TLG on China: COAL?

THE LANTAU GROUP
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The Challenge of Regulation and Market Reform

China's major generation companies enjoyed increasing profitability annually from 2012 through the first half of 2015.[1]

The picture is not all rosy, however. Demand growth has slowed, with limited prospect of a return to past extraordinary growth rates. Frequent major shifts in regulations, often without much consultation or transition, pose new challenges to the industry's operational and financial performance. Most of these shifts involve tightened environmental compliance requirements. Additional uncertainties surround the prospect, nature, and extent of China's power industry reform efforts.

In this issue of TLG on China, we review the impact of recent developments in China's power market and environmental regulations from the perspective of the coal-based generation sector.

Objectively, the path towards a decarbonized power grid was never going to be quick, straight, or easy. And for many more years to come, coal-based generation has a vital role to play along that path. Coal itself is just an input. The important, actionable, and effective questions revolve around how coal is used — at what thermal efficiency, with what emission control systems and standards, and within what overall economic, commercial and policy context.

History Repeats?

Most of China's major thermal generation companies experienced heavy financial losses[2] in the period from 2008 to 2010, due to a range of factors, including high coal prices, lower than expected demand growth, over-investment, exceptionally high leverage, and poor tariff regulation. Their financial stress finally eased only in 2012, after coal prices fell significantly. The resulting increased net operating margin sharply improved profitability and enabled the gencos to pay down their debt.

The left panel of Figure 1 shows the profits earned by the major thermal generation companies[3] from 2012 to 2014, which shows profit increases in 2013 and 2014 relative to 2012 for all gencos except Datang International, which experienced losses in its ventures in the coal-to-chemicals sector.

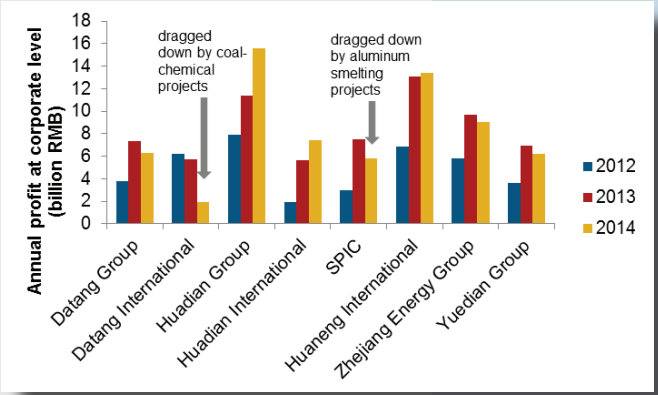
1 The profit of Huadian International, Datang Generation, Huaneng International and Guodian Generation increased by 31%, 3.5%, 19.5% and 15.5% in the first half of 2015, respectively, compared to the previous year, driven by falling fuel costs.

2 More than 60% including all the State-owned five big thermal power generation companies in 2010. See http://finance.sina.com.cn/roll/20101229/06043563308.shtml.

3 The falling coal prices and changing economic conditions have different impacts on the thermal generation companies as they have different portfolio of assets over the supply chain across power generation, coal mining, coal-chemicals, aluminium smelting, finance, etc.

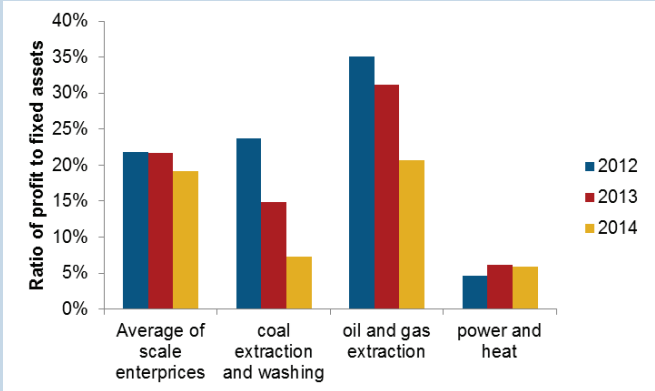
Figure 1: Profitability of major thermal generation companies and sectoral comparisons

Profit of selected generation companies with dominant coal-fuelled generation assets



Source: http://bond.hexun.com/upload/0007.pdf and TLG Research

Comparison of Return on Assets of the Power and Heat Sector with other energy business



Source: NDRC (National Bureau of Statistics of China)

Even as profit in absolute RMB terms increased, profitability, as measured by the return on fixed assets, has remained low, especially when compared to China's other large-scale enterprises[4], oil and gas development companies, or coal mining companies, as shown in the right panel of Figure 1. Surprisingly, the coal industry did better than the power and heat supply industry even in 2014, which was one of the worst years for which data are available for China's coal sector.

