



Hong Kong's Energy Future

A Cleaner Energy Future is
Hong Kong's Responsibility

Paper II: Mainland Gas for Hong Kong

Uncertainties Over Supply,
Price, and Emission Impacts

Bill Barron

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II: Mainland Gas for Hong Kong:

Uncertainties Over Supply, Price, and Emission Impacts

By: Bill Barron, Civic Exchange

Main Points

- The new gas deal negotiated in the 28 August 2008 Memorandum of Understanding (MoU) between the Mainland and the HKSAR Government provides Hong Kong with a more diverse set of gas supply options.
- Whether the MoU will result in lower gas prices remains an open question.
 - Hong Kong buyers of new offshore gas and (if it goes ahead) from a Hong Kong link to the second West-East pipeline will be 'price takers'.
 - Recovery of capital costs, whether they are incurred outside of Hong Kong or inside must ultimately be reflected in prices charged to consumers.
- For an interim period (between about 2013 and 2018) there will almost certainly be considerably less gas available in Hong Kong than would have been the case if the Soko terminal had gone ahead.
 - The deficit will be made up by increased coal-fired power generation with resulting increases in emissions.
 - Even after the offshore gas, the new overland pipeline and the Mainland LNG terminal are in place, increasing demands for electric power in Hong Kong will put unrelenting pressure on the Territory's ability to stay within emission targets.
 - Hence, there will be a need to try to increase gas supplies over time to levels well beyond what is being discussed today.
- A major potential opportunity under the MoU lies with the new Mainland LNG terminal. In order for the MoU to provide more gas than the Soko terminal would have, this source must be able to provide Hong Kong with no less than 1.5 billion cubic meters (BCM) of gas per year initially and more over time.

- The new terminal's ability to play this role will probably depend in part on the extent to which Hong Kong interests have ownership and can exercise control over the terminal and the gas supplies being imported through it.
- The HKSAR Government has been touting the gas deal under the MoU as something of a panacea (increased gas supply at lower costs and clean air to boot). While there is some truth in this position, it is important to distinguish the hype from reality. The reality is that there is that there is much that is uncertain and crucial details have yet to be worked out.

Introduction

Plans for the proposed Hong Kong Liquefied Natural Gas (LNG) terminal at South Soko Island were cancelled following the HKSAR Government's surprise announcement that it had negotiated a deal with Mainland authorities for long-term alternative sources of natural gas for the territory. That deal is sketched out in a 300 word document, the 28 August 2008 Memorandum of Understanding (MoU) between the National Energy Administration of China and the Government of the Hong Kong SAR.

The MoU notes that the Territory will continue to receive no less than its current amount of nuclear power from the Mainland for the next 20 years. It then identifies a number of options for gas supply to Hong Kong:

- To study the feasibility of a branch to Hong Kong of the second West-East gas pipeline from central Asia;
- Continuation of gas supply by the China National Offshore Oil Corporation, CNOOC);and
- A new LNG terminal "jointly built in the Mainland".

The MoU itself says little about gas supply levels¹ and the timing of when delivery might be expected from these potential sources. The MoU notes that the price for the gas will be determined on "commercial principles between the relevant parties" (i.e., not government to government, but supplier to buyer).

Edward Yau, the Secretary for the Environment, says the deal will provide a net increase in natural gas to help reduce the Territory's pollutant emissions and keep electricity prices at a relatively low level by avoiding the HK\$10 billion addition from the South Soko LNG terminal to China Light and Power's (CLP's) net fixed assets.²

Local environmental groups have generally welcomed the deal as a way to avoid development near the Soko Islands, hopefully permanently.

While there clearly are benefits in the new arrangements, there are also important uncertainties and potential drawbacks with respect to local and regional air quality. Basically, these stem from the fact that while the MoU brings in gas supplies greater than what is available in Hong Kong today, it is unclear if it will match the potential of a fully Hong Kong-owned and -controlled Liquefied Natural Gas (LNG) terminal, whether that terminal were in

¹ In fact it is entirely silent on the matter of the volumes of gas to be supplied, except to note that CNOOC will renew its supply agreement for a further 20 years.

² Edward Yau, "A Cleaner, Cheaper Energy Future for Hong Kong" *South China Morning Post* 23 September 2008, page A17.

