Revisiting Natural Gas Imports for India

In January 2005, India signed a long-term deal for 7.5 MMT/annum LNG from Iran based on an indexed price, which is considered expensive at today's oil prices, especially compared to Qatari gas. The Qatari price is lower than many contracts and this may not even be the lowest feasible price. The overarching issue for pipeline gas is one of contracting: for the delivered price, what separate metrics should one evolve for supplier nation costs, transport and transit? This relates to how the contract is set up, as a tripartite agreement between Iran, India and Pakistan, or a pair of bilateral agreements with Iran and with Pakistan.

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Some years ago, we published in this journal analysis on overland natural gas pipelines for India from central or west Asia [Tongia and Arunachalam 1999]. It was a detailed and bottom-up public analysis on the technology, economics, and security of such a pipeline. While the concept might have appeared somewhat premature then, India is presently involved in serious discussions with both energy suppliers such as Iran, and its neighbour, Pakistan, on building such pipelines. This article updates that work, and analyses the scenario for natural gas pipelines in India, especially in light of changes in the energy, political, and geostrategic landscape.

Introduction

Compared to the late 1990s, when oil (and thus gas) prices were relatively low, we are seeing unprecedented high prices today, though not (yet) in real terms. This does not mean the window of opportunity we alluded to in our earlier piece has closed, rather there are differences planners must now account for. Any deal struck must make sense from a sustainability perspective. If the negotiated price is burdensomely high, India will pay a penalty – either through higher costs passed through to gas users and secondary consumers or, even worse, government level interventions, perhaps reminiscent of Dabhol.

The last few years have seen India sustain significant economic growth (on average), and this has correlated with the rising demand for energy. Natural gas is now approximately 10 per cent of the commercial primary energy in India. In the electricity sector, the growth in capacity was lower than desired, largely due to the financial murkiness and insolvency of the State Electricity Boards (SEBs) and their successors. Nonetheless, a disproportionate fraction of the growth in the last decade or so came from combined cycle power plants which burn natural gas (when available) or distillate fuels. While India's population is almost one-sixth of the world's, its total energy consumption is estimated by the US Energy Administration at only 3.5 per cent, including renewable and noncommercial energy usage. Needless to say, in the coming decades, India will be demanding and consuming more and more energy.

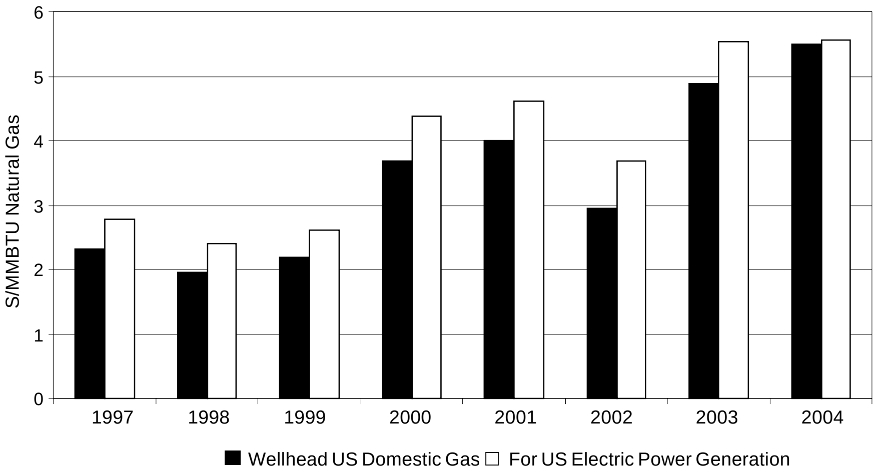
Natural gas saw a significant growth in consumption worldwide in the 1990s, in part due to (then) modest prices and also due to technological (and regulatory) improvements for using it for power production (in efficient combined cycle power plants). According to various estimates, it will reach almost 30 per cent of the world's primary commercial energy by 2030. Importantly, natural gas has significant global reserves, with a reserve to production ratio of 67 years, superior to that of oil (41 years).[1] Of course, like oil, the distribution is not uniform worldwide, but India is near some significant supplies in Asia. In addition, natural gas is now increasingly considered the 'bridge fuel' to a hydrogen economy in the future. It is environmentally more benign than coal, and it also lends itself to separating carbon from hydrogen, which could be sequestered to avoid CO_2 build-up (responsible for global warming). Even when burnt directly, the per unit energy CO_2 release is lower than for coal or oil.[2]