Whereas falling coal prices have been positive for coal-fuelled generators, other market conditions and developments have moved against the gencos. Furthermore, coal prices cannot keep falling forever.

We take this opportunity to dig more deeply into these mounting challenges now facing coal-based generation in China.

Slower Demand Growth Coupled with Supply Surplus

China's average annual GDP growth in the period from 1995 to 2008 exceeded 10%. Since 2010, however, GDP growth has slowed, falling below 7%[5] in 2015, with many anticipating further declines.[6] Electricity demand growth dropped even more, as seen in the left panel diagram of Figure 2, exhibiting merely 0.5%[7] growth in 2015. Investment in new capacity tends to lag unexpected slow-downs in growth because projects have started years in advance, typically based on more optimistic projections. With so much new generation capacity chasing after less robust demand growth than previously expected, utilisation levels for coal plants have fallen, as highlighted in Figure 2.

4 Large-scale enterprises are referred to as those with annual revenues of RMB 20 billion or above from their primary business lines.

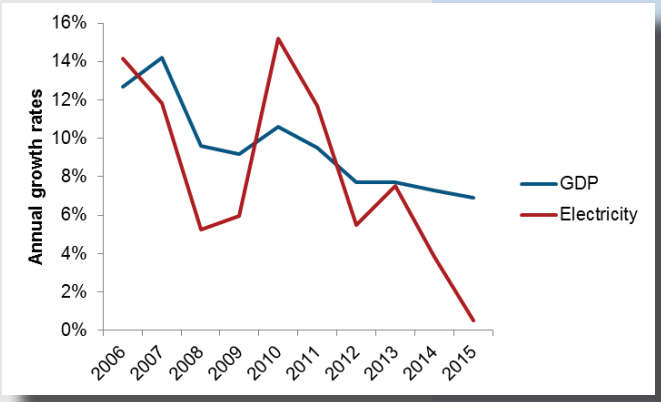
5 GDP growth of 6.9% in 2015 is provisionally reported by China's State Bureau of Statistics: http://www.stats.gov.cn/tjsj/zxfb/201601/t20160120_1306759.html. It is the lowest rate of annual GDP growth since 2008.

6 The Government has released several economic stimulus packages and monetary policies in recent years. Views on China's growth in 2016 range from 5.82% to 7%, with the majority of views projecting 6.5 - 6.8% growth. See http://wallstreetcn.com/node/228100.

7 http://www.nea.gov.cn/2016-01/19/c_135022865.htm.

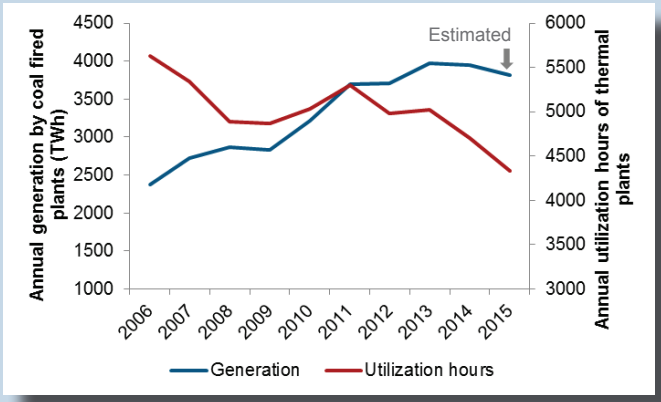
Figure 2: Electricity demand growth and utilisation levels of coal-fuelled power plants