Hong Kong or in nearby Guangdong. In addition, it is important to recognize that considerable uncertainty exists with respect to:

- The total amount of gas Hong Kong will eventually receive from the various options noted in the MoU;
- The timing of supply from the different sources;
- The impacts on price of the need to recover the investment costs associated with new wells and pipelines, removing impurities from the different sources of pipeline gas, and the joint LNG terminal; and
- The prices to be paid by the Hong Kong buyers for gas from each source.

In each of these cases above, it is instructive to compare it to what would have been the case if the Soko terminal had proceeded as planned.

Levels of Gas Supply

Offshore gas

Nearly half of the promised total promised gas supply from the Mainland will be from new, spatially scattered, and not fully developed gas fields in the South China Sea. The MoU states that the Mainland government supports CNOOC “to renew its supply agreement to Hong Kong for a further 20 years.”³

The current amount of gas from this source would be about 1.8 billion cubic meters (BCM) of gas per year.⁴ The offer by CNOOC to continue to supply the current level of gas from that area of ocean to Hong Kong for a full 20 years is presumably based on what CNOOC considers reasonable prospects for the successful drilling and development of additional wells in the general vicinity of Yacheng. As noted below, this likely would have implications for the timing of the gas deliveries from this source if the existing Yacheng field cannot continue to produce 1.8 BCM for perhaps another 7 years or more until the new wells, pipelines, etc. are fully operational. CLP has argued that the existing Yacheng offshore gas field is facing serious decline.⁵

³ Memorandum of Understanding between the National Energy Administration and the Hong Kong Special Administrative Region Government on Supply of Natural Gas and Electricity to Hong Kong. gia.info.gov.hk/general/200808/28/P200808280188_0188_44075.doc

⁴ “CLP Gives Up \$10 billion LNG plan at Soko Island,” *Hong Kong Economic Journal* 12 September 12 2008.

⁵ *Ibid.*

The cost of the new wells, plus needed infrastructure to bring the gas up from depth, pipe it to Hong Kong and remove the worst of the impurities before it can be used are unclear at this stage. But whatever the cost, Hong Kong consumers will have to pay it.

Gas from Central Asia Pipeline

What the MoU offers with respect to overland gas supply to Hong Kong is to study its feasibility. The HKSAR Government, clearly anticipating a favourable conclusion to the feasibility study, holds out the prospect of receiving from this source an estimated annual supply of about 1 BCM.⁶

Thus, presuming both CNOOC and the new branch of the second overland West-East pipeline come on stream at levels expected by the HKSAR Government, the territory would have an annual supply of 2.8 BCM, which is more than the 1.8 coming from Yacheng today.

For both the offshore gas and the overland pipeline, it is likely that the gas will contain significant amounts of impurities such as sulphur and carbon dioxide which will need to be removed before being burned in Hong Kong's power plants. Impurities are far less of concern with LNG since these are mostly removed in the liquefaction process before the gas is shipped. Hence, to the extent that Hong Kong power users will come to rely more on pipeline gas and less on LNG, the cost of purification facilities will be an added cost.

Mainland LNG terminal

The third source of gas mentioned in the MoU is a new LNG terminal jointly built in the Mainland that would supply gas to Hong Kong. In contrast to the other two sources of gas for which the HKSAR Government went beyond the MoU to indicate the volumes of gas it expects to be coming to the Territory, the HKSAR Government has not speculated on the size of the terminal, nor on the how much gas the Hong Kong partners in it might be able to purchase on the international LNG market and bring to the Territory through this terminal.

Nonetheless, it is clear that the amount of gas brought to Hong Kong from the new Mainland LNG terminal would have to be substantial if the Territory wants to keep tight limits on the use of coal. The arrangements would need to go well beyond the type of deal Hong Kong Electric (HKE) and Towngas have with the existing Shenzhen terminal. Under that

⁶ Yau, 23 September 2008.

arrangement, HKE receives 0.4 BCM and Towngas under 0.5 BCM in a facility with a baseline throughput of more than 5.3 BCM.⁷

CLP has indicated that its annual gas usage by 2023 could be as high as 6 BCM, based on HKSAR Government emissions caps and projected growth in demand.⁸ HKE has a generation capacity about half of CLP's and it too will presumably be looking for far more gas to meet rising demands while staying within emission limits.

Quite plausibly, the two Hong Kong power companies together could be looking for something in the order of 8 to 9 BCM of gas by 2023. If the undersea and overland pipeline supplies amounted to 2.8 BCM and HKE's gas supply from the Shenzhen terminal remained at 0.4 BCM,⁹ then the Hong Kong power companies might want to import via the new LNG terminal as much as 5 or 6 BCM of LNG.

