Gas-Fired Power Generation in China: Opportunity or Road Block?

China is a vast potential market for natural gas. The second largest primary energy market in the world after the U.S., its energy demands are growing apace with its accelerating GDP. At around 3 percent of the market, natural gas is by world standards under-represented in the Chinese primary fuel mix, but its consumption is predicted to contribute disproportionately to growth in Chinese energy demand, with some suggesting gas might represent 10 percent of the primary energy mix by 2010. The Chinese government seems keen to develop China’s gas sector, in particular to address some of the country’s severe pollution problems by substituting gas for “dirtier” coal and oil. This backdrop might be expected to offer substantial opportunities to participate in gas infrastructure projects, with gas-fired power generation projects figuring prominently among these. However, not only does this not now appear to be the case, but difficulties with gas-fired power investments in China might also be an impediment to investments in other gas infrastructure in China, at least in the short term.

Gas-Fired Power Generation

Gas-fired power generation should be a key factor in the extent and rate of development of China’s gas market, as it has the potential to create the initial bulk downstream revenue that typically anchors investment upstream of it. A baseload gas-fired power station can absorb large quantities of gas, quickly. It might involve twice the capital cost and 10 years to create gas demand in the residential sector equivalent to that of a 600 MW power station that can be built in three years.

There is certainly a need for more Chinese generating capacity. Electricity demand growth, in a market already second only to the United States in terms of consumption, is forecast at 7-9 percent per annum until 2010, and China is in a state of energy shortfall, with many provinces experiencing blackouts this year. China is thus the richest source of potential power projects in the world. Gas-fired power plants are currently a tiny component of the overall Chinese installed capacity, but the SDPC’s Energy Research Institute (“ERI”) has projected that gas will contribute disproportionately to installed capacity increments, and that 10 percent of Chinese power generation will be gas-fired by 2020.

Coal is the dominant power generation feedstock in China, accounting for more than 70 percent of electricity currently generated there, and it is against coal principally that gas must compete as a feedstock for incremental electrical power generating capacity. Gas would appear to have many advantages. Combined-cycle gas turbines (CCGTs) are recognized, when compared with coal-fired plants generally, as being cheaper to build per kilowatt of electricity output, quicker to construct, producing fewer harmful emissions, offering a higher energy conversion efficiency, occupying less space, and having other advantages such as the ability to ramp electricity production up and down rapidly. Despite gas’s advantages, the ERI’s projections may be optimistic, and even if accurate, might not throw up the profitable opportunities that non-Chinese investors hope for.

According to the IEA, gas is probably not currently cost-competitive with coal for baseload generation in China. China has abundant, cheap coal to supply its power stations. Despite the superior thermal efficiency of CCGTs, the feedstock price differential in China is such that gas-fired power stations there seem unlikely to be able to match standard coal-fired power stations’ price-per-kilowatt for electricity generated, and may continue to be at a cost disadvantage even against coal plants fitted with flue gas desulphurization (“FGD”). The capital-cost
position of gas-fired plants, when compared against coal-fired, is worse in China than elsewhere. While gas power stations are generally considered to be cheaper to build than their coal counterparts, this might not apply in China, where 300MW coal-fired generating units can be manufactured cheaply by international standards, and expensive foreign gas turbines must be imported.

Coal power generation is China’s greatest atmospheric polluter, and so help for gas might be expected from environmental legislation. Sulphur dioxide, particulates, and other harmful by-products of coal combustion, in particular, have given China a grave pollution problem: 40 percent of China is afflicted with acid rains caused by SO$_2$ emissions. However, environmental legislation has set standards comparatively low by OECD standards. For example, while new plants burning coal with a sulphur content greater than 1 percent must install FGD, existing plants burning such coal have until 2010 to install it, and those using coal with less sulphur need not install it at all.