GDP Growth and Electricity Demand Growth



Source: CEC (China Electricity Council), NBSC, TLG Research

Coal-fuelled Generation and Utilisation Hours



Source: CEC, NBSC, TLG Research

In the period from 2008 to 2010, many coal plants were not able to generate because they did not have coal (or the coal price exceeded their expected revenue), leading to lower utilisation hours. However, the situation changed in 2014 and 2015. Falling coal prices and sticky tariffs protected the gencos from the full impact of reduced utilisation. Also utilisation reductions were not uniformly allocated across all plants. In some cases, newer, more efficient and cleaner (less air pollutant emissions) plants were generally allocated more utilisation hours than older, smaller, higher emitting plants. Even so, the extent of reduced utilisation was dramatic. Many coal plants were kept idle due to either insufficient electricity demand or increased penetration of alternative generation sources. In China's possibly new normal of slower growth, the existing capacity surplus is likely to take years to be absorbed unless the older coal plants are retired early.

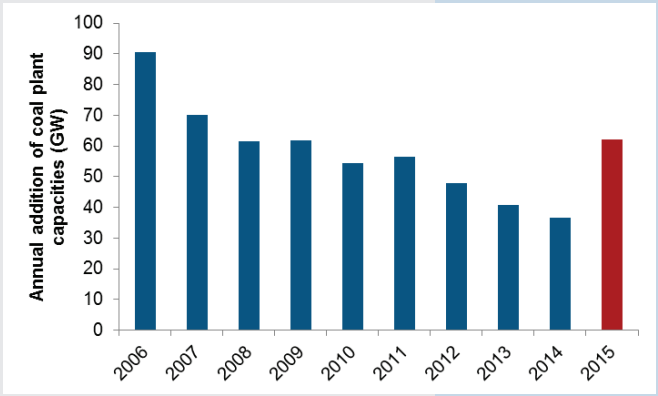
China also appears to be emphasising generation sources other than coal, as part of a possible long-term shift. From 2006, the pace of new coal-fuelled capacity additions slowed steadily through 2014, as shown in the left panel of Figure 3, though it once again surged in 2015. Other types of capacity have been increasing at faster rates, reducing the share of coal power generation capacity from 77.5% in 2006 to 60.7% in 2014. But without sufficient demand growth to offset the increase in supply, the allocation of dispatch hours for coal plants has fallen.

Despite all of these concerns, and despite reduced dispatch hours, the increased profitability of coal-fuelled generation appears to have revived interest from thermal generation companies and other investors in new coal-fuelled generation projects, as shown in the right panel of Figure 3. About 62 GW of new coal-fuelled capacity was commissioned in 2015.[8] A whopping 128 GW of proposed coal-fuelled generation projects received Environmental Impact Assessment (EIA) approval from provincial government departments in the first nine months of 2015, as compared to 160 GW over the entire 2012 - 2014 period, when project approval authority resided with Central Government Departments.

8 NEA reported an addition of thermal power generation capacity of 64 GW in 2015. http://www.nea.gov.cn/2016-01/19/c_135022865.htm.

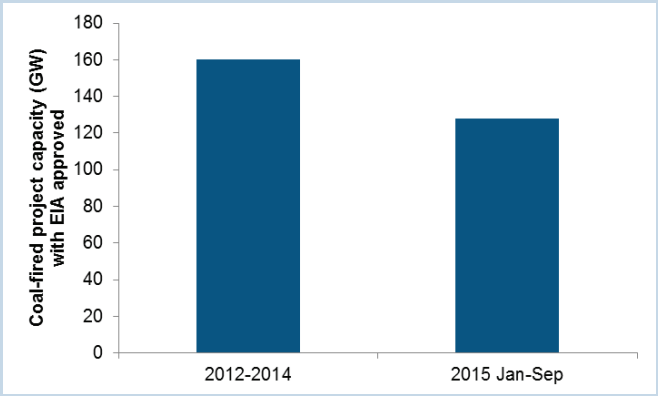
Figure 3: Historical addition of coal-fuelled generation capacity and recent coal power project approvals

Annual addition of coal-fuelled power generation capacity (GW)



Source: CEC, TLG Research (2015 figures estimated)

Recent EIA approvals of coal generation projects (GW)



Source: Greenpeace China[9]

But where is the demand to absorb the generation supply? Clearly, without sufficient demand growth, the revived investment interest in new coal plants will only exert further downward pressure on utilisation hours. If so, who will bear the pain?