India has aggressively explored for gas (and oil), and there have been substantial finds, especially off the coast of Andhra Pradesh. In addition, the first deliveries of liquefied natural gas (LNG) began in early 2004 – Dahej is now at a capacity of 5 million tonnes/year – and several additional projects have been proposed or are under construction throughout the country. Shell's Hazira LNG facilities are due to receive their first shipment very soon (at the time of writing), and all of these have pushed India's gas supply to over 31 billion cubic metres (BCM) per year.[3] Of course, many of the proposed LNG facilities, which at one point totalled 51million tonnes/year capacity,[4] will not be realised, but an estimated 10-15,000 metric tonnes LNG annual capacity could be online within a few years (perhaps including Dabhol, whose LNG facilities were some 90 per cent complete but are now on hold).

In addition to large-scale consumption of natural gas by industrial, fertiliser and power plants, one new trend has been the rise of distributed and small-scale consumption – for transportation (as compressed natural gas, or CNG) and for household use (cooking, and perhaps heating). While such use is yet low overall in India, in the west piped gas to homes is the norm, instead of bottled gas (liquefied petroleum gas, LPG) as used in India. Cooking usage has another dimension, with many users of traditional (biomass) fuels switching to commercial (fossil) fuels. This adds to the pressure on LPG supplies, and creates additional drivers for the use of natural gas. Going from today's modest LPG usage for domestic cooking of 3.87 million tonnes (in 2001) [D'Sa and Murthy 2004] and CNG for transportation in just a few cities in India consuming 1.2 million kg/day as of January 1, 2004,[5] if we extrapolate to higher usage of natural gas for such purposes, this would lead to several million tonnes of additional natural gas demand in the coming decades (or more depending on the switchover rates).[6]

On the political front, post-nuclear explosions of 1998, there have been ups (Lahore bus diplomacy, cricket, etc) and downs (Kargil, parliament bombing, etc) in the relationship with Pakistan. One overarching subtext has been the post-9/11 global landscape, where Pakistan is being courted by the US. The US has also placed additional pressure on isolating Iran, but that is unlikely to be a deal-breaker for Indian supplies.

Figure 1: US Natural Gas Prices for Electricity Generation



Note: These are the average prices, across locations and with varying sources of supply.
Source: US Energy Information Administration (2005).

Price of Natural Gas

The other main development has been the changes in the world energy markets, exemplified by the surge in crude oil prices, especially in recent weeks. Even without such peaks, the landed price of natural gas in most of the world has been drifting upwards for several years (Figure 1).

The euphoric rush to gas for power production has been tempered by these high prices. In the US, because of high gas costs, the plant load factor (PLF) of all gas plants (combined and simple cycle) put together in 2004 was only about 15 per cent! India does not have the luxury of surplus capacity from which to choose dispatch.

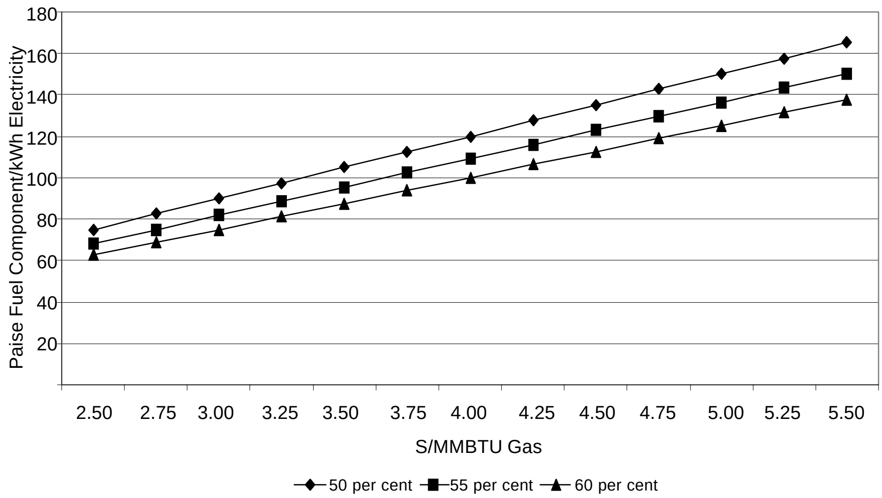
Even with a simple order-of-magnitude calculation, it is easy to show that at an efficiency of 55 per cent (net, higher heating value),[7] the cost of electricity using gas becomes higher than coal at a certain price of fuel (Figure 2). Power producers are correct to insist on 'affordable' delivered gas costs. NTPC has made announcements that it would like to directly buy gas (LNG), bypassing distribution companies and, in theory, reduce some of the risks posed by the financial disarray of the power sector (NTPC made over one billion dollars profit last year). In fact, they have asked for delivered (regasified) costs close to $3/MMBTU, which is technically feasible but quite aggressive on price.