LNG terminals typically have a baseline throughput capacity of between about 3 and 16 BCM per year.¹⁰ Hence, the volumes of LNG Hong Kong is likely to be seeking from the new Mainland terminal would be quite large compared to its likely size (judging by other existing or proposed terminals in the area, probably something between 5 and 7 BCM). It remains an open question at this point what the relative ownership and operational control shares will be between Mainland interests and Hong Kong interests in the "jointly built" Mainland LNG terminal.

Timing of Gas Supply

The speed at which Yacheng declines and new offshore wells can begin feeding gas into an underwater pipeline to Hong Kong is uncertain. Under the best of circumstances, Yacheng will be able to keep producing at near current levels until such time that new wells in the area are brought into production and connected to the pipeline. Little has been made public about prospects for long-term (20-year) output potential from the existing Yacheng field (at a level of 1.8 BCM) nor of the development status or size of new offshore gas fields to be developed in the area. It would be important for the HKSAR Government to confirm that there will be no shortfall in the 1.8 BCM gas supply as Yacheng winds down and new field comes online. This would probably be no sooner than about 2016.

⁷ Guangdong Technoeconomic Research & Development Centre
iis-db.stanford.edu/evnts/4164/Guangdong_Zhang_Lemin.pdf.

⁸ *Hong Kong Economic Journal*, 12 September 2008.

⁹ There are plans (not firm date yet) for a Phase II of the Shenzhen terminal adding another 5.3BCM to the existing plant. (Guangdong Technoeconomic Research & Development Centre). It is possible that HKE will be able to negotiate for somewhat more gas from this source than it currently receives.

¹⁰ www.ferc.gov/industries/lng/indus-act/terminals/exist-prop-lng.pdf

Given that the Mainland government has only agreed to study the feasibility of having Hong Kong connected to a second West-East pipeline, the timing of gas from this source is very difficult to project with any confidence. An optimistic timeframe probably would be about 2018-2020. If the HKSAR Government has information to indicate that the 1 BCM of gas from the overland pipeline could arrive in Hong Kong before 2018 (that is assuming the feasibility study agrees that it can come at all) then the government should inform the public.

A large LNG terminal normally would take more than a decade to go from the very early planning stages to the start of operation. It seems that the new joint LNG terminal is now in the early planning stages and if so, then it would probably be 2020 before substantial amounts of gas from this source could be arriving in the Territory.

Nonetheless, it may be that if CLP plans a major role in the new terminal, some of the experience gained through its well advanced planning for the Soko terminal before the surprise announcement of the MoU might help speed up the process for designing and developing the new one. In addition, if the Mainland authorities were to expedite the process, including environmental impact identification and mitigation, things could move somewhat more quickly.

With an expedited approval process, the new LNG terminal might be able to begin supplying gas to Hong Kong by perhaps 2018. Here again it would be helpful if the HKSAR Government could provide at least a preliminary timeframe for major gas supplies coming to Hong Kong through the new LNG terminal.

For each of these cases: the near term reliability of the existing 1.8 BCM from the offshore gas fields; the possible 1 BCM from the second overland pipeline (if a branch to Hong Kong is found to be feasible); and the newly announced "joint" LNG terminal in the Mainland; the timeframe for the arrival of large reliable volumes of gas for the Territory is far from clear. In light of the serious concerns raised above about the delay in the arrival of the gas, it would be helpful for the government to make public what information it has on the timing of the various sources of gas mentioned in the MoU.

Price

As the MoU states and the HKSAR Government stresses, the price of the gas will not be set by the government agencies who signed the MoU, but by the seller and buyer of the gas on the basis of 'commercial principles'. So what are the principles in this case?

With respect to both the new offshore gas and the gas from the new overland pipeline, there will be a single State Owned Enterprise seller and one or two Hong Kong regulated private sector buyers. The sellers will have other potential buyers outside of Hong Kong for the gas but will be under pressure from the National government to provide amounts of gas generally

in line with what has been discussed publicly (i.e., 1.8 BCM from the offshore fields and 1 from the overland pipeline) and at prices that would not appear to be obviously exorbitant. The Hong Kong buyers will be under pressure to secure as much as gas they can from each source to help meet emission goals. Hence, it seems disingenuous to claim that the price would be worked as if some form truly competitive market were at work.

The actual price Hong Kong will pay for the offshore and pipeline gas supplies will likely be set, at least in part, through political considerations. Such considerations probably would tend to favour Hong Kong, because without them the Hong Kong buyers would simply be price takers unable to refuse because they are under pressure at home to maximize their use of gas.