Looking forward, the levels of profitability achieved by coal-fuelled generation in 2013 and 2014 do not appear sustainable. In addition to the risk of reduced utilisation hours, environmental compliance costs have increased whereas on-grid tariffs have decreased. One scenario involves allocating relatively more dispatch hours to more efficient facilities, which makes both economic and environmental sense, but which will greatly increase the financial risk of less efficient facilities. So, not only is the coal generation sector battling the slowing Chinese economy and rising competition from renewable energy, but the industry will likely also face tension between its more efficient and less efficient facilities.

Increasing Competition from Alternative Generation Sources

The planned roll-out of China's UHV transmission system is another factor that will intensify the competitive pressures on existing coal-fuelled plants (See Figure 4).

China has stated plans to increase its solar and wind capacity by 226 GW, and its conventional hydro and nuclear generation capacity by 108 GW in 2020, compared to 2014. The generation from this capacity alone is estimated to be about 1,093TWh[10] by 2020. If China's electricity demand grows at 3%[11] per annum over in the next five year (2016-2020) – not unreasonable given recent growth trends and a rate still considerably higher than electricity demand growth in developed countries -- incremental demand will be less than 900 TWh.[12]

9 Source: http://www.greenpeace.org.cn/china-facing-700-billion-investment-bubble-of-coal-power-2/.

10 We assume solar utilisation of 1500 hours, wind 2200 hours, hydro 4653 hours and nuclear 7500 hours a year.

11 Note that China's electricity demand growth is 0.35% in 2015.

12 The incremental generation in 2015 is about 72 TWh.

Coal plants in Shanghai, Zhejiang, and Anhui already feel the pain. The annual utilisation rates of thermal plants in these three regions fell by 817 hours, 1346 hours and 1067 hours respectively, between 2013 and 2015. Henan province, which is connected by the Hami-Zhenzhou UHV DC line commissioned in 2014, has seen the utilisation of its thermal plants reduced by 917 hours between 2013 and 2015. And, when the Zhundong-Wannan UHV DC line is commissioned, the utilisation rates in Shanghai, Zhejiang and Anhui will also likely fall.[13] By 2017, Shandong and Jiangsu will be connected to several UHV lines (Figure 4), with the likely consequence of utilisation rates in those regions dropping significantly, as well.

Figure 4: UHV Projects connecting the West, Northwest and North to the East

UHV AC projects

Source: TLG Research based on various sources

UHV DC projects

Source: TLG Research based on various sources

Compliance with Ultra-low Emission and Energy Efficiency Regulations

Operationally, the cost to comply with the new environmental and plant efficiency regulation will increase. National Development and Reform Commission (NDRC), and National Energy Administration (NEA) jointly issued the "Action Plan for Full Implementation of Ultra-Low Emission[14] and Energy Conservation Refurbishment for Coal-fuelled Power Plants".[15]

The additional cost of accommodating an ultra-low emission retrofit varies, depending on the plants' existing condition, boiler design, and technologies deployed. The left panel shows the per kW cost of extra-low emission retrofits based on various reports for 28 coal plants. The costs range from RMB 40/kW (the lowest one is new with unit size of 1000 MW) to RMB 833/kW, compared with the kW cost of RMB 208/kW, assumed in the calculation of per kWh cost of additional extra-low emission retrofit cost by China's Electric Power Planning and Engineering Institute (EPPEI). The additional cost per kWh arising from an extra-low emission retrofit for a 2x300 MW genset with annual utilisation of 5000 hours and investment repayment of 10 years is RMB 0.016, in addition to the