Although restrictions have been placed on coal-fired power stations in specified acid rain and SO$_2$ “Control Areas,” this does not prevent coal-fired electricity from being generated outside the Control Areas and transmitted into them via the transmission network. Those environmental standards in place are not always observed or stringently enforced, with the result, for instance, that some coal-fired plants fitted with FGD units do not use them so as to avoid the additional operating costs associated with their use. Environmental Protection Bureaus, responsible for policing such matters, reputedly do not have the funds to conduct the inspections that might discover such errant behavior.

Even coal-fired plants fitted with FGD can still enjoy a cost advantage. The IEA estimated a swingeing emission fee of $1,200/ton of SO$_2$ would have to be imposed on coal plants in Shanghai to render gas-fired generation competitive at anticipated gas prices. It is only when compared with coal plants using capital-intensive advanced clean coal technologies, such as integrated gasification combined cycle and pressurized fluidized bed plants, that gas looks clearly to be competitive. It is interesting to conjecture what might happen should the capital costs of such clean coal technologies decline, as new technology tends to, offering the prospect of “clean” coal to compete with gas’s environmentally friendly credentials.

Even in those regions where gas-fired power generation seems most competitive, it faces competition in baseload applications by virtue of the transmission network under development, if not from coal then from other possible feedstocks. Geography is no protection if there is a transmission system in place with sufficiently small transmission losses to import competitive electricity from elsewhere. The Chinese transmission network is being improved with, for instance, a west-east transmission line project to parallel the west-east gas pipeline project. A modern grid will be able to transmit electricity from power plants in resource-rich regions to load centers in resource-poor regions. Thus coal-fired power stations and hydroelectric projects, from coal-rich and hydro-rich regions respectively, will be able to service baseload electricity demand that might otherwise be met by gas.

All this is not to say that a gas-fired plant is not competitive for non-baseload applications. Its capacity to ramp generation up and down rapidly renders it suitable for peak shaving, a particular need in China where the peak–baseload gap is substantial and growing. Introduction of pricing to give adequate premium to generation capacity at peak times would increase gas’s attractiveness in China. Also, a gas-fired plant — more compact in itself, and without the need for substantial fuel and ash storage — demands less space than a coal plant, and is modular so that even small gas-fired units maintain their comparatively high efficiency. These characteristics, combined with a gas power station’s relatively low environmental impact, make gas-fired power suitable for distributed generation, in which small gas-fired units are distributed close to loads, e.g. around a city. This is an attractive economic proposition, lessening as it does the need for long-distance transmission infrastructure, and permitting energy-efficient applications like combined-heat-and-power schemes. This approach is even more attractive in China, as it would fill the gap left by the numerous small coal-fired power stations shut over the last few years. However, these applications will not of themselves create the bulk downstream demand to justify the pipeline infrastructure upstream of them, and so they must await the arrival of an appropriate level of demand from other consumers. For that, a baseload plant is required, and gas does not in the current environment seem a cost-competitive choice for that application.
Reform of the Chinese Power Industry

The ongoing reform of the Chinese electricity industry adds to the complications facing those contemplating gas-fired power plant investments in China. Reform of the Chinese power sector has been under way since the 1980s and has certainly attracted substantial numbers of foreign investors into the generation sector, but it is incomplete. While the reforms have doubtless been a significant factor in attracting foreign investment into the Chinese power generation sector, the current state of uncertainty as to their ultimate outcome is a disincentive to investment and, in particular, to investment in gas-fired plants.

Since the 1985 “Provisional Regulations on Promoting Fund-Raising for Investment in the Power Sector and Implementing Different Power Prices” opened the generating sector to foreign investors, the industry has been radically restructured, most recently pursuant to the 2002 “Plan for the Structural Reform of the Power Industry.” State Power Company, the former integrated electricity monolith, was broken up at the end of last year into two transmission and five generating companies, and a State Electricity Regulatory Commission (“SERC”) was established to regulate an electricity industry apparently moving toward a competitive market. Among other things, the 2002 Plan set out as goals the introduction of emissions charging to address environmental concerns, and increased competition in energy pricing. The environmental goal, if pursued, would increase the competitiveness of gas, but as described above, it has not been implemented yet, and even if it were, may not open the way to widespread gas-fired baseload generation. Movement toward competition in electricity provision is more problematic for gas.