How inexpensively can gas reasonably be delivered? There are several mechanisms for determining the price of oil or gas. At one end, there can be a market that operates to determine the price, and at the other end, prices may be locked in, often determined by a costs-plus mechanism. The former usually involves higher volatility, but also possible windfalls for a particular stakeholder. In reality, many contracts are a hybrid, in that the end prices are not determined a priori, but themselves rely on a benchmark or index. For example, gas prices can be indexed to crude oil prices, such as the Japanese Crude Cocktail, but the mechanisms for relating these two is mutually agreed upon beforehand.[8] In addition, participants in the deal may choose to utilise financial instruments for risk mitigation and management, e g, the use of futures contracts or hedging. Gas suppliers often prefer indexed prices, or even a netback mechanism, but consumers often prefer a costs-plus mechanism.

Oil prices have risen dramatically recently, touching nearly 57 dollars/barrel in March 2005. If we simply converted this into energy, measured, say, in British Thermal Units (BTU), a barrel has 5.8 MMBTU of energy (notation for thousand, thousand BTU). This means the crude oil is worth roughly $10/MMBTU![9] Now one does not burn crude oil, but rather distils it into various fractions and components. The form used for fertiliser feedstock or power production (light distillates such as naphtha) end up being more expensive on a per unit energy basis. At such levels, we can immediately see that natural gas is relatively 'inexpensive' compared to oil. This 'discount' is especially pronounced with higher oil prices. However, the premium nature of oil products arises in part due to their dense, liquid nature – ideal for use in transportation in the form of gasoline. From a power production perspective, the comparison should come from the alternative fuel available, which in India's case is coal. Coal is much less expensive on a per MMBTU basis (starting at $1.3/MMBTU at some fields (pithead) for the typical grade in India, plus the non-trivial railways freight costs), and even when we factor in its lower thermal efficiency during conversion (steam cycle coal plants versus more efficient combined cycle gas turbine), it represents a less expensive fuel. Of course, one also has to account for the higher capital costs of coal plants (on the order of double) to determine the true comparison. Such integrated calculations lead to netback pricing for natural gas, the price at which the delivered power becomes the same.

What would a reasonable price for natural gas be in India? The answer is not as easy as the above calculation seems to suggest since there are a number of issues that planners and decision-makers must add in, ranging from the environment, fuel security, and locationality (including issues such as the integration with the power grid). If we attempt a bottom-up calculation for prices, there are several components of the delivered gas. The first is the supplier price (which can be considered the wellhead price). The second is the transport cost, what it takes to deliver the gas; for simplicity, we assume a single trunk pipeline, not factoring in secondary (distribution) pipelines. The third component is transit fees, paid to any intermediate countries en route.

Figure 2: Gas Contribution to Electricity Costs



Note: This is for varying levels of thermal efficiency for the combined cycle power plant. In addition to this total (doorstep delivered) cost of gas, there are other variable costs (much smaller), and fixed costs, primarily amortisation of the capital investment. The fixed costs can be anywhere on the order of 80 paise/kWh for competitive construction costs, depending on plant load factor (PLF), cost of capital, and amortisation period. This assumes $1=Rs 44.

Issues in the Cost of the Iran-India Pipeline

Newspapers report the cost of the Iran-India pipeline via Pakistan to be around $4.16 billion, which, on the surface, appears expensive. The question is what is or is not included in such a cost, such as field development. A now moribund route to India, from Turkmenistan through Afghanistan, was cited as costing around $2.5 billion. In our past analysis [Tongia and Arunachalam 1999], we projected a length of 2,655 km for an Iranian pipeline, very close to the reported lengths one sees in some published reports. The difference in cost might come from including the field development costs (which relate to supplier costs), or the fact that the new pipeline is designed taking into account its future capacity, which could expand well beyond our proposed 20 BCM/year. We also assumed a supplier price of $1.1/MMBTU, feasible then, but which might appear low in today's market. However, supplier prices also depend on the richness or leanness of the gas (quality – presence of higher compounds of carbon than methane).