13 Construction started in 2016.

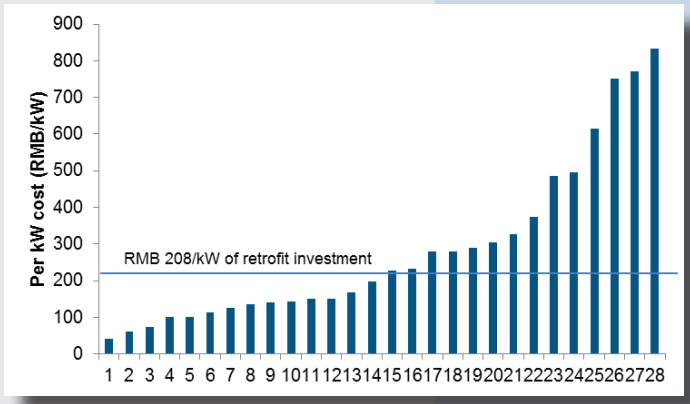
14 At Reference Oxygen Content of 6%, SO2, NOx and dust and smoke densities of flue gas NOT exceeding 35 mg/m3, 50 mg/m3 and 10 mg/m3, respectively.

15 http://www.mep.gov.cn/gkml/hbb/bwj/201512/t20151215_319170.htm.

cost of RMB 0.026/kWh of meeting the emission standards effective from 2011. The total cost of compliance appears to be at least RMB 0.042/kWh[16] given a generous assumption of 5000 hours of utilisation (which is much higher than what is being achieved by many coal-fuelled plants at present). See the right panel of Figure 5.

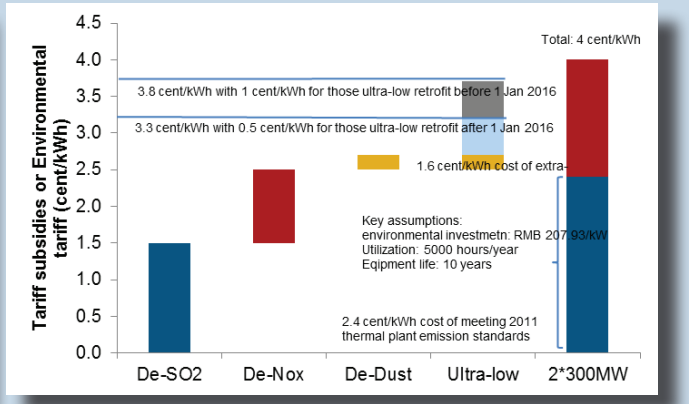
Figure 5: Investment cost of ultra-low emission retrofit and environmental tariffs

Unit cost of ultra-low emission retrofit (28 plant samples)



Source: TLG Research based on various reports

Environmental subsidies versus cost of compliance



*Source: China Electric Power Planning and Engineering Institute (EPPEI) for cost of 2*300MW example (2012 RMB)*

Further Benefit from Lower Coal Prices is Limited

The Bohai-rim Steam-Coal Price Index (BSPI) dropped from RMB 634 per tonne (5500 kcal/kg) in December 2012 end to RMB 372 per tonne at the end of December 2015, with an accumulated decrease of RMB 262 per tonne as shown in the left panel of Figure 6. This translates to a cost savings of RMB 0.104 per kWh in the fuel component for a coal plant with 42% generation thermal efficiency and 6% plant auxiliary use.

There have been several rounds of increases in environmental tariffs to cover the cost of de-NOx, de-Dust and other emission reduction costs (see Figure 5) with an accumulated total of RMB 0.033-0.038/kWh. There have been four downward adjustments of the corresponding on-grid tariffs for coal plants from 2013 through 2015, two of these having been implemented in 2015. The total net reduction of the on-grid tariffs from 2013 to 2015 has been RMB 0.0503 per kWh, as shown in the right panel of Figure 6.

The National Development and Reform Commission (NDRC) published[17] a new coal-power price linkage mechanism, which became effective from 1 January 2016. The key features of the linkage mechanism are:

