Coal Chemicals: A Preliminary Evaluation

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The Good

According to Hu Qianlin, the deputy secretary general of China Petroleum and Chemical Industry Federation, there are currently 26 Coal-to-Oil and 58 Coal-to-Olefin (via methanol) projects in various stages - from the planning stage to plants that are already running. If all these projects are realized, by 2020 they will have a combined annual capacity of about 40 million tons of oil and a similar capacity of olefins. However, this rush into coal chemicals does not necessarily mean the segment is attractive for all entrants. China's chemical industry provides many examples of segments quickly losing their profitability after being entered by new players. This paper therefore aims to evaluate the attractiveness of this area for current and potential participants.

The key reason for investment in coal chemicals is the expected high profitability of the plants. Shenhua's Baotou coal-to-olefins plant achieved an EBIT margin of about 19% in the past. And though the exact numbers vary, different sources agree that coal-to-oil should definitely be profitable at oil prices above US$100 per barrel. For example, according to Zhang Yuzhou of Shenhua, its direct coal liquefaction is profitable above an oil price of US$85 per barrel. This indicates recent decent profitability as the oil price was about US$110 per barrel both in 2012 and 2013.

Profitability of such plants obviously depends on coal prices. Plants therefore are located in those areas where due to lack of logistics, global-level coal prices cannot be obtained. Within China, there are huge variations in coal price. Coal prices in Xinjiang may be three to five times cheaper than at different locations on the Eastern seaboard. The "stranded coal" can only be transported economically after transformation into higher-value materials – which is what coal chemistry is about. Coal chemical projects therefore are mouth mine projects, at least those which involve the first step of the coal chemical value chain (methanol-to-olefin projects may also be located elsewhere as they may rely on imported methanol).

Another factor positive for coal chemicals is the encouragement this technology has been given by the government. The background is a desire to reduce China's energy dependency on imported oil. However, recently this support has weakened as the government worries about overcapacities and the environmental consequences of widespread coal conversion. This has not lead to a complete stop of such projects but rather to a more lengthy and centralized approval process as well as to lower limits for plant capacity.

Overall, these factors have led to the huge number of coal chemical projects mentioned at the beginning of this paper, including projects with foreign participation, such as the joint project of CPI and the French Total. However, how justified is this optimism?

The Bad

The main issues of coal chemicals fall into three categories – technical, environmental and commercial issues.

Even though China by now has some experience with coal chemicals, technical issues still represent an obstacle. A particular case is that of Datang Duolon's MTP (methanol-to-propylene) project. As reported by Zhang Chi, an analyst at China's Guotai Junan Futures, the project suffers from quality issues as well as low capacity utilization of only about 45%. A reason may be that the catalyst was developed by Datang internally and thus lacks long-term, large scale proof of efficiency. As a result, the project suffered a loss of RMB1.5 billion in 2013 – losses that come on top of major delays in the project timeline and massive cost overruns of about RMB10 billion.

A more common and widespread issue on the technical side is the lack of suitably qualified staff, in particular engineers. This does not affect all companies – Shenhua hired many qualified employees from PetroChina and Sinopec – but has led to low capacity utilization at Shaanxi Yanchang Petroleum's ton methanol-to-olefins project and at the MTO project of China National Coal Group. Similar issues are likely to arise in the next few years as the number of operating coal chemicals projects increases without a corresponding increase in experienced engineers. This will particularly affect companies for which coal gasification has not been a core area in the past. In the longer run, however, China is likely to develop more qualified staff, alleviating the current problem of lack of skill.

Environmental issues have also already reduced the profitability of operating projects. In January 2013, Shenhua's Baotou project was stopped by the Ministry of Environmental Protection and had to pass an environmental check before restarting, resulting in estimated losses of RMB3

million per day. According to the ministry, Shenhua had started trial production before having passed reviews for pollution prevention and control.

Carbon dioxide emission so far is an environmental issue that has not been an obstacle to the development of coal chemicals, even though this is seen as a big disadvantage of the technology by some environmentalists. However, currently the reduction of pollution in China's most populated areas seems to be regarded as more important than reducing China's overall carbon dioxide emission.