Another difference appears to be in the transit fees Pakistan would want. We estimated transit fees based on several cents per MMBTU-100 km. Newspaper reports state that Pakistan is seeking annual payments in the neighbourhood of $600 million. If the pipeline is 20 BCM/year, this implies roughly 85 cents/MMBTU transit fees, or roughly 12 cents/MMBTU-100 km. This appears unsustainably high. The lower figure we suggested in our earlier paper is in line with other pipeline deals, especially if Pakistan is a recipient of natural gas. While there are differences of opinion on when and in what volumes imports will be required in Pakistan, as we presented earlier, there are enormous cost savings to Pakistan from a shared pipeline, especially from economies of scale. Such a design, with Pakistan a recipient of gas, would also assuage India's security fears – this would be a shared pipeline, instead of an Indian gas pipeline going through Pakistan.

While Pakistan's import needs are more nebulous, India's needs are well recognised. In fact, the demand is so much greater than supply that projections of shortfall and calculations of elasticity are somewhat meaningless. Economic equilibrium also requires pricing information, without which we cannot make projections. Much of the drive towards natural gas in India for power production was not based on economics per se, but due to inconsistencies and asymmetric incentives favouring gas over coal, especially for private producers who could apply the two-part tariff for electricity generation [Tongia and Banerjee 1998]. Domestic gas was also inexpensive, but limited in supply (e g, along the HBJ pipeline). Take these away, and the push for gas diminishes. In addition, there are significant lags in building capital stock to deliver or consume natural gas.

If we consider medium-level transit fees, and supplier nation costs of only $1.1/MMBTU, then the delivered price of gas to north India could be as low as $2.5-2.6/MMBTU. Our calculations are very close to the projected numbers from BHP,[10] the Australian firm involved in building gas pipelines out of Iran. The important question remains what delivered price can India sustain, and who should get any 'rent'. Given the security premium for such a gas, India should look for a price lower than both LNG at the coast (where power plants could be sited) and the netback price from coal.

LNG has an interesting role to play for piped gas. While the share of natural gas moved as LNG around the world in the 1990s was only about 5 per cent,[11] this modest share belies its significance. In addition to a rising share, especially as increasing supplies reach European or US markets (which were largely pipeline fed), the market force of LNG helps balance supplier power. The conventional wisdom of requiring firm contracts and capacity for LNG, driven mainly by large investments, is slowing giving way to the possibility of a global gas (LNG) market.

In January 2005, India signed a long-term deal for 7.5 million metric tonnes/annum LNG from Iran, based on an indexed price (with a ceiling at oil of $31/barrel brent crude), which at today's oil prices comes to the ceiling of $3.21/MMBTU FOB.[12] Critics contend this to be expensive, especially when compared to Qatari gas, said to be sold for some years at $2.53/MMBTU FOB (free on board, i e, excluding shipping costs, or regasification).

The Qatari price, especially in the initial years, is lower than many contracts, and this may not even be the lowest feasible price. There have been significant innovations in LNG technologies that should bring down the cost, and improvements have not plateaued. Additional trenches at existing fields (say, at the Arun field in Indonesia), should make the delivered LNG price (termed, CIF, carriage, insurance, and freight) quite competitive. These prices may even turn out to be cheaper than imported piped gas (depending on how the prices are contracted). The overarching issue for pipeline gas then becomes one of contracting: for the delivered price, what separate metrics should one evolve for supplier nation costs, transport, and transit?

This relates to how the overall contract is to be set up, as a tripartite agreement between Iran, India, and Pakistan, or a pair of bilateral agreements with Iran and with Pakistan. Iran would likely prefer a bilateral agreement, as it wants to ensure it gets paid, and leave India with the issue of dealing with Pakistan. India will be better off with a tripartite agreement, as then any liability for disruption in supply would not inherently fall upon India alone. One perhaps more complicated way for bilaterals to work would be for an additional agreement between Pakistan and Iran. However, a tripartite agreement could more easily allow for Pakistani gas consumption, which is useful on security grounds. As we indicated in our earlier work, there are multiple policy and contractual possibilities for mitigating the risks of supply disruption. India's first choice should be to not agree to a take-or-pay clause, at least without delivery failure waivers. A minimum offtake clause, if necessary, can be an option.