Pricing issues with respect to the new Mainland LNG terminal will be quite different. Here, hopefully the Hong Kong buyers would be able to negotiate their own pricing and supply deals for LNG on the international market. To such a price one would of course need to add charges sufficient to recover the capital and operating costs for the terminal.¹¹

Hence, if the scale of Hong Kong's involvement in ownership and control of the new Mainland LNG terminal is large (and to meet future gas requirements it arguably should be), then Hong Kong consumers will be paying for the capital costs of the terminal. The inferences that some might draw from The Secretary for the Environment's public comments¹² notwithstanding, with energy there is no free lunch in avoiding capital costs. The only issue in this case is how the HKSAR Government would have treated as fixed assets the Soko terminal compared to how it (and the Mainland) will treat Hong Kong ownership in a Mainland terminal.

¹¹ The formula for such cost and profit recovery would change, and perhaps also the bottom line for consumers, depending on whether the Hong Kong LNG buyers were renters of the Mainland terminal's facilities or (more likely) part owners. Either way, in the end the costs would need to be reflected in the price passed on to consumers of electricity in Hong Kong.

¹² Yau, 23 September 2008.

The Cancelled Soko Terminal

By way of comparison, the cancelled Soko terminal would have had a baseline annual throughput of about 4.3 BCM.¹³ Over time, throughput could have been expanded via faster drawdown to perhaps 5 or 6 BCM. In the longer term capacity, it could be expanded even further through installation of an additional onshore storage tank and offloading facilities. The terminal in its baseline configuration would have been operational no later than 2013.¹⁴

If Hong Kong's share in the new Mainland LNG terminal provides a baseline supply to the Territory of more than 1.5 BCM, and if that amount could be scaled up over time, then the MPU overall would provide more gas to Hong Kong than the Soko terminal. Yet, even if this proves to be the case, we estimate that there could well be a gap perhaps 5-7 years (roughly 2013-2020) or more in which Hong Kong will have substantially less gas under the MoU than would have been the case if the Soko terminal had gone ahead.¹⁵

The above estimate of a serious shortfall in gas supplies over the coming decade is admittedly based on a number of broad assumptions, some of which may prove to be too pessimistic. Nonetheless, the potential risk of a deficit for gas for a period of some years and as a consequence the burning of far more coal appears to be substantial. Again, if the government has information on the likely timelines for the gas it would be useful to make it public.

Emission Consequences, Burning Coal Instead of Gas for Power Generation

For perspective, consider that in 2006 the Hong Kong power sector burned an amount of coal containing the energy equivalent of 7.4 BCM of natural gas and 2.9 BCM of actual natural gas.¹⁶ To understand the emissions impacts of a shortfall in gas supply (e.g., 1.5 BCM for five years), consider that for each kilowatt hour of electricity generated with natural gas instead of coal in a multi-fuel facility such as Castle Peak with Flue Gas Desulphurization [FGD] in place, Particulate Matter (PM) falls by 83%, NO_x falls by 33%, SO₂ falls by 86% and CO₂ falls by 31%. When natural gas is used in a far more efficient

¹³ Kevin Leung Cheuk Ming, China Light and Power Company, personal communication to Bill Barron by email 12 February 2007.

¹⁴ Sara Yin, "Doubts Cloud Gas Deal" *South China Morning Post*, 28 September 2008.

¹⁵ If there were more time to plan for it, part of the deficit could have been made up with more aggressive power sector energy conservation (especially efficiency improvements) and more power generation from renewable energy. However, the timeframe now is simply too short for such measures to have a significant additional impact by the 2013-2018 period.

¹⁶ That is 2.5 BCM from Yacheng and 0.4 to Hong Kong Electric from the Shenzhen LNG terminal.

combined cycle plant such as the ones at Black Point, the percentage reductions are even more striking: PM falls by 89%, NO_x by 57%, SO₂ by 91%, and CO₂ by 56%.

Since the power sector in Hong Kong is the largest emitter of particulate matter, sulphur dioxide, nitrogen dioxide and carbon dioxide, it is clear that any reduction in the availability of gas for power generation compared to what it might have been will have a major impact on Hong Kong's total pollutant emissions.