High water consumption is often mentioned as the biggest environmental issue of coal chemistry, though recently there also have been some dissenting voices, for example by John Richardson of ICIS. A calculation by Management Consulting – Chemicals shows that indeed the water consumption by the planned coal chemicals projects is small compared to China's water resources and its water use for agricultural purposes. Assuming that all the projects listed at the beginning of this paper come onstream, they would require about 1.6 billion tons of water (40 million tons oil production, 40 million tons olefin production, each ton of material requiring 20 tons of water). This is small compared to the water resources of Xinjiang (about 90 billion tons) or Inner Mongolia (53 billion tons, data according to China Statistical Yearbook 2013). In addition, in both these provinces agriculture rather than industry is the main user of water, so any water usage of coal chemicals plants could presumably be compensated for by reducing agricultural water usage by just a small percentage.

However, the picture is probably not quite as simple as that. Xinjiang currently already uses about 66% of its water resources. According to a survey on water resources, water consumption in northwest China should not exceed 70% of the water resources, otherwise the over-exploitation is likely to have serious consequences. Thus even a small increase in water usage could have negative impacts. In addition, coal chemical plants are highly localized water users, so even if on a provincial level the water resources are sufficient, this can still lead to local water shortage. After all, China as a whole only uses 21% of its water resources, but there is no doubt that certain regions in China suffer from water shortage.

Finally, there are several commercial issues. Obviously, with the current boom in projects, there is the danger of overheating. A large amount of additional methanol capacity will be created even though China already has methanol overcapacity. So coal chemicals companies are well advised not to rely on the open market but rather build integrated plants that convert the methanol into products further down the value chain, e.g., olefins or polyolefins. However, even for such projects the methanol market price will be one determinant of their profitability. In July, two Chinese chemical companies announced plans to build huge methanol plants in the US based on natural gas, and to ship the vast majority of the methanol to China. This indicates that at least in coastal regions of China, coal-based methanol produced in Xinjiang or Inner Mongolia is probably not competitive.

Oil price dependency is another commercial issue of coal chemicals projects. Though the oil price has been consistently above US$100 in the past few years, it currently only barely reaches this level. A relatively minor decline could bring the price quite close to the US$85 break-even point given by Shenhua. And for some other companies, the break-even point quite likely is somewhat higher.

Finally, coal chemicals projects require large investment. According to IHS, capital costs are about three times higher than those of naphtha crackers. As a consequence, they need to run for a long period of time to reach a positive project value. However, according to a paper co-authored by the China University of Petroleum, China is likely to reach its peak level of coal production ("peak coal") as early as 2024, far before most coal chemicals projects will have paid back their initial capital investment. Such peak forecasts may not come true, but if peak production is indeed achieved within the next 10-15 years, coal prices may rise substantially and many of the calculations for coal chemical projects may turn out to be wrong.

The Conclusion

As in other crowded areas of China's commercial industry, it will still be possible for highly competitive producers to earn money in the segment. However, it is also very likely that players with inferior positions will make substantial losses. As long as the chemical products produced from coal are undifferentiated basic organic chemicals and basic plastics, the competitiveness of each industry participant will almost exclusively depend on its position in the cost curve. In turn, this position in the cost curve is mainly influenced by the technology used, the price of raw material (coal), and economies of scale (plant size).

Any potential participants in the industry should therefore thoroughly consider whether they can have a competitive advantage in any of these three areas. Examples of such advantages would be long-term access to low-cost (probably stranded) coal, a superior technology, an extended value chain participation including higher-value downstream products, or to some extent access to capital to invest in an above-average plant scale (though this factor is likely to be the least relevant above a certain minimum plant size).

The evaluation of the competitive position of potential participants will not be limited to the individual participants. Many suppliers to the coal chemical industry – be it for equipment, for water treatment or for gas supply - will only be able to get decent returns on their initial investment if their clients stay in business. Thus the evaluation of the coal chemicals segment will remain relevant and will have to be updated continuously as new information on its performance emerges. ■