Since 1998, single province pooling has been tested in trial pools in the grids of Heilongjiang, Jilin, Liaoning, Shanghai, and Zhejiang. After some mixed messages as to the Chinese view of their results, it was finally announced that regional power pools are to be established, with the first to begin in January 2004 in provinces in northeastern China, and a pool for eastern China slated to start in April 2004. Current indications are that the type and amount of generating capacity allowed to participate in the pools will be restricted, with only state-owned and IPP-owned coal-fired plants of 100MW capacity or more permitted to participate, and only 20 percent of electricity output to be traded, with the remaining 80 percent left outside of the pool. However, Beijing’s expressed aim is a nationwide competitive power pool, including smaller generators, with an electricity futures exchange to be established, and it is unclear the extent to which in the longer term other generating capacity will be left out of the pool market. It is clear, however, that should gas-fired generation continue to produce comparatively expensive energy, it will struggle to compete in a market where offtakers will naturally seek the cheapest supplier. Some hope here is offered in the suggestions from Beijing that two-tier pricing might be introduced, with tier a function of fuel feedstock.

A number of other issues with the reforms vex investors in Chinese power plants generally. For example, the role of the SERC remains to be fully clarified, and the detailed functioning of the competitive power pool markets must be promulgated. The interaction between generating capacity outside and within the pool remains unclear. Pool pricing remains unknown, because in the trial pools the pool settlement price was kept secret. Hedging instruments, such as contracts for differences, have yet to be officially sanctioned. Perhaps most significantly, no commitment has been given as to the fate of generators’ rights under signed power purchase agreements (“PPAs”) once the pools are introduced. Thus, if they sign long-term agreements underpinning their investments, developers of gas-fired baseload plants may find they have assumed merchant risk to compete in an as-yet ill-defined market as among the most expensive generators. In any event, it might be wrong to place too much value on PPAs even if “grandfathered”: experience suggests that offtakers bound by contract to take uncompetitively priced electricity are likely to look for an exit from their obligations.

With the current “cost-plus” tariff structure offering generators a profit of 6-8 percent on capital and operating expenses, the reward available now for assuming the risks involved in gas-fired power investments in China appears to be scant. It would seem hard for international investors and lenders to participate in gas-fired power projects until at least some of the uncertainties surrounding them are removed and/or greater rewards are offered for the risks involved.
Conclusion

The lower capital costs, higher efficiencies, and other advantages normally associated with CCGTs do not appear currently to make up for the cost differential between coal and gas feedstocks when CCGTs are considered for baseload power generation in China. Even if they did, the current state of China’s power reforms would subject investment in Chinese gas-fired power plants to much risk. While gas-fired power plants might be competitive in peak-load, mid-merit, and distributed generation, these applications will not provide the bulk downstream demand required, at least initially, to underpin pipeline projects upstream of them while demand from residential and commercial consumers grows. Thus the difficulties confronting Chinese gas-fired power plants have the potential to retard development of infrastructure upstream of them.

The Chinese authorities might change this analysis through implementation of a number of measures. For instance, enactment and enforcement of regulations requiring installation of FGD and other pollution countermeasures in coal-fired power plants, and/or imposing substantial emissions fees on coal generators, would shift the economics toward gas-fired baseload generation. So would tax incentives for CCGTs and the government-sponsored promotion of domestic capacity to manufacture them.

In any event, even without these measures, development of China’s gas infrastructure is unlikely to halt. The Chinese government’s policy is clearly to press on with development of the gas industry, and the Chinese themselves can perhaps take a more sanguine view of the risks involved in a landscape with which they are most familiar. China’s banks certainly show a willingness to provide the capital to fund this infrastructure development on less stringent terms and lower margins than would be obtainable from their international counterparts. High-profile projects like the west-east pipeline, while suffering well-publicized difficulties, advance. However, unless matters change, international investors and lenders are unlikely for the time being to flock to the Chinese gas-infrastructure party.

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