The fears of security appear overblown, and one or more month's supply of liquid fuel can be stored onsite for a modest cost at the consumption end. LNG can play a strong complementary role, and imported pipeline gas can link to the same network transporting regasified LNG. Not only does this enhance security, it can also provide greater flexibility when choosing a source of supply, depending on how the LNG and piped gases are indexed to oil prices, for example. In fact, given India has negotiated LNG supplies from Iran, it could consider interfacing the piped gas to this as well. If there were a disruption in piped gas supply, Iran would make it up with additional LNG.

Governmental relationships are key when we consider such long-term supplies. During earlier periods of pipeline discussion, the ministries of external affairs in India and Pakistan had an overwhelming say in any pipeline deal. Today, the economic and energy divisions have improved their participation, which is a positive step. In fact, these groups are now coordinating more, as can be seen by the expansion of Indian oil and gas companies into Africa and Asia in the hopes of securing new sources of supply. To that end, India is competing head-to-head with China, in a calculus that could shift the balance away from western oil companies and even their governments in the coming decades.

A pipeline through Pakistan will have a salutary benefit in improving cooperation and as a confidence building measure. However, the decision should ultimately be based on economic as much as strategic considerations. A single pipeline, in fact, will only provide a fraction of India's gas requirements, and should be considered the first of multiple pipelines, ultimately covering multiple fuels and multiple suppliers.

In the coming decades, natural gas will play an increasingly important role in India's energy future. Already India is emerging as a world-class R&D centre for new and efficient conversion technologies such as fuel cells and advanced gas turbines. Natural gas, combined with innovation, planning, and diplomacy, can help provide much needed energy in the coming decades fuel India's economic growth. EPW

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Notes

1 BP Statistical Review of World Energy 2004.

2 The author does not feel carbon considerations should drive any shift towards gas. However, reductions in particulates are a strong reason for using natural gas and other cleaner fuels (compared to biomass used for cooking and traditional diesel used for transportation).

3 One million metric tonnes of LNG is roughly 0.725 billion cubic metres of natural gas.

4 GAIL presentations (2002).

5 A K De, Indraprastha Gas, *Development of CNG Infrastructure in India*, presented at FICCI Workshop, February 2-3, 2004, New Delhi.

6 While the exact requirements for cooking depend on conversion to modern fuels (with less than 20 per cent of households using LPG today), LPG has 0.825 times lower energy per kg than natural gas, so less natural gas is required than LPG by weight. If we assume a tripling of modern fuel usage, and only 10 per cent moving to natural gas in the near/medium-term, that implies the order of one million tonnes of natural gas. Similarly, only a small fraction of vehicles (including most commercial vehicles in Delhi) run on CNG, totalling about 2,00,000 cars, autos, and buses put together. Expanding to other cities and allowing for growth in vehicular use, transportation CNG requirements could easily go to several million tonnes per annum, constrained only by the availability and distribution of natural gas.

7 Fossil fuel conversion efficiencies can be calculated as either net (the norm in most countries) or gross (the practice in India). Another choice of convention is to use higher or lower heating value of a fuel; the difference is based on the latent energy that remains as water vapour when hydrogen combusts into water. Using a lower heating value raises the corresponding nameplate efficiency by some 5-10 per cent, and is thus favoured by some manufacturers. Again, it is simply a matter of convention and consistency, but we have to remember that in Enron's Dabhol plant, initial calculations were off by several per cent due to the difference between gross and net output.

8 Often, the relationship is not linear, with price ceilings and floors.

9 All calculations use industry standard approximations for conversions unless otherwise specified. In addition, oil or gas from different fields have slightly different calorific values, and the numbers used are averages, unless otherwise specified.

10 BHP as quoted in *PETROWATCH*, Vol 6, Issue 2, March 27, 2002.

11 Geopolitics of Gas Study Working Paper (2004), Programme on Energy and Sustainable Development, Stanford University and the Energy Forum, Rice University.

12 For the initial few years, the terms include favourable pricing of \$2.97/MMBTU. As reported in *The Indian Express*, January 8, 2005, 'Oil Diplomacy Pays Off, India Signs Mega LNG Import Deal with Iran'.

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