Risk of Net Reduction in Regional Gas supplies

The use of natural gas on the Mainland is severely supply-constrained. In the interest of lowering the persistently high levels of pollution in the region, power producers and other major energy users in Guangdong and nearby provinces would be willing to buy far more natural gas than they do now if extra supply was available. For example, a major new LNG terminal in Zhuhai has been on the drawing board for a number of years, but has not moved forward because the necessary approvals from authorities in Beijing have not been forthcoming. One would now need to ask if the new joint LNG terminal in Guangdong (for which Hong Kong will be a part owner) will further delay the Zhuhai terminal.

Meanwhile Hainan had hoped to make use of the gas from new fields to be developed near Yacheng. Have they now been deprived of this resource, at least until supplies to Hong Kong reach 1.8 BCM? Likewise, if 1 BCM of gas is siphoned off to Hong Kong from the second West-East pipeline, is that 1 BCM less each year available to users in Guangdong?

For each unit of natural gas sent to Hong Kong that would otherwise have gone to Guangdong, regional pollutant emissions will go up. Mainland coal-fired power plants are typically less thermally efficient than those in Hong Kong and have less effective emission controls.

Thus in a gas-short environment, we need to ask not only what the MoU will mean in terms of gas coming to the Territory, but also, what it means for total gas supplies coming into the region. Gas from the Mainland itself or otherwise already coming into the Mainland and sent to Hong Kong do not increase regional gas supplies. New imports do. To the extent that Hong Kong's gas under the MoU comes at the expense of users in the region then we could actually be worse off with respect to regional air quality.

Conclusion

The August 2008 deal for Mainland gas potentially is a good one for Hong Kong's environment, its power companies and their customers. However, the matter is far from straightforward. How well Hong Kong's interests fare in the end depends on several factors.

With respect to the eventual quantity of gas, it depends on whether the MoU will ultimately provide more than would have been the case under the now cancelled Soko LNG terminal. Since the quantities being discussed with respect to the combined offshore and overland gas sources are considerably less than the Soko terminal would have provided (2.8 BCM compared to 4.3), for the MoU to provide more gas than the Soko terminal, Hong Kong's share of LNG from the new terminal would have to exceed 1.5 BCM.

Nonetheless, by our estimates for an interim period of perhaps 5-7 years (roughly 2013-2020) Hong Kong probably will have substantially less gas under the MoU than it would have had with the Soko terminal. During that time the Territory will be more dependent on coal-fired power generation, with a subsequent substantial increase in emissions for the period. As noted above, this estimate is based on a number of assumptions we made due to the lack of details in the MoU or statements from the HKSAR Government about the timeframe for delivery of gas from the various sources. If the HKSAR Government has information to show that our projected gas deficit (and consequent increases) in coal-fired power emissions will be not as severe or as prolonged as we estimate, it would be most helpful to make such information public.

Over the longer term, rising demands for electricity threaten to keep up relentless pressure on the Territory's ability to meet emission targets. If Hong Kong's participation in the new Mainland LNG terminal and international LNG market conditions permit, the supply of natural gas to the Territory might be steadily increased over time as they could have been with the Soko terminal. Nonetheless, it would be prudent of the HKSAR Government to much more aggressively pursue electricity demand efficiency improvements (e.g., strict appliance efficiency requirements, updated building codes, and more thoughtful urban planning to lessen urban heat island effects). Likewise, the government should support on-going evaluations of innovative renewable energy technologies, especially those that might allow for widespread small scale applications such as on building surfaces, or that capture power from weak winds.

With respect to the price paid for the gas, in bargaining for gas coming from both the undersea pipeline and the second West-East overland pipeline, Hong Kong interests will largely be what economists call 'price takers' in their dealings with monopoly suppliers. The Hong Kong gas buyers, facing the need to meet emissions targets, will be under considerable pressure to secure as much gas as possible from each source and to pay what it takes to get it. How well the Territory's consumers do in the end may well depend on whether Mainland authorities seek to intercede on Hong Kong's behalf with the State owned Enterprises that supply the gas.

The price paid for LNG from the new Mainland terminal will depend on the ownership and operational control of the terminal. If Hong Kong interests are permitted to be major shareholders, and if they retain considerable control over their own contracting with

overseas LNG providers, then the gas price would probably be quite similar to what would have been the case with the Soko terminal. Hong Kong's share of the capital costs, management fees, etc. of the terminal would, of course, need to be recovered and ultimately reflected in the price of electricity.

The HKSAR Government has been touting the gas deal with the Mainland as something of a panacea (increased gas supply at lower costs and clean air to boot). While there is some truth in this position, it is important to distinguish the hype from reality. The reality is that there is much that is uncertain and a number of vital specifics have yet to be worked out.