in a materiality matrix or if the company does not use a materiality matrix, it is written as a key issue to manage Add note if (a) it is a key issue but management methods are fossil energy based; (b) Appears in the materiality matrix, but is not ranked as "high importance" to the company
3	Emissions data in sustainability report assured by external auditor	External assurance statement is provided in the actual report, even if it notes partial coverage
4	Board member with experience in sustainability	Board member profiles in annual report or online demonstrate operational experience within a related sector i.e. renewable (wind & solar) energy or specifically noted leadership in sustainability (e.g. Chief Sustainability Officer in different sector)
5	Designation of the board member or committee responsible for sustainability	Specific board level committee or specified board member designated with oversight capacity. Executive level committees or personnel are not included.
6	Disclosed the list of plants that are approved but not under construction	Information in Annual Report and corresponding Sustainability Report can be analysed to produce a list of plants that have been approved but yet to be constructed
7	Targets for non-fossil/renewable capacity or utilisation	Targets for non-fossil energy sources are available for either capacity, utilisation or capex spend with specific target dates Add note if target is noted as low-carbon but it is likely to include hydro or nuclear
8	Financial impact assessment under carbon trading/certificate system	Dollar value, % impact on expenditures/liabilities, or comment on severity of (potential) financial impact is available in management discussion, risk discussion or in financial statements
9	Scenario analysis on financial impact from transition risks	Scenario analysis conducted aligned with TCFD recommendations and comments made on potential financial impact
10	Targets provided for carbon-related metrics (CO_2, GHG)	Targets are specified with dates, even if these are expressed as intensity targets or Scope 1 targets only
11	Targets provided for SO_2, NO_x	Targets for air emissions are specified with dates, even if these are aligned just to meeting future regulatory requirements
12	Disclosure and closure of all sub-300MW coal-fired plants	There is a firm and clear statement that all of such plants are closed, or there is a list of plants with generating unit sizes available in the Annual Report or website and it is clear no such plants with generating unit <300MW exist.
13	Timeline and commitment for a complete halt of coal-fired capacity addition	There is a firm and clear statement that there will not be future coal-fired capacity additions starting at a fixed date.

Strategic disclosure analysis annotations

SD	Assessment questions on strategic disclosures	Company	Reason
1	ESG metrics included in public reporting	Tenaga Nasional Berhad	Tenaga Nasional Berhad did not disclose the FY2018 environmental indicators, and as such, it is marked as "No" even though the Sustainability Statement in the FY2018 Annual Report reported metrics from FY2017.
2	Climate change or GHG emissions management considered as a material issue	Datang	While "Clean Energy" was listed as a substantive issue, the report refers to low emissions coal in several areas as "clean energy".
		Hongkong Electric	While "Climate Change" is noted as a key challenge to the company, the management method is largely a transition towards LNG, and not renewables.
7	Targets for non-fossil/renewable capacity or utilisation	CLP	The target includes nuclear power.
		Tata Power	The target includes hydro power.
		Tenaga Nasional Berhad	The target includes hydro power.
		Engie	The target includes hydro power.
		Xcel Energy	The target includes nuclear power.
12	Disclosure and closure of all sub300MW coal-fired plants	CLP	CLP did not disclose the generating unit sizes for these coal-fired power stations: Guangxi Fangchenggang Power Station and power stations under CSEC Guohua International Power Company Limited.

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