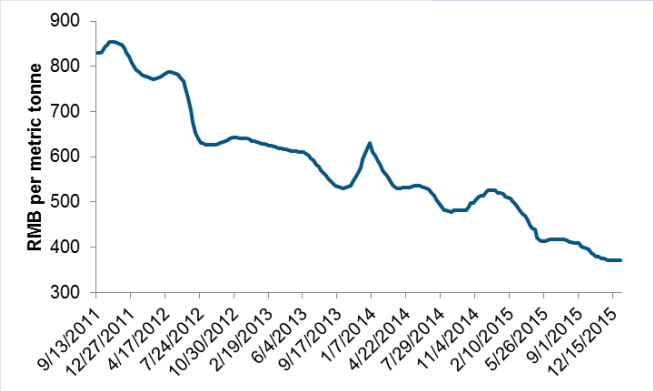
- The coal price reference (base) is 2014, determined on a provincial basis;
- The threshold of variation that triggers the mechanisms is RMB 30 per tonne and different pass-through coefficients apply to different variation intervals;
- Both on-grid tariffs for coal-fuelled plants and sales tariffs for end-users are tied to the coal price variations.

16 The environmental tariffs for de-SO2, de-NOx, de-dust facilities are RMB 0.015/kWh, RMB0.01/kWh and RMB0.002/kWh, respectively. An extra-low emission subsidy announced in December 2015 is available as well, with the subsidy being RMB0.01/kWh for facilities installed before 1 January 2016 and RMB0.005/kWh for those installed afterwards.

17 NDRC, Notice on Matters related to Improvement of Coal-Power Price Linkage Mechanism, December 2015, http://jgs.ndrc.gov.cn/zcfg/201512/t20151231_770446.html.

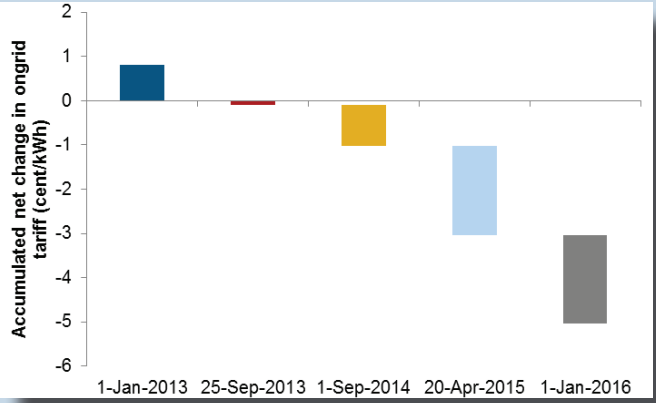
Figure 6: Trends of coal prices and changes of on-grid tariffs for coal plants

Weekly BSPI of Q5500 coal prices



Source: TLG Research from public data sources

Average net on-grid tariff change



Source: TLG Research based on announced tariffs

Given these, the financial benefit to coal-based power generating companies from the further coal price declines is limited.

Summary

Coal-based power generating companies in China have benefitted immensely from falling coal prices, but have since experienced tariff adjustments that neutralise the future benefit of any further falls (although they may be protected against any future increases).

The cost to comply with China's evolving energy policies can differ widely from facility to facility and location to location. Slowing demand growth and a large and possibly growing generation capacity surplus will intensify competition among generators as China gradually reforms its power plant dispatch and power contracting policies. Yet, if China is to achieve its emission reduction objectives, new efficient capacity will need to continue to displace older less efficient capacity. Shutting down facilities becomes imperative. China's power sector needs to enter an era of Significant Rebalancing.

Even for those that survive these headwinds in the short-term, the future is unclear. Finding the right balance or the best transition path will not be easy.

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Xinmin is an expert in the Chinese power sector and energy economics having advised clients on generation, transmission and energy supply issues as well as regulatory developments and cost trends. He is a former lecturer at Jilin University in Changchun and at Zhongshan University in Guangzhou. He combines his knowledge of China's power sector with over a decade of experience as a consultant in the Australian and other power markets and as an associate director of RepuTex (AU) focusing on environmental and greenhouse gas emission issues. Over the past several years, Dr Hu and the TLG team have advised clients on a range of engagements concerning the Chinese power and gas markets, including the economics of different sources of generation, the prospect of grid curtailment of renewable energy resources, and the impact of shifting economic fundamentals and evolving policy developments on end-user power and gas prices. In addition to his consulting work, Dr Hu, is a regular reviewer for several international energy, operations research and optimization journals. He holds a PhD in operations research with a minor in economics from the University of Melbourne and an MSc in Applied Mathematics from Jilin University of Technology, China.

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